

BID DOCUMENTS

**TOWN OF RICHLANDS – 4.0 MGD WWTP UPGRADES
AND IMPROVEMENTS FOR TOWN OF RICHLANDS**

VCWRLF PROJECT NO. C-515667

TOWN OF RICHLANDS, VIRGINIA



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TOWN OF RICHLANDS, VIRGINIA



*4950 Brambleton Avenue SW, Suite A
Roanoke, Virginia 24018*

November 2025

24.00343

Michael T. Dowd



Civil Engineering
Divisions 00 and 01

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TECHNICAL SPECIFICATIONS PREPARED BY THOMPSON & LITTON

**ADVERTISEMENT FOR BID
FOR
4.0 MGD WWTP UPGRADES AND IMPROVEMENTS
TOWN OF RICHLANDS, VIRGINIA**

The Town of Richlands is seeking bids from qualified companies for the 4.0 MGD WWTP Upgrades and Improvements project.

Bids must be received at the **Town Hall, 200 Washington Square, Richlands, Virginia 24641** until, but not later than **2:00 PM** local time on **January 12th, 2025**. Bids will be received at the office of the Town of Richlands, 200 Washington Square, Richlands, Virginia, 24641 and read aloud.

THE PROJECT GENERALLY CONSISTS OF **improvements to the existing pretreatment building** including replacement of screening equipment, grit equipment, pumps and blowers (including VFDs), influent sampler(s), flow meter(s), gates and valves, and associated piping along with renovation of existing pre-engineered metal building (including HVAC improvements), installation of new bollards, and electrical improvements; **improvements to existing primary and secondary clarifiers** including replacement of clarifier equipment, rehabilitation of access bridges, valve replacement, and associated electrical and piping improvements; and **improvements to the existing shop building** including replacement of the existing sludge belt press and polymer feed system, pumps and blowers (including VFDs), valves, associated piping and electrical improvements, and building modifications including wall penetration(s) and belt press foundation.

Funding assistance for this project is provided by the Virginia Clean Water Revolving Loan Fund (VCWRLF).

The Bidding Documents for the project may be examined at the following locations during normal business hours:

Town of Richlands
McGill Associates, PA

200 Washington Square, Richlands, Virginia
4950 Brambleton Ave SW, Suite A, Roanoke, Virginia

Digital copies of Bid Documents are available for purchase at **Virginia's eProcurement Marketplace (eVA) - eva.virginia.gov** . For assistance, contact eVA Customer Care at 1-866-289-7367 or visit eva.virginia.gov/get-help-customer-care.html and follow assistance links.

Each bid shall be accompanied with a cash deposit or certified check drawn on a bank or trust company insured by the FDIC or a Bid Bond prepared on the form of Bid Bond contained in the Bidding Documents or a Surety Company's standard form and properly executed by a corporate surety licensed under the laws of Virginia to execute such bonds. The amount of the bid bond shall be equal to **five (5) percent** of the total of the bid. The bid deposit shall be retained by the Owner if the successful bidder fails to execute the contract or fails to provide the required bonds, as stated above, within ten (10) days after the proper notice of award of the contract.

Bidders must comply with the requirements of the Commonwealth of Virginia and be appropriately licensed as a Contractor as provided in General Statutes.

Bidders must also comply with the President's Executive Order #11246, prohibiting discrimination in employment regarding race, color, creed, sex, or national origin, and Executive Orders #12138 and #11625 regarding the utilization of MBE/WBE firms.

Bidders must have certification that they do not or will not maintain or provide for their employees any facilities that are segregated on the basis of race, color, creed, or national origin. Bidders must also comply with the Civil Rights Act of 1964.

Bidders must comply with the Davis-Bacon Act and American Iron and Steel Provisions.

Bidders are encouraged to only secure project bid documents as noted above. Neither the Owner nor the Engineer will be responsible for full or partial sets of Bidding Documents, including any Addenda, obtained from any source other than the Engineer and their representative plan provider, eVA. Each Bidder shall be responsible for the review of all addenda for the project and shall acknowledge the addenda on the bid form.

The Owner reserves the right to reject any and all Bids, to waive informalities, or to reject non-conforming, non-responsive, or conditional bids. The Owner reserves the right to award a contract to the lowest, responsive, responsible bidder or bidders, taking into consideration quality, performance and time.

Interested parties are invited to attend a non-mandatory pre-bid meeting held at 425 Plant Rd, Doran, VA 24612 on December 17th, 2025 at 2:00 pm local time.

All questions pertaining to this bid must be received in writing by the deadline. Questions should be emailed to Wes Fleming, PE, Senior Project Manager, at wes.fleming@mcgillassociates.com. Technical questions should be emailed to Wes Fleming, PE, Senior Project Manager, at wes.fleming@mcgillassociates.com

The deadline for questions is January 5th, 2025 at 2:00 pm local time. Responses to questions will be issued via addendum.

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

MODIFIED INSTRUCTIONS TO BIDDERS FOR CONSTRUCTION CONTRACTS

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by



AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASSOCIATED GENERAL CONTRACTORS OF AMERICA

AMERICAN SOCIETY OF CIVIL ENGINEERS

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A Practice Division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

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1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

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

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

Associated General Contractors of America
2300 Wilson Boulevard, Suite 400, Arlington, VA 22201-3308
(703) 548-3118
www.agc.org

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ARTICLE 1 – DEFINED TERMS

- 1.01 Terms used in these Instructions to Bidders have the meanings indicated in the Modified General Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. *Issuing Office* – The office from which the Contract Documents are to be issued and where the bidding procedures are to be administered.
 - B. *Disadvantaged Business Enterprise (DBE)* – A business meeting one of the following criteria:
 - 1. Minority Business Enterprise (MBE) – A qualified socially and economically disadvantaged minority-owned business certified by any state and/or Federal agency.
 - 2. Women’s Business Enterprise (WBE) – A qualified independent business at least 51% owned by a woman or women and certified by any state and/or Federal agency.
 - C. *Unbalanced Bid* - An unbalanced bid is one that meets the following criteria:
 - 1. A mathematically unbalanced Bid is one that contains lump sum or unit bid items that do not appear to reflect reasonable actual costs. Those reasonable actual costs would include a reasonable proportionate share of the Bidder’s anticipated profit, overhead costs, and other indirect costs that the Bidder anticipates for the performance of the items in question.
 - 2. A materially unbalanced Bid is one that produces a reasonable doubt that Award to the low Bidder, who submitted the mathematically unbalanced Bid, would result in the lowest ultimate cost to the Owner.
 - D. *Responsible Bidder* - A bidder who has demonstrated the attribute of trustworthiness, as well as quality, fitness, capacity, and experience to satisfactorily perform the work described in the Contract Documents.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

- 2.01 Complete sets of the Bidding Documents may be obtained from the Issuing Office upon payment of the fee stated in the advertisement or invitation to bid. The fee is non-refundable.
- 2.02 Complete sets of Bidding Documents shall be used in preparing Bids. Neither the Owner nor the Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.03 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

- 3.01 The Owner may make such investigations as he deems necessary to determine the qualifications of the Bidder to perform the work and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request. The Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the contract, and to complete the work contemplated therein. Conditional bids will not be accepted.
- 3.02 Bidders shall comply with all applicable laws regulating the practice of General Contracting as provided in the General Statutes of the Commonwealth of Virginia and be properly licensed as a contractor.
- 3.03 To demonstrate Bidder's qualifications to perform the Work, after submitting its Bid and within five (5) days of Owner's request, Bidder shall submit (a) written evidence establishing its qualifications such as financial data, previous experience, and present commitments, and (b) the following additional information:
- A. Evidence of Bidder's authority to do business in the state where the Project is located.
 - B. Bidder's state or other contractor license number, if applicable. Bidder shall be a Class A Contractor registered and in good standing with the Commonwealth of Virginia
- 3.04 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

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

4.01 *Site and Other Areas*

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

4.02 *Existing Site Conditions*

- A. Subsurface and Physical Conditions; Hazardous Environmental Conditions

1. The Bidding Documents identify:

- a. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site.
- b. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

- 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 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 Modified 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 Modified General Conditions will apply.
- 4. Geotechnical Report: The Bidding Documents may contain a Geotechnical Report. If included, the Geotechnical Report describes certain select subsurface conditions that are anticipated to be encountered by Contractor during construction in specified locations. The Geotechnical Report is a Contract Document.
 - a. The conditions described in the Geotechnical Report are intended to reduce uncertainty and the degree of contingency in submitted Bids. However, Bidders cannot rely solely on the conditions described. Bids should be based on a comprehensive approach that includes an independent review and analysis of the Geotechnical Report, all other Contract Documents, Technical Data, other available information, and observable surface conditions. Not all potential subsurface conditions are described in the Geotechnical Report.
 - b. Nothing in the Geotechnical Report is intended to relieve Bidders of the responsibility to make their own determinations regarding construction costs, bidding strategies, and Bid prices, nor of the responsibility to select and be responsible for the means, methods, techniques, sequences, and procedures of construction, and for safety precautions and programs incident thereto.
- B. Underground Facilities: Information and data shown or indicated in the Bidding Documents with respect to existing Underground Facilities at or contiguous to the Site are set forth in the Contract Documents and are based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities, including Owner, or others.
- C. Adequacy of Data: Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions, and Underground Facilities, and possible changes in the Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in Paragraphs 5.03, 5.04, and 5.05 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or

Specifications or identified in the Contract Documents to be within the scope of the Work, appear in Paragraph 5.06 of the General Conditions.

4.03 *Site Visit and Testing by Bidders*

- A. Bidder shall conduct Site visits during normal working hours and shall not disturb any ongoing operations at the Site. The Owner may require site visits by the Bidder to be scheduled with the Owner in advance.
- B. The Bidder is not required to conduct any subsurface testing, or exhaustive investigations of Site conditions. However, on request, and to the extent the Owner has control over the Site, and schedule permitting, the Owner will provide Bidder access to the Site to conduct such additional examinations, investigations, explorations, tests, and studies as Bidder deems necessary for preparing and submitting a 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.
- C. Bidder shall comply with all applicable Laws and Regulations regarding excavation and location of utilities, obtain all 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.
- D. Bidder shall fill all holes and clean up and restore the Site to its former condition upon completion of such explorations, investigations, tests, and studies.

4.04 *Owner's Safety Program*

- A. Site visits and work at the Site may be governed by an Owner's Safety Program. As the General Conditions indicate, Bidders are responsible for complying with Owner's Safety Program, if any.

4.05 *Other Work at the Site*

- A. Reference is made to the Supplementary Conditions 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 confidential matters), if any.

ARTICLE 5 – BIDDER'S REPRESENTATIONS

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

- A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;
- B. visit the Site and become familiar with and satisfy itself as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;

- C. become familiar with and satisfy itself as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site including Underground Facilities that may be made available by the Owner and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Contract Documents.
- E. consider the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;
- F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of any work that may be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and
- I. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

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

5.03 No verbal agreement or conversation with any officer, agent or employee of the Owner, either before or after the execution of the Contract, shall affect or modify any of the terms or obligations therein.

ARTICLE 6 – INTERPRETATIONS AND ADDENDA

- 6.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to the Engineer in writing. Interpretations or clarifications considered necessary by the Engineer in response to such questions will be issued by Addenda delivered by either mail or approved electronic means to all parties recorded by the Engineer as having received the Bidding Documents. Questions received less than five (5) days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect. Contractor waives the right to rely on information provided by the Engineer which is not provided in writing and in the form of a formal Addendum.
- 6.02 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.
- 6.03 Failure of any Bidder to receive any such Addenda shall not relieve said Bidder from any obligation under his Bid as submitted.
- 6.04 All addenda so issued shall become a part of the Contract Documents.
- 6.05 Prospective Bidders are cautioned concerning the use of a Post Office Box address as Addenda cannot be sent via overnight carrier to Post Office Boxes.

ARTICLE 7 – BID SECURITY

- 7.01 A Bid must be accompanied by Bid security made payable to the Owner in an amount of **five percent (5%)** of Bidder's maximum Bid price and in the form of a certified check, bank money order, or a Bid bond (on the form included or the standard form of the surety company) issued by a surety meeting the requirements of Paragraphs 5.01 and 5.02 of the Modified General Conditions.
- 7.02 The Bid security of the apparent Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned as necessary. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within ten (10) days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults. The Bid security of all other Bidders may be retained by Owner until the earlier of ten (10) days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned as necessary.

ARTICLE 8 – CONTRACT TIMES

- 8.01 The number of calendar days within which, the Work is to be completed and ready for final payment are set forth in the Agreement.

ARTICLE 9 – LIQUIDATED DAMAGES

- 9.01 Provisions for liquidated damages, if any, for failure to timely attain, 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, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or “or-equal” items. Whenever it is specified or described in the Bidding Documents that a substitute or “or-equal” item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.
- 10.02 All prices that Bidder sets forth in its Bid shall be based on the presumption that the Contractor will furnish the materials and equipment specified or described in the Bidding Documents, as supplemented by Addenda. Any assumptions regarding the possibility of post-Bid approvals of “or-equal” or substitution requests are made at Bidder’s sole risk.

ARTICLE 11 – SUBCONTRACTORS, SUPPLIERS AND OTHERS

- 11.01 The Contract Documents may require the identification of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five (5) days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute. In which case apparent Successful Bidder shall submit an acceptable substitute, Bidder’s Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award.
- 11.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in the Modified General Conditions.
- 11.03 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 12 – PREPARATION OF BID

- 12.01 The Bid Form included with the Bidding Documents shall be used and shall not be altered, contain any unauthorized additions, deletions, or conditional bids.
- 12.02 The Bidder shall not add any provision reserving the right to accept or reject an award, or to enter into a Contract pursuant to an award.
- 12.03 The Bid shall not contain irregularities of any kind which make the Bid incomplete, indefinite, or ambiguous as to its meaning.
- 12.04 All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each section, Bid item, and alternate item listed therein. Alternative Bids will not be considered unless specifically shown on the Bid Form
- 12.05 A Bid by a corporation shall be executed in the corporate name by a corporate officer (whose title must appear under the signature), accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.
- 12.06 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.
- 12.07 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm shall be shown.
- 12.08 A Bid by an individual shall show the Bidder's name and official address and shall be signed by the individual.
- 12.09 A Bid by a joint venture shall be executed by each of the joint venturers in the manner indicated on the Bid Form. The official address of the joint venture shall be shown.
- 12.10 All names shall be printed in ink below the signatures.
- 12.11 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 12.12 Street, postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 12.13 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid.
- 12.14 Bidder's state contractor license number shall be shown on the Bid Form.
- 12.15 All attachments, certifications or acknowledgements attached to the Bid shall be executed in the same manner as the Bid.

ARTICLE 13 – BASIS OF BID; COMPARISON OF BIDS

13.01 *Lump Sum*

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

13.02 *Base Bid with Alternates*

- A. Bidders shall submit a Bid for the base Bid as shown on the Bid Form and include a separate price for the alternate described in the Bidding Documents and as provided for in the Bid Schedule. The price for the alternate will be the amount added to the base Bid if Owner selects the alternate.

13.03 Bids will be compared on the basis of the lump sum Base Bid Item and the total of the Base Bid Item and the Alternate Bid Item. Either the Base Bid Item or the total of both items may be selected at the sole discretion of the Owner. The resulting Contract Bid Price will include and cover the furnishing of all materials, and the performance of all labor requisite for proper completion of all the work called for under the accompanying Contract, and in the manner set forth and described in the Contract Documents.

13.04 The lowest Bidder will be that Bidder whose Bid totals the lowest number of dollars as determined above.

ARTICLE 14 – SUBMITTAL OF BID

14.01 The Bid Form in the Bidding Documents is to be completed and submitted with the Bid security.

14.02 A sealed Bid shall be received no later than the time and date prescribed and at the place indicated in the advertisement or invitation for bids. The bid shall be submitted in a single (one (1)) envelope system. The envelope shall be plainly marked with the Project title, Owners name and address in the middle of the envelope and the name, address, license number, limitation and classification of Bidder in the upper left hand corner of the envelope. The envelope shall contain the Bid security, the Bid and any other required information as defined in the advertisement or invitation for bid or bid documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED."

14.03 If received prior to the designated time of opening, bids will be securely kept, sealed. Mailed bids will be treated in every respect as though filed in person and will be subject to the same requirements. Bids received subsequent to the designated time of opening will be returned to the Bidder unopened.

ARTICLE 15 – MODIFICATION AND WITHDRAWAL OF BID

- 15.01 A Bid may be withdrawn prior to the Bid opening by the Bidder by providing an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids. Upon receipt of such notice, the unopened Bid will be returned to the Bidder.
- 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 17.01 and submit a new Bid prior to the date and time for the opening 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, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 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, read aloud publicly. An abstract of the amounts of the Base Bids and alternate, will be made available to Bidders after the opening of Bids.

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 if there is a reasonable doubt that the bid will result in the lowest overall cost to the Owner even though it may be the low evaluated bid, or if it is so unbalanced as to be tantamount to allowing an advanced payment.
- 18.02 Owner will reject the Bid of any Bidder that Owner finds, after reasonable inquiry and evaluation, to not be responsible. If Bidder purports to add terms or conditions to its Bid, takes exception to any provision of the Bidding Documents, or attempts to alter the contents of the Contract Documents for purposes of the Bid, then the Owner will reject the Bid as nonresponsive; provided that Owner also reserves the right to waive all minor informalities not involving price, time, or changes in the Work.
- 18.03 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

- 18.04 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 18.05 In evaluating whether a Bidder is responsible, Owner will consider the qualifications of the Bidder and may consider the qualifications and experience of Subcontractors and Suppliers proposed for those portions of the Work for which the identity of Subcontractors and Suppliers must be submitted as provided in the Bidding Documents.
- 18.06 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work in accordance with the Contract Documents.
- 18.07 If Owner awards the contract for the Work, such award shall be to the responsible Bidder submitting the lowest responsive Bid based on either the Base Bid Item or the Base Bid Item plus the Alternate Bid Item at the sole discretion of the Owner.

ARTICLE 19 – CONTRACT SECURITY AND INSURANCE

- 19.01 The Modified General Conditions, and as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds and insurance documentation.

ARTICLE 20 – SIGNING OF AGREEMENT

- 20.01 When Owner issues a Notice of Award to the Successful Bidder, it shall be accompanied by the required number of unsigned counterparts of the Agreement along with the other Contract Documents which are identified in the Agreement as attached thereto. Within 10 days thereafter, Successful Bidder shall sign and deliver the required number of counterparts of the Agreement and attached documents to Owner. The Owner shall thereafter set a time and place for a Preconstruction conference. One fully signed counterpart of the Contract Documents shall be provided to the Contractor following review from the Owner's legal counsel.

ARTICLE 21 – RETAINAGE

- 21.01 Provisions concerning Contractor's rights to deposit securities in-lieu of retainage are set forth in the Agreement.

ARTICLE 22 – COMMENCEMENT OF WORK

- 22.01 Upon execution and delivery of the Contract and the delivery of the required Performance and Payment Bonds and insurance certificates and policies by the Contractor to the Owner, the Contractor will be notified to proceed with the work of the Contract. The work of the Contract shall be commenced within ten (10) days following such notification or as otherwise specified in the Notice to Proceed.
- 22.02 The Contractor shall notify the Engineer, in writing, of his intention to enter upon the site of the work at least three (3) days in advance of such entrance.

BID FORM

Town of Richlands, Virginia
4.0 MGD WWTP UPGRADES AND IMPROVEMENTS

VCWRLF PROJECT NO. C-515667

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ARTICLE 1 – BID RECIPIENT

This Bid is submitted to:

**Town of Richlands
200 Washington Square
Richlands, Virginia 24641**

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

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

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

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

- A. Bidder has examined and carefully studied the Bidding Documents, the other related data identified in the Bidding Documents, and the following Addenda, receipt of which is hereby acknowledged. ***Note: All previously issued technical addenda by Thompson & Litton are included in the bidding documents and are not required to be acknowledged. All non-technical addenda previously issued by Thompson & Litton have been omitted.***

Addendum No.

Addendum Date

- B. Bidder has visited the Project Site and has become familiar with and is satisfied as to the general, local and Site conditions that may affect cost, progress, and performance of the Work.
- C. Bidder is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress and performance of the Work.
- D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures, including Underground Facilities, at or contiguous to the Site which have been included as a part of the Contract Documents.
- E. Bidder has obtained and carefully studied (or accepts the consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to

the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

- F. Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.
- I. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder or, if no written response was made by Engineer, that Bidder has resolved the issue to its satisfaction prior to the submittal of its Bid.
- J. The Bidding Documents are sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.
- K. Bidder will submit written evidence of its authority to do business in the Commonwealth of Virginia not later than the date of its execution of the Agreement.
- L. Bidder has not relied upon any information provided by the Engineer except information which is part of the Bidding Documents and is in writing and in the form of a formal addendum.
- M. The submission of a Bid constitutes an incontrovertible representation by Bidder that Bidder has complied with every requirement of the Bid Documents and the Instructions to Bidders, and that without exception the Bid is premised upon performing and furnishing the Work required by the Bidding Documents and applying any specific means, methods, techniques, sequences, and procedures of construction that may be shown or indicated or expressly required by the Bidding Documents.

ARTICLE 4 – FURTHER REPRESENTATIONS

4.01 Bidder further represents that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

ARTICLE 5 – BASIS OF BID

Bidder will complete the work in accordance with the contract documents for the following price(s):

LUMP SUM BASE BID

Lump Sum Base Bid Price: _____

_____ Dollars

(words)

(\$ _____)

(numbers)

BASE BID EQUIPMENT / MATERIAL MANUFACTURERS

The Bidder agrees that the Contract, if awarded, will be on the basis of the materials and equipment specified in the Contract Documents, and on the basis of the equipment manufacturer listed below.

SCHEDULE OF PROPOSED MAJOR EQUIPMENT SUPPLIERS			
Spec Section	Description	Pre-Approved Equipment Manufacturers/ Suppliers	Major Identify Name of Supplier Or Manufacturer Included In Bidder's Base Bid Price:
41 1213.19	Belt Conveyors	KWS Keystone	
43 1113	Rotary Lobe Blower Packages	Aerzen Excelsior Gardner Denver Kaeser Roots United Blower, Inc.	
46 0550	Wastewater Sampling System	Isco Hach	
46 1010	Wastewater Pumps - Submersible Non-Clog Sewage Pumps	ABS Fairbanks Flowserve Grundfos Hydromatic Flygt KSB Smith & Loveless	

46 1010	Wastewater Pumps - Dry Pit Submersible Non-Clog Sewage Pumps	Fairbanks Flowserve Flygt KSB Smith & Loveless	
46 2020	Mechanically Cleaned Filter Screen	Parkson Kusters Veolia	
46 2300	Grit Removal and Handling Equipment	Enviro-Care Envirodyne Jim Myers & Sons Lakeside	
46 4322	Clarifier Restoration	Amwell Evoqua Ovivo Walker Process	
46 5103	Air Diffusers	Alfa Laval Aqua-Aerobic Environmental Dynamics Sanitaire SSI	
46 7621	Belt Filter Presses	Alfa Laval Komline-Sanderson	

SUBCONTRACTORS

The Bidder shall submit in writing the names of the following subcontractors, if any, proposed for the work. Subcontractors may not be changed, except at the request or with the approval of the Owner. The following schedule shall be completed by the Bidder. The bid, as submitted, is based upon the following Subcontractors:

TYPE	NAME OF COMPANY	TELEPHONE NUMBER
Electrical		
SCADA / Integration		
Other:		
Other:		

ARTICLE 6 – TIME OF COMPLETION

- 6.01 Bidder agrees that the Work will be substantially complete within 300 calendar days after the date when the Contract Times commence to run as provided in the General Conditions and will be completed and ready for final payment in accordance with the General Conditions within 330 calendar days after the date when the Contract Times commence to run.
- 6.02 Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work within the Contract Times.

ARTICLE 7 – ATTACHMENTS TO THIS BID

- 7.01 The following documents are attached to and made a condition of this Bid:
 - A. Required Bid security;
 - B. List of Subcontractors;
 - C. List of Suppliers;
 - D. Evidence of authority to do business in the state of the Project;
 - E. Required Bidder Qualification Statement with supporting data;
 - F. Certification of Bidder Regarding Debarment by Agency of the Commonwealth of Virginia;
 - G. Commonwealth of Virginia Workers Compensation Certificate of Coverage;
 - H. VCWRLF Contract Inserts, including American Iron and Steel (AIS) Certification Statement (Attachment 4).

ARTICLE 8 – BID SUBMITTAL

This Bid Submitted By:

If Bidder is:

An Individual

Name (typed or printed): _____

By: _____ (SEAL)
(Individual's signature)

Doing business as: _____

A Partnership

Partnership Name: _____ (SEAL)

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

Name (typed or printed): _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____
Type (General Business, Professional, Service, Limited Liability): _____

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

Name (typed or printed): _____

Title: _____ (CORPORATE SEAL)

Attest _____

Date of Authorization to do business in [State Where Project is Located] is _____

A Joint Venture

Name of Joint Venture: _____

First Joint Venturer Name: _____ (SEAL)

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

Name (typed or printed): _____

Title: _____

Second Joint Venturer Name: _____ (SEAL)

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

Name (typed or printed): _____

Title: _____

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

FOR ALL BIDDERS:

Address

Bidder's Business Address _____

Phone No. (____) ____ - ____ Fax No. (____) ____ - ____

SUBMITTED on _____, 20____

State Contractor License No. _____

BID BOND

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

BIDDER (*Name and Address*):

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

OWNER (*Name and Address*):

Town of Richlands
200 Washington Square
Richlands, Virginia, 24641

BID

Bid Due Date:

Description (*Project Name— Include Location*): 4.0 MGD WWTP Upgrades and Improvements, Richlands, VA

BOND

Bond Number:

Date:

Penal sum _____ \$ _____
(Words) (Figures)

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

BIDDER

SURETY

Bidder's Name and Corporate Seal

Surety's Name and Corporate Seal

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

Print Name Print Name

Title Title

Attest: _____ Attest: _____
Signature Signature

Title Title

Note: Addresses are to be used for giving any required notice.

Provide execution by any additional parties, such as joint venturers, if necessary.

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.
2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.
3. This obligation shall be null and void if:
 - 3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or
 - 3.2 All Bids are rejected by Owner, or
 - 3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).
4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.
5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from the Bid due date without Surety's written consent.
6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after the Bid due date.
7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.
8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.
9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.
10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.
11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

Davis-Bacon Instructions for SRF Projects

To be included in the Contract Documents:

- The entire contents of 29 CFR 5.5
- The appropriate wage determination (usually Heavy). This determination must be the most current and have been in effect at least 10 days prior to bid opening. If a wage determination for the project location is not available, then the Statewide wage determination may be used. If it takes longer than 90 days to execute contracts and the wage determination changes, then the new wage rates must be incorporated into the contract. Wage Determinations can be found at:
https://beta.sam.gov/search?index=wd&is_active=true&date_filter_index=0&date_rad_selection=date&wdType=dba&page=1

During Construction:

- Post the Davis-Bacon Poster
<https://www.dol.gov/sites/dolgov/files/WHD/legacy/files/fedprojc.pdf>
- Post the appropriate wage rates. These should be the ones included in the specifications and any new classifications approved by the Department of Labor.
- Weekly payrolls are to be maintained onsite for all subject contractors and subcontractors. Number them for each week of the construction period including weeks that do not have payroll. Form WH 347 is suggested. Do not submit these to the State SRF office, submit them to the municipality for review. Link to Form WH 347 -
<https://www.dol.gov/sites/dolgov/files/WHD/legacy/files/wh347.pdf>
- The municipality will conduct interviews with employees when there are irregularities concerning wages being paid. Use Standard Form 1445.
- For additional wage classification approvals, complete form SF 1444 found at this link:
https://www.nps.gov/dscw/upload/sf1444-classificationrateauthorizationrequest_7-14-06.pdf
Email this form to: whd-cbaconformance_incoming@dol.gov

The entire contents of this package is:

- 1) These Instructions
- 2) 29 CFR 5.5
- 3) Davis-Bacon Poster
- 4) Payroll form WH 347

29 CFR §5.5 Contract provisions and related matters.

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

(1) *Minimum wages.* (i) All laborers and mechanics employed or working upon the site of the work (or under the United States Housing Act of 1937 or under the Housing Act of 1949 in the construction or development of the project), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under section 1(b)(2) of the Davis-Bacon Act on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(iv) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics shall be paid the appropriate wage rate and fringe benefits on the wage determination for the classification of work actually performed, without regard to skill, except as provided in §5.5(a)(4). Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein: *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classification and wage rates conformed under paragraph (a)(1)(ii) of this section) and the Davis-Bacon poster (WH-1321) shall be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

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

(1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and

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

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

(B) If the contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken shall be sent by

the contracting officer to the Administrator of the Wage and Hour Division, Employment Standards Administration, U.S. Department of Labor, Washington, DC 20210. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.

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

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

(iii) Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor shall either pay the benefit as stated in the wage determination or shall pay another bona fide fringe benefit or an hourly cash equivalent thereof.

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

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

(3) *Payrolls and basic records.* (i) Payrolls and basic records relating thereto shall be maintained by the contractor during the course of the work and preserved for a period of three years thereafter for all laborers and mechanics working at the site of the work (or under the United States Housing Act of 1937, or under the Housing Act of 1949, in the construction or development of the project). Such records shall contain the name, address, and social security number of each such worker, his or her correct classification, hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in section 1(b)(2)(B) of the Davis-Bacon Act), daily and weekly number of hours worked, deductions made and actual wages paid. Whenever the Secretary of Labor has found under 29 CFR 5.5(a)(1)(iv) that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in section 1(b)(2)(B) of the Davis-Bacon Act, the contractor shall maintain records which show

that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits. Contractors employing apprentices or trainees under approved programs shall maintain written evidence of the registration of apprenticeship programs and certification of trainee programs, the registration of the apprentices and trainees, and the ratios and wage rates prescribed in the applicable programs.

(ii)(A) The contractor shall submit weekly for each week in which any contract work is performed a copy of all payrolls to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the payrolls to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency). The payrolls submitted shall set out accurately and completely all of the information required to be maintained under 29 CFR 5.5(a)(3)(i), except that full social security numbers and home addresses shall not be included on weekly transmittals. Instead the payrolls shall only need to include an individually identifying number for each employee (e.g., the last four digits of the employee's social security number). The required weekly payroll information may be submitted in any form desired. Optional Form WH-347 is available for this purpose from the Wage and Hour Division Web site at <http://www.dol.gov/esa/whd/forms/wh347instr.htm> or its successor site. The prime contractor is responsible for the submission of copies of payrolls by all subcontractors. Contractors and subcontractors shall maintain the full social security number and current address of each covered worker, and shall provide them upon request to the (write in name of appropriate federal agency) if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit them to the applicant, sponsor, or owner, as the case may be, for transmission to the (write in name of agency), the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or audit of compliance with prevailing wage requirements. It is not a violation of this section for a prime contractor to require a subcontractor to provide addresses and social security numbers to the prime contractor for its own records, without weekly submission to the sponsoring government agency (or the applicant, sponsor, or owner).

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

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

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

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

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

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

(iii) The contractor or subcontractor shall make the records required under paragraph (a)(3)(i) of this section available for inspection, copying, or transcription by authorized representatives of the (write the name of the agency) or the Department of Labor, and shall permit such representatives to interview employees during working hours on the job. If the contractor or subcontractor fails to submit the required records or to make them available, the Federal agency may, after written notice to the contractor, sponsor, applicant, or owner, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available may be grounds for debarment action pursuant to 29 CFR 5.12.

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

(ii) *Trainees*. Except as provided in 29 CFR 5.16, trainees will not be permitted to work at less than the predetermined rate for the work performed unless they are employed pursuant to and individually registered in a program which has received prior approval, evidenced by formal certification by the U.S. Department of Labor, Employment and Training Administration. The ratio of trainees to journeymen on the job site shall not be greater than permitted under the plan approved by the Employment and Training Administration. Every trainee must be paid at not less than the rate specified in the approved program for the trainee's level of progress, expressed as a percentage of the journeyman hourly rate specified in the applicable wage determination. Trainees shall be paid fringe benefits in accordance with the provisions of the trainee program. If the trainee program does not mention fringe benefits, trainees shall be paid the full amount of fringe benefits listed on the wage determination unless the Administrator of the Wage and Hour Division determines that there is an apprenticeship program associated with the corresponding journeyman wage rate on the wage determination which provides for less than full fringe benefits for apprentices. Any employee listed on the payroll at a trainee rate who is not registered and participating in a training plan approved by the Employment and Training Administration shall be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In

addition, any trainee performing work on the job site in excess of the ratio permitted under the registered program shall be paid not less than the applicable wage rate on the wage determination for the work actually performed. In the event the Employment and Training Administration withdraws approval of a training program, the contractor will no longer be permitted to utilize trainees at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

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

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

(6) *Subcontracts.* The contractor or subcontractor shall insert in any subcontracts the clauses contained in 29 CFR 5.5(a)(1) through (10) and such other clauses as the (write in the name of the Federal agency) may by appropriate instructions require, and also a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor shall be responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in 29 CFR 5.5.

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

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

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

(10) *Certification of eligibility.* (i) By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of section 3(a) of the Davis-Bacon Act or 29 CFR 5.12(a)(1).

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

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

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

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

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

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

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

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

EMPLOYEE RIGHTS UNDER THE DAVIS-BACON ACT

FOR LABORERS AND MECHANICS EMPLOYED ON FEDERAL OR FEDERALLY ASSISTED CONSTRUCTION PROJECTS

THE UNITED STATES DEPARTMENT OF LABOR WAGE AND HOUR DIVISION

PREVAILING WAGES	You must be paid not less than the wage rate listed in the Davis-Bacon Wage Decision posted with this Notice for the work you perform.
OVERTIME	You must be paid not less than one and one-half times your basic rate of pay for all hours worked over 40 in a work week. There are few exceptions.
ENFORCEMENT	Contract payments can be withheld to ensure workers receive wages and overtime pay due, and liquidated damages may apply if overtime pay requirements are not met. Davis-Bacon contract clauses allow contract termination and debarment of contractors from future federal contracts for up to three years. A contractor who falsifies certified payroll records or induces wage kickbacks may be subject to civil or criminal prosecution, fines and/or imprisonment.
APPRENTICES	Apprentice rates apply only to apprentices properly registered under approved Federal or State apprenticeship programs.
PROPER PAY	If you do not receive proper pay, or require further information on the applicable wages, contact the Contracting Officer listed below:

or contact the U.S. Department of Labor's Wage and Hour Division.



For additional information:
1-866-4-USWAGE
(1-866-487-9243) TTY: 1-877-889-5627



WWW.WAGEHOUR.DOL.GOV

PAYROLL NO.

FOR WEEK ENDING

PROJECT AND LOCATION

PROJECT OR CONTRACT NO.

(1) NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g., LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER	(2) NO. OF WITHHOLDING EXEMPTIONS	(3) WORK CLASSIFICATION	OT OR ST	(4) DAY AND DATE							(5) TOTAL HOURS	(6) RATE OF PAY	(7) GROSS AMOUNT EARNED	(8) DEDUCTIONS						(9) NET WAGES PAID FOR WEEK
														FICA	WITH- HOLDING TAX			OTHER	TOTAL DEDUCTIONS	
				HOURS WORKED EACH DAY																
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While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that it will take an average of 55 minutes to complete this collection, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W. Washington, D.C. 20210

(over)

Date _____

I, _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by _____ on the _____
(Contractor or Subcontractor)
_____ ; that during the payroll period commencing on the _____
(Building or Work)
_____ day of _____, _____, and ending the _____ day of _____, _____,
all persons employed on said project have been paid the full weekly wages earned, that no rebates have
been or will be made either directly or indirectly to or on behalf of said
_____ from the full
(Contractor or Subcontractor)

weekly wages earned by any person and that no deductions have been made either directly or indirectly
from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part
3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948,
63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

(2) That any payrolls otherwise under this contract required to be submitted for the above period are
correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the
applicable wage rates contained in any wage determination incorporated into the contract; that the classifications
set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship
program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and
Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered
with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:
(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

- ☐ — in addition to the basic hourly wage rates paid to each laborer or mechanic listed in
the above referenced payroll, payments of fringe benefits as listed in the contract
have been or will be made to appropriate programs for the benefit of such employees,
except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

- ☐ — Each laborer or mechanic listed in the above referenced payroll has been paid,
as indicated on the payroll, an amount not less than the sum of the applicable
basic hourly wage rate plus the amount of the required fringe benefits as listed
in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR
SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 231 OF TITLE
31 OF THE UNITED STATES CODE.

"General Decision Number: VA20250033 01/03/2025

Superseded General Decision Number: VA20240033

State: Virginia

Construction Types: Heavy (Heavy and Sewer and Water Line)

County: Tazewell County in Virginia.

HEAVY CONSTRUCTION PROJECTS (Including Sewer and Water Lines)

Note: Contracts subject to the Davis-Bacon Act are generally required to pay at least the applicable minimum wage rate required under Executive Order 14026 or Executive Order 13658. Please note that these Executive Orders apply to covered contracts entered into by the federal government that are subject to the Davis-Bacon Act itself, but do not apply to contracts subject only to the Davis-Bacon Related Acts, including those set forth at 29 CFR 5.1(a)(1).

If the contract is entered into on or after January 30, 2022, or the contract is renewed or extended (e.g., an option is exercised) on or after January 30, 2022:	. Executive Order 14026 generally applies to the contract. The contractor must pay all covered workers at least \$17.75 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on the contract in 2025.

If the contract was awarded on or between January 1, 2015 and January 29, 2022, and the contract is not renewed or extended on or after January 30, 2022:	. Executive Order 13658 generally applies to the contract. The contractor must pay all covered workers at least \$13.30 per hour (or the applicable wage rate listed on this wage determination, if it is higher) for all hours spent performing on that contract in 2025.

The applicable Executive Order minimum wage rate will be adjusted annually. If this contract is covered by one of the Executive Orders and a classification considered necessary for performance of work on the contract does not appear on this

wage determination, the contractor must still submit a conformance request.

Additional information on contractor requirements and worker protections under the Executive Orders is available at <http://www.dol.gov/whd/govcontracts>.

Modification Number Publication Date
0 01/03/2025

SUVA2010-034 09/01/2010

The following rates were revised pursuant to 29 CFR 1.6(c)(1) on 12/13/2024

	Rates	Fringes
CARPENTER.....	\$ 12.69 **	1.18
CEMENT MASON/CONCRETE FINISHER...	\$ 15.50 **	1.44
ELECTRICIAN.....	\$ 21.92	3.34
LABORERS		
Common or General.....	\$ 10.22 **	0.89
Flagger.....	\$ 10.22 **	0.0
Pipelayer.....	\$ 11.12 **	0.0
POWER EQUIPMENT OPERATOR:		
Backhoe.....	\$ 14.45 **	1.35
Bulldozer.....	\$ 25.37	0.0
Crane.....	\$ 29.08	10.26
Excavator.....	\$ 16.01 **	1.54
Loader.....	\$ 18.03	1.65
TRUCK DRIVER		
Dump Truck.....	\$ 14.96 **	1.45
Off the Road Truck.....	\$ 23.26	0.0

WELDERS - Receive rate prescribed for craft performing operation to which welding is incidental.

** Workers in this classification may be entitled to a higher minimum wage under Executive Order 14026 (\$17.75) or 13658 (\$13.30). Please see the Note at the top of the wage determination for more information. Please also note that the minimum wage requirements of Executive Order 14026 are not currently being enforced as to any contract or subcontract to which the states of Texas, Louisiana, or Mississippi, including

their agencies, are a party.

Note: Executive Order (EO) 13706, Establishing Paid Sick Leave for Federal Contractors applies to all contracts subject to the Davis-Bacon Act for which the contract is awarded (and any solicitation was issued) on or after January 1, 2017. If this contract is covered by the EO, the contractor must provide employees with 1 hour of paid sick leave for every 30 hours they work, up to 56 hours of paid sick leave each year.

Employees must be permitted to use paid sick leave for their own illness, injury or other health-related needs, including preventive care; to assist a family member (or person who is like family to the employee) who is ill, injured, or has other health-related needs, including preventive care; or for reasons resulting from, or to assist a family member (or person who is like family to the employee) who is a victim of, domestic violence, sexual assault, or stalking. Additional information on contractor requirements and worker protections under the EO is available at <https://www.dol.gov/agencies/whd/government-contracts>.

Unlisted classifications needed for work not included within the scope of the classifications listed may be added after award only as provided in the labor standards contract clauses (29CFR 5.5 (a) (1) (iii)).

The body of each wage determination lists the classifications and wage rates that have been found to be prevailing for the type(s) of construction and geographic area covered by the wage determination. The classifications are listed in alphabetical order under rate identifiers indicating whether the particular rate is a union rate (current union negotiated rate), a survey rate, a weighted union average rate, a state adopted rate, or a supplemental classification rate.

Union Rate Identifiers

A four-letter identifier beginning with characters other than ""SU"", ""UAVG"", ?SA?, or ?SC? denotes that a union rate was prevailing for that classification in the survey. Example: PLUM0198-005 07/01/2024. PLUM is an identifier of the union whose collectively bargained rate prevailed in the survey for this classification, which in this example would be Plumbers. 0198 indicates the local union number or district council number where applicable, i.e., Plumbers Local 0198. The next number, 005 in the example, is an internal number used in processing the wage determination. The date, 07/01/2024 in the example, is the effective date of the most current negotiated rate.

Union prevailing wage rates are updated to reflect all changes

over time that are reported to WHD in the rates in the collective bargaining agreement (CBA) governing the classification.

Union Average Rate Identifiers

The UAVG identifier indicates that no single rate prevailed for those classifications, but that 100% of the data reported for the classifications reflected union rates. EXAMPLE: UAVG-OH-0010 01/01/2024. UAVG indicates that the rate is a weighted union average rate. OH indicates the State of Ohio. The next number, 0010 in the example, is an internal number used in producing the wage determination. The date, 01/01/2024 in the example, indicates the date the wage determination was updated to reflect the most current union average rate.

A UAVG rate will be updated once a year, usually in January, to reflect a weighted average of the current rates in the collective bargaining agreements on which the rate is based.

Survey Rate Identifiers

The ""SU"" identifier indicates that either a single non-union rate prevailed (as defined in 29 CFR 1.2) for this classification in the survey or that the rate was derived by computing a weighted average rate based on all the rates reported in the survey for that classification. As a weighted average rate includes all rates reported in the survey, it may include both union and non-union rates. Example: SUFL2022-007 6/27/2024. SU indicates the rate is a single non-union prevailing rate or a weighted average of survey data for that classification. FL indicates the State of Florida. 2022 is the year of the survey on which these classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 6/27/2024 in the example, indicates the survey completion date for the classifications and rates under that identifier.

?SU? wage rates typically remain in effect until a new survey is conducted. However, the Wage and Hour Division (WHD) has the discretion to update such rates under 29 CFR 1.6(c)(1).

State Adopted Rate Identifiers

The ""SA"" identifier indicates that the classifications and prevailing wage rates set by a state (or local) government were adopted under 29 C.F.R 1.3(g)-(h). Example: SAME2023-007 01/03/2024. SA reflects that the rates are state adopted. ME refers to the State of Maine. 2023 is the year during which the state completed the survey on which the listed classifications and rates are based. The next number, 007 in the example, is an internal number used in producing the wage determination. The date, 01/03/2024 in the example, reflects the date on which the classifications and rates under the ?SA? identifier took

effect under state law in the state from which the rates were adopted.

WAGE DETERMINATION APPEALS PROCESS

1) Has there been an initial decision in the matter? This can be:

- a) a survey underlying a wage determination
- b) an existing published wage determination
- c) an initial WHD letter setting forth a position on a wage determination matter
- d) an initial conformance (additional classification and rate) determination

On survey related matters, initial contact, including requests for summaries of surveys, should be directed to the WHD Branch of Wage Surveys. Requests can be submitted via email to davisbaconinfo@dol.gov or by mail to:

Branch of Wage Surveys
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

Regarding any other wage determination matter such as conformance decisions, requests for initial decisions should be directed to the WHD Branch of Construction Wage Determinations. Requests can be submitted via email to BCWD-Office@dol.gov or by mail to:

Branch of Construction Wage Determinations
Wage and Hour Division
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

2) If an initial decision has been issued, then any interested party (those affected by the action) that disagrees with the decision can request review and reconsideration from the Wage and Hour Administrator (See 29 CFR Part 1.8 and 29 CFR Part 7). Requests for review and reconsideration can be submitted via email to dba.reconsideration@dol.gov or by mail to:

Wage and Hour Administrator
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210

The request should be accompanied by a full statement of the interested party's position and any information (wage payment

data, project description, area practice material, etc.) that the requestor considers relevant to the issue.

3) If the decision of the Administrator is not favorable, an interested party may appeal directly to the Administrative Review Board (formerly the Wage Appeals Board). Write to:

Administrative Review Board
U.S. Department of Labor
200 Constitution Avenue, N.W.
Washington, DC 20210.

=====

END OF GENERAL DECISION"

Notice of Award

Date: _____

Project: **4.0 MGD WWTP UPGRADES AND IMPROVEMENTS**

Owner: **Town of Richlands**

Owner's Contract No.:

Contract: **4.0 MGD WWTP UPGRADES AND IMPROVEMENTS**

Engineer's Project No.: 24.00343

Bidder:

Bidder's Address:

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

The Contract Price of your Contract is _____ Dollars (\$_____).

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

You must comply with the following conditions precedent within ten (10) days of the date you receive this Notice of Award.

1. Deliver to the Owner [_____] fully executed counterparts of the Contract Documents.
2. Deliver with the executed Contract Documents the Contract security [Bonds] and other documents as specified.

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

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

Owner
By: _____
Authorized Signature
Town Manager

Title

ACCEPTED

Contractor
By: _____
Authorized Signature

Title

MODIFIED AGREEMENT BETWEEN OWNER AND CONTRACTOR

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by



AMERICAN COUNCIL OF ENGINEERING COMPANIES

ASSOCIATED GENERAL CONTRACTORS OF AMERICA

AMERICAN SOCIETY OF CIVIL ENGINEERS

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
A Practice Division of the
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1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

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

American Society of Civil Engineers
1801 Alexander Bell Drive, Reston, VA 20191-4400
(800) 548-2723
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2300 Wilson Boulevard, Suite 400, Arlington, VA 22201-3308
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MODIFIED AGREEMENT
BETWEEN OWNER AND CONTRACTOR
FOR CONSTRUCTION CONTRACT (STIPULATED PRICE)

THIS AGREEMENT is by and between _____ Town of Richlands _____ (“Owner”) and
_____. (“Contractor”).

Effective Date of Agreement: _____

Owner and Contractor hereby agree as follows:

ARTICLE 1 – WORK

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

ARTICLE 2 – Improvements to the existing pretreatment building including replacement of screening equipment, grit equipment, pumps and blowers (including VFDs), influent sampler(s), flow meter(s), gates and valves, and associated piping along with renovation of existing pre-engineered metal building (including HVAC improvements), installation of new bollards, and electrical improvements; improvements to existing primary and secondary clarifiers including replacement of clarifier equipment, rehabilitation of access bridges, valve replacement, and associated electrical and piping improvements; and improvements to the existing shop building including replacement of the existing sludge belt press and polymer feed system, pumps and blowers (including VFDs), valves, associated piping and electrical improvements, and building modifications including wall penetration(s) and belt press foundation.

ENGINEER

- 2.01 The Project, which was designed by others, is being administered by McGill Associates, P.A. (Engineer), which is to act as Owner’s representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 3 – CONTRACT TIMES

- 3.01 *Time of the Essence*

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

3.02 *Dates for Substantial Completion and Final Payment*

- A. The Work will be substantially completed within **300 calendar days** and completed and ready for final payment in accordance with the Modified General Conditions within **330 calendar days**.

3.03 *Liquidated Damages*

- A. Contractor and Owner recognize that time is of the essence and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph 3.02 above, plus any extensions thereof allowed in accordance with Article 12 of the Modified General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner **\$750** for each calendar day that expires after the time specified in Paragraph 3.02 above for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner **\$1,000** for each calendar day that expires after the time specified in Paragraph 3.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 4 – CONTRACT PRICE

- 4.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount equal to the sum of the amounts determined pursuant to paragraph below:

- A. For lump sum work an amount equal to the percentage completed of specific items of work provided by the Contractor as a schedule of values for the Lump Sum work.

ARTICLE 5 – PAYMENT PROCEDURES

5.01 *Submittal and Processing of Payments*

- A. Contractor shall submit Applications for Payment in accordance with Article 14 of the Modified General Conditions. Applications for Payment will be processed by Engineer as provided in the Modified General Conditions.

5.02 *Progress Payments; Retainage*

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 25th day of each month during performance of the Work as provided in Paragraph 5.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the Modified General Conditions (and in the case of Unit Price Work based on the number of units completed).

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the Modified General Conditions.
 - a. 95 percent of Work completed (with the balance being retainage). If the Work has been 50 percent completed as determined by Engineer, and if the character and progress of the Work have been satisfactory to Owner and Engineer, then as long as the character and progress of the Work remain satisfactory to Owner and Engineer, there will be no additional retainage; and
- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 95 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the Modified General Conditions and less 100 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

5.03 *Final Payment*

- A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the Modified General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in said Paragraph 14.07.

ARTICLE 6 – CONTRACTOR'S REPRESENTATIONS

- 6.01 In order to induce Owner to enter into this Agreement, Contractor makes the following representations:
 - A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.
 - B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
 - C. Contractor is familiar with and is satisfied as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.
 - D. Contractor has reviewed all General and Supplementary Conditions applicable to the Work.
 - E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and

procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

- F. Based on the information and observations referred to in Paragraph 6.01.E above, Contractor does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.
- G. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.
- J. Contractor's entry into this Contract constitutes an incontrovertible representation by Contractor that without exception all prices in the Agreement are premised upon performing and furnishing the Work required by Contract Documents.

ARTICLE 7 – MISCELLANEOUS

7.01 *Terms*

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

7.02 *Assignment of Contract*

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

7.03 *Successors and Assigns*

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

7.04 *Severability*

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

7.05 *Contractor's Certifications*

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 7.05:
 - 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.

ARTICLE 8 – CONTRACT DOCUMENTS

8.01 Contents

- A. The Contract Documents consist of the following:
1. This Agreement (pages __ through __, inclusive).
 2. Performance bond (pages __ through __, inclusive).
 3. Payment bond (pages __ through __, inclusive).
 4. Other bonds (pages __ through __, inclusive).
 5. Notice of Award (pages __ through __, inclusive).
 6. Modified General Conditions (pages 1 through 82, inclusive).
 7. Supplementary Conditions (pages __ through __, inclusive).
 8. Specifications as identified in the table of contents of the bound Project Manual.
 9. Drawings consisting of __ sheets with each sheet bearing the following general title: _____
 10. Addenda (numbers __ through __, inclusive).
 11. Exhibits to this Agreement (enumerated as follows):
 - a. Contractor's Bid (pages __ through __, inclusive).
 12. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed (pages __ through __, inclusive).
 - b. Work Change Directives.
 - c. Change Orders.
- B. The documents listed in Paragraph 8.01.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 8.
- D. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the Modified General Conditions.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement. Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

OWNER:

Town of Richlands

By: _____

Title: Town Manager

Attest: _____

Title: _____

Address for giving notices:

200 Washington Square

Richlands, Virginia 24641

Pre-Audit Statement: This instrument has been preaudited in the manner required by the Local Budget and Fiscal Control Act as amended.

By: _____

Title: _____

Date: _____

Approved as to Form:

By: _____

Title: _____

Date: _____

CONTRACTOR

By: _____

Title: _____

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

Attest: _____

Title: _____

Address for giving notices:

License No.:

Agent for service of process:

Notice to Proceed

Date: _____

Project: **4.0 MGD WWTP Upgrades and Improvements**

Owner: **Town of Richlands**

Owner's Contract No.:

Contract: **4.0 MGD WWTP Upgrades and Improvements**

Engineer's Project No.: **24.00343**

Contractor:

Contractor's Address:

You are notified that the Contract Times under the above Contract will commence to run on _____. On or before that date, you are to start performing your obligations under the Contract Documents. In accordance with the Agreement, the Work will be substantially completed within **270 calendar days**, or by _____. Also in accordance with the Agreement, the Work will be completed and ready for final payment in accordance with the General Conditions within **300 calendar days**, for a date of Completion of _____.

CONTRACTOR

OWNER

Given by:

Authorized Signature

Authorized Signature

Town Manager

Title

Title

Date

Date

PERFORMANCE BOND

CONTRACTOR *(name and address):*

SURETY *(name and address of principal place of business):*

OWNER *(name and address):*

Town of Richlands

200 Washington Square

Richlands, Virginia 24641

CONSTRUCTION CONTRACT

Effective Date of the Agreement: _____, 20__

Amount:

Description *(name and location)*: 4.0 MGD WWTP Upgrades and Improvements for Town of Richlands, VA

BOND

Bond Number:

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*: _____, 20__

Amount:

Modifications to this Bond Form: ☐ None ☐ See Paragraph 16

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

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal

Surety's Name and Corporate Seal

By: _____
Signature

By: _____
Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

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 shall 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 shall 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 shall 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 shall 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 shall 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 shall not be greater than those of the Contractor under the Construction Contract, and the responsibilities of the Owner to the Surety shall 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 shall not be reduced or set off on account of any such unrelated obligations. No right of action shall accrue on this Bond to any person or entity other than 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 may be instituted in any court of competent jurisdiction in the location in which the work or part of the work is located and shall be instituted within two years after 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 shall be applicable.

12. Notice to the Surety, the Owner, or the Contractor shall 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 shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall 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 shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

16. Modifications to this Bond are as follows:

PAYMENT BOND

CONTRACTOR *(name and address)*:

SURETY *(name and address of principal place of business)*:

OWNER *(name and address)*:

Town of Richlands
200 Washington Square
Richlands, Virginia 24641

CONSTRUCTION CONTRACT

Effective Date of the Agreement: _____, 20__

Amount: \$ _____

Description *(name and location)*: 4.0 MGD WWTP Upgrades and Improvements for Town of Richlands

BOND

Bond Number: _____

Date *(not earlier than the Effective Date of the Agreement of the Construction Contract)*: _____, 20__

Amount: \$ _____

Modifications to this Bond Form: ☐ None ☐ See Paragraph 18

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

CONTRACTOR AS PRINCIPAL

SURETY

(seal)

Contractor's Name and Corporate Seal

(seal)

Surety's Name and Corporate Seal

By: _____

Signature

By: _____

Signature *(attach power of attorney)*

Print Name

Print Name

Title

Title

Attest: _____

Signature

Attest: _____

Signature

Title

Title

Notes: (1) Provide supplemental execution by any additional parties, such as joint venturers. (2) Any singular reference to Contractor, Surety, Owner, or other party shall be considered plural where applicable.

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 shall 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 shall 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 shall 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 shall 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 shall 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 shall 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 satisfy 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 shall 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 shall be applicable.

13. Notice and Claims to the Surety, the Owner, or the Contractor shall be mailed or delivered to the address shown on the page on which their signature appears. Actual receipt of notice or Claims, however accomplished, shall 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 shall be deemed deleted herefrom and provisions conforming to such statutory or other legal requirement shall be deemed incorporated herein. When so furnished, the intent is that this Bond shall 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:

1. The name of the Claimant;
2. The name of the person for whom the labor was done, or materials or equipment furnished;
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;
4. A brief description of the labor, materials, or equipment furnished;
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;
6. The total amount earned by the Claimant for labor, materials, or equipment furnished as of the date of the Claim;
7. The total amount of previous payments received by the Claimant; and
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 shall be 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 shall be deemed to be Subcontractor and the term Owner shall be deemed to be Contractor.

18. Modifications to this Bond are as follows:

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

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by



Issued and Published Jointly by



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1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

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

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1801 Alexander Bell Drive, Reston, VA 20191-4400
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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

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

11. *Constituent of Concern*—Asbestos, petroleum, radioactive materials, polychlorinated biphenyls (PCBs), hazardous waste, and any substance, product, waste, or other material of any nature whatsoever that is or becomes listed, regulated, or addressed pursuant to (a) the Comprehensive Environmental Response, Compensation and Liability Act, 42 U.S.C. §§9601 et seq. (“CERCLA”); (b) the Hazardous Materials Transportation Act, 49 U.S.C. §§5501 et seq.; (c) the Resource Conservation and Recovery Act, 42 U.S.C. §§6901 et seq. (“RCRA”); (d) the Toxic Substances Control Act, 15 U.S.C. §§2601 et seq.; (e) the Clean Water Act, 33 U.S.C. §§1251 et seq.; (f) the Clean Air Act, 42 U.S.C. §§7401 et seq.; or (g) any other federal, state, or local statute, law, rule, regulation, ordinance, resolution, code, order, or decree regulating, relating to, or imposing liability or standards of conduct concerning, any hazardous, toxic, or dangerous waste, substance, or material.
12. *Contract*—The entire and integrated written contract between the Owner and Contractor concerning the Work.
13. *Contract Documents*—Those items so designated in the Agreement, and which together comprise the Contract.
14. *Contract Price*—The money that Owner has agreed to pay Contractor for completion of the Work in accordance with the Contract Documents. .
15. *Contract Times*—The number of days or the dates by which Contractor shall: (a) achieve Milestones, if any; (b) achieve Substantial Completion; and (c) complete the Work.
16. *Contractor*—The individual or entity with which Owner has contracted for performance of the Work.
17. *Cost of the Work*—See Paragraph 13.01 for definition.
18. *Drawings*—The part of the Contract that graphically shows the scope, extent, and character of the Work to be performed by Contractor.
19. *Effective Date of the Contract*—The date, indicated in the Agreement, on which the Contract becomes effective.
20. *Engineer*—The individual or entity named as such in the Agreement.
21. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but does not change the Contract Price or the Contract Times.
22. *Hazardous Environmental Condition*—The presence at the Site of Constituents of Concern in such quantities or circumstances that may present a danger to persons or property exposed thereto. The presence at the Site of materials that are necessary for the execution of the Work, or that are to be incorporated in the Work, and that are controlled and contained pursuant to industry practices, Laws and Regulations, and the requirements of the Contract, does not establish a Hazardous Environmental Condition.
23. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, statutes, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

24. *Liens*—Charges, security interests, or encumbrances upon Contract-related funds, real property, or personal property.
25. *Milestone*—A principal event in the performance of the Work that the Contract requires Contractor to achieve by an intermediate completion date or by a time prior to Substantial Completion of all the Work.
26. *Notice of Award*—The written notice by Owner to a Bidder of Owner's acceptance of the Bid.
27. *Notice to Proceed*—A written notice by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work.
28. *Owner*—The individual or entity with which Contractor has contracted regarding the Work, and which has agreed to pay Contractor for the performance of the Work, pursuant to the terms of the Contract.
29. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.
30. *Project*—The total undertaking to be accomplished for Owner by engineers, contractors, and others, including planning, study, design, construction, testing, commissioning, and start-up, and of which the Work to be performed under the Contract Documents is a part.
31. *Project Manual*—The written documents prepared for, or made available for, procuring and constructing the Work, including but not limited to the Bidding Documents or other construction procurement documents, geotechnical and existing conditions information, the Agreement, bond forms, General Conditions, Supplementary Conditions, and Specifications. The contents of the Project Manual may be bound in one or more volumes.
32. *Resident Project Representative*—The authorized representative of Engineer assigned to assist Engineer at the Site. As used herein, the term Resident Project Representative or "RPR" includes any assistants or field staff of Resident Project Representative.
33. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and that establish the standards by which such portion of the Work will be judged.
34. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements for Engineer's review of the submittals and the performance of related construction activities.
35. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.
36. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information that are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work. Shop Drawings, whether approved or not, are not Drawings and are not Contract Documents.

37. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements, and such other lands furnished by Owner which are designated for the use of Contractor.
38. *Specifications*—The part of the Contract that consists of written requirements for materials, equipment, systems, standards, and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable to the Work.
39. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work.
40. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
41. *Successful Bidder*—The Bidder whose Bid the Owner accepts, and to which the Owner makes an award of contract, subject to stated conditions.
42. *Supplementary Conditions*—The part of the Contract that amends or supplements these General Conditions.
43. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or a Subcontractor.
44. *Technical Data*—Those items expressly identified as Technical Data in the Supplementary Conditions, with respect to either (a) subsurface conditions at the Site, or physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) or (b) Hazardous Environmental Conditions at the Site. If no such express identifications of Technical Data have been made with respect to conditions at the Site, then the data contained in boring logs, recorded measurements of subsurface water levels, laboratory test results, and other factual, objective information regarding conditions at the Site that are set forth in any geotechnical or environmental report prepared for the Project and made available to Contractor are hereby defined as Technical Data with respect to conditions at the Site under Paragraphs 5.03, 5.04, and 5.06.
45. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including but not limited to those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, fiber optic transmissions, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
46. *Unit Price Work*—Work to be paid for on the basis of unit prices.
47. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction; furnishing, installing, and incorporating all materials and equipment into such construction; and may include related services such as testing, start-up, and commissioning, all as required by the Contract Documents.

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

1.02 Terminology

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

3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. If the Contract Documents establish an obligation of Contractor with respect to specific services, materials, or equipment, but do not expressly use any of the four words “furnish,” “install,” “perform,” or “provide,” then Contractor shall furnish and install said services, materials, or equipment complete and ready for intended use.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

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

2.02 *Copies of Documents*

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

2.03 *Before Starting Construction*

- A. *Preliminary Schedules*: Within 10 days after the Effective Date of the Contract (or as otherwise specifically required by the Contract Documents), Contractor shall submit to Engineer for timely review:
 1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract;
 2. a preliminary Schedule of Submittals; and

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

2.04 *Preconstruction Conference; Designation of Authorized Representatives*

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

2.05 *Initial Acceptance of Schedules*

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

2.06 *Electronic Transmittals*

- A. Except as otherwise stated elsewhere in the Contract, the Owner, Engineer, and Contractor may transmit, and shall accept, Project-related correspondence, text, data, documents, drawings, information, and graphics, including but not limited to Shop Drawings and other submittals, in electronic media or digital format, either directly, or through access to a secure Project website.
- B. If the Contract does not establish protocols for electronic or digital transmittals, then Owner, Engineer, and Contractor shall jointly develop such protocols.
- C. When transmitting items in electronic media or digital format, the transmitting party makes no representations as to long term compatibility, usability, or readability of the items resulting from the recipient's use of software application packages, operating systems, or

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

ARTICLE 3 – DOCUMENTS: INTENT, REQUIREMENTS, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents.
- C. Unless otherwise stated in the Contract Documents, if there is a discrepancy between the electronic or digital versions of the Contract Documents (including any printed copies derived from such electronic or digital versions) and the printed record version, the printed record version shall govern.
- D. The Contract supersedes prior negotiations, representations, and agreements, whether written or oral.
- E. Engineer will issue clarifications and interpretations of the Contract Documents as provided herein.

3.02 *Reference Standards*

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

3.03 *Reporting and Resolving Discrepancies*

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

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

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

B. *Resolving Discrepancies:*

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

3.04 *Requirements of the Contract Documents*

- A. During the performance of the Work and until final payment, Contractor and Owner shall submit to the Engineer all matters in question concerning the requirements of the Contract Documents (sometimes referred to as requests for information or interpretation—RFIs), or relating to the acceptability of the Work under the Contract Documents, as soon as possible after such matters arise. Engineer will be the initial interpreter of the requirements of the Contract Documents, and judge of the acceptability of the Work thereunder.
- B. Engineer will, with reasonable promptness, render a written clarification, interpretation, or decision on the issue submitted, or initiate an amendment or supplement to the Contract Documents. Engineer's written clarification, interpretation, or decision will be final and binding on Contractor, unless it appeals by submitting a Change Proposal, and on Owner, unless it appeals by filing a Claim.
- C. If a submitted matter in question concerns terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work under the Contract Documents, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, then Engineer will promptly give written notice to Owner and Contractor that Engineer is unable to provide a decision or interpretation. If Owner and Contractor are unable to agree on resolution of such a matter in question, either party may pursue resolution as provided in Article 12.

3.05 *Reuse of Documents*

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

ARTICLE 4 – COMMENCEMENT AND PROGRESS OF THE WORK

4.01 *Commencement of Contract Times; Notice to Proceed*

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

4.02 *Starting the Work*

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

4.03 *Reference Points*

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

4.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.05 as it may be adjusted from time to time as provided below.
 - 1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.05) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 11.
- B. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, or during any appeal process, except as permitted by Paragraph 16.04, or as Owner and Contractor may otherwise agree in writing.

4.05 *Delays in Contractor's Progress*

- A. If Owner, Engineer, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Times and Contract Price. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delay, disruption, or interference caused by or within the control of Contractor. Delay, disruption, and interference attributable to and within the control of a Subcontractor or Supplier shall be deemed to be within the control of Contractor.
- C. If Contractor's performance or progress is delayed, disrupted, or interfered with by unanticipated causes not the fault of and beyond the control of Owner, Contractor, and those for which they are responsible, then Contractor shall be entitled to an equitable adjustment in Contract Times. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays, disruption, and interference described in this paragraph. Causes of delay, disruption, or interference that may give rise to an adjustment in Contract Times under this paragraph include but are not limited to the following:
 1. severe and unavoidable natural catastrophes such as fires, floods, epidemics, and earthquakes;
 2. abnormal weather conditions;
 3. acts or failures to act of utility owners (other than those performing other work at or adjacent to the Site by arrangement with the Owner, as contemplated in Article 8); and
 4. acts of war or terrorism.
- D. Delays, disruption, and interference to the performance or progress of the Work resulting from the existence of a differing subsurface or physical condition, an Underground Facility that was not shown or indicated by the Contract Documents, or not shown or indicated with reasonable accuracy, and those resulting from Hazardous Environmental Conditions, are governed by Article 5.
- E. Paragraph 8.03 governs delays, disruption, and interference to the performance or progress of the Work resulting from the performance of certain other work at or adjacent to the Site.
- F. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for any delay, disruption, or interference if such delay is concurrent with a delay, disruption, or interference caused by or within the control of Contractor.

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

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

5.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which permanent improvements are to be made and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

5.02 *Use of Site and Other Areas*

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

- 1. Contractor shall confine construction equipment, temporary construction facilities, the storage of materials and equipment, and the operations of workers to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and such other adjacent areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for (a) damage to the Site; (b) damage to any such other adjacent areas used for Contractor's operations; (c) damage to any other adjacent land or areas; and (d) for injuries and losses sustained by the owners or occupants of any such land or areas; provided that such damage or injuries result from the performance of the Work or from other actions or conduct of the Contractor or those for which Contractor is responsible.
- 2. If a damage or injury claim is made by the owner or occupant of any such land or area because of the performance of the Work, or because of other actions or conduct of the Contractor or those for which Contractor is responsible, Contractor shall (a) take immediate corrective or remedial action as required by Paragraph 7.12, or otherwise; (b) promptly attempt to settle the claim as to all parties through negotiations with such owner or occupant, or otherwise resolve the claim by arbitration or other dispute resolution proceeding, or at law; and (c) to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against any such claim, and against all costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused directly or indirectly, in whole or in part

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

- B. *Removal of Debris During Performance of the Work:* During the progress of the Work the Contractor shall keep the Site and other adjacent areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site and adjacent areas all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading of Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent structures or land to stresses or pressures that will endanger them.

5.03 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or adjacent to the Site;
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities); and
 - 3. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely upon the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions, or information.

5.04 *Differing Subsurface or Physical Conditions*

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

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

- B. *Engineer's Review:* After receipt of written notice as required by the preceding paragraph, Engineer will promptly review the subsurface or physical condition in question; determine the necessity of Owner's obtaining additional exploration or tests with respect to the condition; conclude whether the condition falls within any one or more of the differing site condition categories in Paragraph 5.04.A above; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the subsurface or physical condition in question and the need for any change in the Drawings or Specifications; and advise Owner in writing of Engineer's findings, conclusions, and recommendations.
- C. *Owner's Statement to Contractor Regarding Site Condition:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the subsurface or physical condition in question, addressing the resumption of Work in connection with such condition, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations, in whole or in part.
- D. *Possible Price and Times Adjustments:*
1. Contractor shall be entitled to an equitable adjustment in Contract Price or Contract Times, or both, to the extent that the existence of a differing subsurface or physical condition, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must fall within any one or more of the categories described in Paragraph 5.04.A;
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03; and,

- c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times with respect to a subsurface or physical condition if:
 - a. Contractor knew of the existence of such condition at the time Contractor made a commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract, or otherwise; or
 - b. the existence of such condition reasonably could have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas expressly required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 5.04.A.
3. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
4. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the subsurface or physical condition in question.

5.05 *Underground Facilities*

- A. *Contractor's Responsibilities:* The information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or adjacent to the Site is based on information and data furnished to Owner or Engineer by the owners of such Underground Facilities, including Owner, or by others. Unless it is otherwise expressly provided in the Supplementary Conditions:
 1. Owner and Engineer do not warrant or guarantee the accuracy or completeness of any such information or data provided by others; and
 2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all information and data regarding existing Underground Facilities at the Site;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents as being at the Site;
 - c. coordination of the Work with the owners (including Owner) of such Underground Facilities, during construction; and
 - d. the safety and protection of all existing Underground Facilities at the Site, and repairing any damage thereto resulting from the Work.
- B. *Notice by Contractor:* If Contractor believes that an Underground Facility that is uncovered or revealed at the Site was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, then Contractor shall, promptly after

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

- C. *Engineer's Review:* Engineer will promptly review the Underground Facility and conclude whether such Underground Facility was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy; obtain any pertinent cost or schedule information from Contractor; prepare recommendations to Owner regarding the Contractor's resumption of Work in connection with the Underground Facility in question; determine the extent, if any, to which a change is required in the Drawings or Specifications to reflect and document the consequences of the existence or location of the Underground Facility; and advise Owner in writing of Engineer's findings, conclusions, and recommendations. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
- D. *Owner's Statement to Contractor Regarding Underground Facility:* After receipt of Engineer's written findings, conclusions, and recommendations, Owner shall issue a written statement to Contractor (with a copy to Engineer) regarding the Underground Facility in question, addressing the resumption of Work in connection with such Underground Facility, indicating whether any change in the Drawings or Specifications will be made, and adopting or rejecting Engineer's written findings, conclusions, and recommendations in whole or in part.
- E. *Possible Price and Times Adjustments:*
 - 1. Contractor shall be entitled to an equitable adjustment in the Contract Price or Contract Times, or both, to the extent that any existing Underground Facility at the Site that was not shown or indicated in the Contract Documents, or was not shown or indicated with reasonable accuracy, or any related delay, disruption, or interference, causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated the existence or actual location of the Underground Facility in question;
 - b. With respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraph 13.03;
 - c. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times; and
 - d. Contractor gave the notice required in Paragraph 5.05.B.
 - 2. If Owner and Contractor agree regarding Contractor's entitlement to and the amount or extent of any adjustment in the Contract Price or Contract Times, or both, then any such adjustment shall be set forth in a Change Order.
 - 3. Contractor may submit a Change Proposal regarding its entitlement to or the amount or extent of any adjustment in the Contract Price or Contract Times, or both, no later than 30 days after Owner's issuance of the Owner's written statement to Contractor regarding the Underground Facility in question.

5.06 *Hazardous Environmental Conditions at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
1. those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at or adjacent to the Site; and
 2. Technical Data contained in such reports and drawings.
- B. *Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the Technical Data expressly identified in the Supplementary Conditions with respect to such reports and drawings, but such reports and drawings are not Contract Documents. If no such express identification has been made, then Contractor may rely on the accuracy of the Technical Data (as defined in Article 1) contained in any geotechnical or environmental report prepared for the Project and made available to Contractor. Except for such reliance on Technical Data, Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any Technical Data or any such other data, interpretations, opinions or information.
- C. Contractor shall not be responsible for removing or remediating any Hazardous Environmental Condition encountered, uncovered, or revealed at the Site unless such removal or remediation is expressly identified in the Contract Documents to be within the scope of the Work.
- D. Contractor shall be responsible for controlling, containing, and duly removing all Constituents of Concern brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible, and for any associated costs; and for the costs of removing and remediating any Hazardous Environmental Condition created by the presence of any such Constituents of Concern.
- E. If Contractor encounters, uncovers, or reveals a Hazardous Environmental Condition whose removal or remediation is not expressly identified in the Contract Documents as being within the scope of the Work, or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, then Contractor shall immediately: (1) secure or otherwise isolate such condition; (2) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 7.15); and (3) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 5.06.F. If Contractor or anyone for whom Contractor is responsible created the Hazardous Environmental Condition in question, then Owner may remove and remediate the Hazardous Environmental Condition, and impose a set-off against payments to account for the associated costs.

- F. Contractor shall not resume Work in connection with such Hazardous Environmental Condition or in any affected area until after Owner has obtained any required permits related thereto, and delivered written notice to Contractor either (1) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work, or (2) specifying any special conditions under which such Work may be resumed safely.
- G. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, then within 30 days of Owner's written notice regarding the resumption of Work, Contractor may submit a Change Proposal, or Owner may impose a set-off.
- H. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work, following the contractual change procedures in Article 11. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 8.
- I. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition (1) was not shown or indicated in the Drawings, Specifications, or other Contract Documents, identified as Technical Data entitled to limited reliance pursuant to Paragraph 5.06.B, or identified in the Contract Documents to be included within the scope of the Work, and (2) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.H shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- J. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the failure to control, contain, or remove a Constituent of Concern brought to the Site by Contractor or by anyone for whom Contractor is responsible, or to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 5.06.J shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- K. The provisions of Paragraphs 5.03, 5.04, and 5.05 do not apply to the presence of Constituents of Concern or to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 6 – BONDS AND INSURANCE

6.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish a performance bond and a payment bond, each in an amount at least equal to the Contract Price, as security for the faithful performance and payment of all of Contractor's obligations under the Contract. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 15.08, whichever is later, except as provided otherwise by Laws or Regulations, the Supplementary Conditions, or other specific provisions of the Contract. Contractor shall also furnish such other bonds as are required by the Supplementary Conditions or other specific provisions of the Contract.
- B. All bonds shall be in the form prescribed by the Contract except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (as amended and supplemented) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. A bond signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed the accompanying bond.
- C. Contractor shall obtain the required bonds from surety companies that are duly licensed or authorized in the jurisdiction in which the Project is located to issue bonds in the required amounts.
- D. If the surety on a bond furnished by Contractor is declared bankrupt or becomes insolvent, or its right to do business is terminated in any state or jurisdiction where any part of the Project is located, or the surety ceases to meet the requirements above, then Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the bond and surety requirements above.
- E. If Contractor has failed to obtain a required bond, Owner may exclude the Contractor from the Site and exercise Owner's termination rights under Article 16.
- F. Upon request, Owner shall provide a copy of the payment bond to any Subcontractor, Supplier, or other person or entity claiming to have furnished labor or materials used in the performance of the Work.

6.02 *Insurance—General Provisions*

- A. Owner and Contractor shall obtain and maintain insurance as required in this Article and in the Supplementary Conditions.
- B. All insurance required by the Contract to be purchased and maintained by Owner or Contractor shall be obtained from insurance companies that are duly licensed or authorized, in the state or jurisdiction in which the Project is located, to issue insurance policies for the required limits and coverages. Unless a different standard is indicated in the Supplementary Conditions, all companies that provide insurance policies required under this Contract shall have an A.M. Best rating of A-VII or better.
- C. Contractor shall deliver to Owner, with copies to each named insured and additional insured (as identified in this Article, in the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Contractor has obtained and is

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

- D. Owner shall deliver to Contractor, with copies to each named insured and additional insured (as identified in this Article, the Supplementary Conditions, or elsewhere in the Contract), certificates of insurance establishing that Owner has obtained and is maintaining the policies, coverages, and endorsements required of Owner by the Contract (if any). Upon request by Contractor or any other insured, Owner shall also provide other evidence of such required insurance (if any), including but not limited to copies of policies and endorsements, and documentation of applicable self-insured retentions and deductibles. Owner may block out (redact) any confidential premium or pricing information contained in any policy or endorsement furnished under this provision.
- E. Failure of Owner or Contractor to demand such certificates or other evidence of the other party's full compliance with these insurance requirements, or failure of Owner or Contractor to identify a deficiency in compliance from the evidence provided, shall not be construed as a waiver of the other party's obligation to obtain and maintain such insurance.
- F. If either party does not purchase or maintain all of the insurance required of such party by the Contract, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage.
- G. If Contractor has failed to obtain and maintain required insurance, Owner may exclude the Contractor from the Site, impose an appropriate set-off against payment, and exercise Owner's termination rights under Article 16.
- H. Without prejudice to any other right or remedy, if a party has failed to obtain required insurance, the other party may elect to obtain equivalent insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and the Contract Price shall be adjusted accordingly.
- I. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor or Contractor's interests.
- J. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner and other individuals and entities in the Contract.

6.03 *Contractor's Insurance*

- A. *Workers' Compensation:* Contractor shall purchase and maintain workers' compensation and employer's liability insurance for:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts.
 - 2. United States Longshoreman and Harbor Workers' Compensation Act and Jones Act coverage (if applicable).
 - 3. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees (by stop-gap endorsement in monopolist worker's compensation states).

4. Foreign voluntary worker compensation (if applicable).
- B. *Commercial General Liability—Claims Covered:* Contractor shall purchase and maintain commercial general liability insurance, covering all operations by or on behalf of Contractor, on an occurrence basis, against:
1. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees.
 2. claims for damages insured by reasonably available personal injury liability coverage.
 3. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom.
- C. *Commercial General Liability—Form and Content:* Contractor's commercial liability policy shall be written on a 1996 (or later) ISO commercial general liability form (occurrence form) and include the following coverages and endorsements:
1. Products and completed operations coverage:
 - a. Such insurance shall be maintained for three years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured (as identified in the Supplementary Conditions or elsewhere in the Contract) evidence of continuation of such insurance at final payment and three years thereafter.
 2. Blanket contractual liability coverage, to the extent permitted by law, including but not limited to coverage of Contractor's contractual indemnity obligations in Paragraph 7.18.
 3. Broad form property damage coverage.
 4. Severability of interest.
 5. Underground, explosion, and collapse coverage.
 6. Personal injury coverage.
 7. Additional insured endorsements that include both ongoing operations and products and completed operations coverage through ISO Endorsements CG 20 10 10 01 and CG 20 37 10 01 (together); or CG 20 10 07 04 and CG 20 37 07 04 (together); or their equivalent.
 8. For design professional additional insureds, ISO Endorsement CG 20 32 07 04, "Additional Insured—Engineers, Architects or Surveyors Not Engaged by the Named Insured" or its equivalent.
- D. *Automobile liability:* Contractor shall purchase and maintain automobile liability insurance against claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance, or use of any motor vehicle. The automobile liability policy shall be written on an occurrence basis.
- E. *Umbrella or excess liability:* Contractor shall purchase and maintain umbrella or excess liability insurance written over the underlying employer's liability, commercial general liability, and automobile liability insurance described in the paragraphs above. Subject to industry-standard exclusions, the coverage afforded shall follow form as to each and every one of the underlying policies.
- F. *Contractor's pollution liability insurance:* Contractor shall purchase and maintain a policy covering third-party injury and property damage claims, including clean-up costs, as a result

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

- G. *Additional insureds*: The Contractor's commercial general liability, automobile liability, umbrella or excess, and pollution liability policies shall include and list as additional insureds Owner and Engineer, and any individuals or entities identified in the Supplementary Conditions; include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds; and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby (including as applicable those arising from both ongoing and completed operations) on a non-contributory basis. Contractor shall obtain all necessary endorsements to support these requirements.
- H. *Contractor's professional liability insurance*: If Contractor will provide or furnish professional services under this Contract, through a delegation of professional design services or otherwise, then Contractor shall be responsible for purchasing and maintaining applicable professional liability insurance. This insurance shall provide protection against claims arising out of performance of professional design or related services, and caused by a negligent error, omission, or act for which the insured party is legally liable. It shall be maintained throughout the duration of the Contract and for a minimum of two years after Substantial Completion. If such professional design services are performed by a Subcontractor, and not by Contractor itself, then the requirements of this paragraph may be satisfied through the purchasing and maintenance of such insurance by such Subcontractor.
- I. *General provisions*: The policies of insurance required by this Paragraph 6.03 shall:
 - 1. include at least the specific coverages provided in this Article.
 - 2. be written for not less than the limits of liability provided in this Article and in the Supplementary Conditions, or required by Laws or Regulations, whichever is greater.
 - 3. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed, or renewal refused until at least 10 days prior written notice has been given to Contractor. Within three days of receipt of any such written notice, Contractor shall provide a copy of the notice to Owner, Engineer, and each other insured under the policy.
 - 4. remain in effect at least until final payment (and longer if expressly required in this Article) and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work as a warranty or correction obligation, or otherwise, or returning to the Site to conduct other tasks arising from the Contract Documents.
 - 5. be appropriate for the Work being performed and provide protection from claims that may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable.
- J. The coverage requirements for specific policies of insurance must be met by such policies, and not by reference to excess or umbrella insurance provided in other policies.

6.04 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 6.03, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.
- B. Owner's liability policies, if any, operate separately and independently from policies required to be provided by Contractor, and Contractor cannot rely upon Owner's liability policies for any of Contractor's obligations to the Owner, Engineer, or third parties.

6.05 *Property Insurance*

- A. *Builder's Risk:* Unless otherwise provided in the Supplementary Conditions, Contractor shall purchase and maintain builder's risk insurance upon the Work on a completed value basis, in the amount of the full insurable replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
 - 1. include the Owner and Contractor as named insureds, and all Subcontractors, and any individuals or entities required by the Supplementary Conditions to be insured under such builder's risk policy, as insureds or named insureds. For purposes of the remainder of this Paragraph 6.05, Paragraphs 6.06 and 6.07, and any corresponding Supplementary Conditions, the parties required to be insured shall collectively be referred to as "insureds."
 - 2. be written on a builder's risk "all risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire; lightning; windstorm; riot; civil commotion; terrorism; vehicle impact; aircraft; smoke; theft; vandalism and malicious mischief; mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; flood; collapse; explosion; debris removal; demolition occasioned by enforcement of Laws and Regulations; water damage (other than that caused by flood); and such other perils or causes of loss as may be specifically required by the Supplementary Conditions. If insurance against mechanical breakdown, boiler explosion, and artificially generated electric current; earthquake; volcanic activity, and other earth movement; or flood, are not commercially available under builder's risk policies, by endorsement or otherwise, such insurance may be provided through other insurance policies acceptable to Owner and Contractor.
 - 3. cover, as insured property, at least the following: (a) the Work and all materials, supplies, machinery, apparatus, equipment, fixtures, and other property of a similar nature that are to be incorporated into or used in the preparation, fabrication, construction, erection, or completion of the Work, including Owner-furnished or assigned property; (b) spare parts inventory required within the scope of the Contract; and (c) temporary works which are not intended to form part of the permanent constructed Work but which are intended to provide working access to the Site, or to the Work under construction, or which are intended to provide temporary support for the Work under construction, including scaffolding, form work, fences, shoring, falsework, and temporary structures.
 - 4. cover expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects).

5. extend to cover damage or loss to insured property while in temporary storage at the Site or in a storage location outside the Site (but not including property stored at the premises of a manufacturer or Supplier).
 6. extend to cover damage or loss to insured property while in transit.
 7. allow for partial occupation or use of the Work by Owner, such that those portions of the Work that are not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
 8. allow for the waiver of the insurer's subrogation rights, as set forth below.
 9. provide primary coverage for all losses and damages caused by the perils or causes of loss covered.
 10. not include a co-insurance clause.
 11. include an exception for ensuing losses from physical damage or loss with respect to any defective workmanship, design, or materials exclusions.
 12. include performance/hot testing and start-up.
 13. be maintained in effect, subject to the provisions herein regarding Substantial Completion and partial occupancy or use of the Work by Owner, until the Work is complete.
- B. *Notice of Cancellation or Change:* All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 6.05 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 10 days prior written notice has been given to the purchasing policyholder. Within three days of receipt of any such written notice, the purchasing policyholder shall provide a copy of the notice to each other insured.
- C. *Deductibles:* The purchaser of any required builder's risk or property insurance shall pay for costs not covered because of the application of a policy deductible.
- D. *Partial Occupancy or Use by Owner:* If Owner will occupy or use a portion or portions of the Work prior to Substantial Completion of all the Work as provided in Paragraph 15.04, then Owner (directly, if it is the purchaser of the builder's risk policy, or through Contractor) will provide notice of such occupancy or use to the builder's risk insurer. The builder's risk insurance shall not be canceled or permitted to lapse on account of any such partial use or occupancy; rather, those portions of the Work that are occupied or used by Owner may come off the builder's risk policy, while those portions of the Work not yet occupied or used by Owner shall remain covered by the builder's risk insurance.
- E. *Additional Insurance:* If Contractor elects to obtain other special insurance to be included in or supplement the builder's risk or property insurance policies provided under this Paragraph 6.05, it may do so at Contractor's expense.
- F. *Insurance of Other Property:* If the express insurance provisions of the Contract do not require or address the insurance of a property item or interest, such as tools, construction equipment, or other personal property owned by Contractor, a Subcontractor, or an employee of Contractor or a Subcontractor, then the entity or individual owning such property item will be responsible for deciding whether to insure it, and if so in what amount.

6.06 *Waiver of Rights*

- A. All policies purchased in accordance with Paragraph 6.05, expressly including the builder's risk policy, shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any insureds thereunder, or against Engineer or its consultants, or their officers, directors, members, partners, employees, agents, consultants, or subcontractors. Owner and Contractor waive all rights against each other and the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Engineer, its consultants, all Subcontractors, all individuals or entities identified in the Supplementary Conditions as insureds, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner or Contractor as trustee or fiduciary, or otherwise payable under any policy so issued.
- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, for:
 - 1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 - 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial occupancy or use pursuant to Paragraph 15.04, after Substantial Completion pursuant to Paragraph 15.03, or after final payment pursuant to Paragraph 15.06.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 6.06.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, or the officers, directors, members, partners, employees, agents, consultants, or subcontractors of each and any of them.
- D. Contractor shall be responsible for assuring that the agreement under which a Subcontractor performs a portion of the Work contains provisions whereby the Subcontractor waives all rights against Owner, Contractor, all individuals or entities identified in the Supplementary Conditions as insureds, the Engineer and its consultants, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by builder's risk insurance and any other property insurance applicable to the Work.

6.07 *Receipt and Application of Property Insurance Proceeds*

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

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

- B. Proceeds for such insured losses may be made payable by the insurer either jointly to multiple insureds, or to the named insured that purchased the policy in its own right and as fiduciary for other insureds, subject to the requirements of any applicable mortgage clause. A named insured receiving insurance proceeds under the builder's risk and other policies of insurance required by Paragraph 6.05 shall distribute such proceeds in accordance with such agreement as the parties in interest may reach, or as otherwise required under the dispute resolution provisions of this Contract or applicable Laws and Regulations.
- C. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the money so received applied on account thereof, and the Work and the cost thereof covered by Change Order, if needed.

ARTICLE 7 – CONTRACTOR'S RESPONSIBILITIES

7.01 *Supervision and Superintendence*

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

7.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours, Monday through Friday. Contractor will not perform Work on a Saturday, Sunday, or any legal holiday. Contractor may perform Work outside regular working hours or on Saturdays, Sundays, or legal holidays only with Owner's written consent, which will not be unreasonably withheld.

7.03 *Services, Materials, and Equipment*

- A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start up, and completion of the Work, whether or not such items are specifically called for in the Contract Documents.
- B. All materials and equipment incorporated into the Work shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and

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

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

7.04 "Or Equals"

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the Contract Price has been based upon Contractor furnishing such item as specified. The specification or description of such an item is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or equal" item is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment, or items from other proposed suppliers under the circumstances described below.
 - 1. If Engineer in its sole discretion determines that an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, Engineer shall deem it an "or equal" item. For the purposes of this paragraph, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole;
 - 3) it has a proven record of performance and availability of responsive service; and
 - 4) it is not objectionable to Owner.
 - b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.
- B. *Contractor's Expense:* Contractor shall provide all data in support of any proposed "or equal" item at Contractor's expense.
- C. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each "or-equal" request. Engineer may require Contractor to furnish additional data about the proposed "or-equal" item. Engineer will be the sole judge of acceptability. No "or-equal" item will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an "or-equal", which will be evidenced by an approved Shop Drawing or other written communication. Engineer will advise Contractor in writing of any negative determination.

- D. *Effect of Engineer's Determination:* Neither approval nor denial of an "or-equal" request shall result in any change in Contract Price. The Engineer's denial of an "or-equal" request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents.
- E. *Treatment as a Substitution Request:* If Engineer determines that an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item, Contractor may request that Engineer consider the proposed item as a substitute pursuant to Paragraph 7.05.

7.05 Substitutes

- A. Unless the specification or description of an item of material or equipment required to be furnished under the Contract Documents contains or is followed by words reading that no substitution is permitted, Contractor may request that Engineer authorize the use of other items of material or equipment under the circumstances described below. To the extent possible such requests shall be made before commencement of related construction at the Site.
 - 1. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is functionally equivalent to that named and an acceptable substitute therefor. Engineer will not accept requests for review of proposed substitute items of material or equipment from anyone other than Contractor.
 - 2. The requirements for review by Engineer will be as set forth in Paragraph 7.05.B, as supplemented by the Specifications, and as Engineer may decide is appropriate under the circumstances.
 - 3. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - a. shall certify that the proposed substitute item will:
 - 1) perform adequately the functions and achieve the results called for by the general design,
 - 2) be similar in substance to that specified, and
 - 3) be suited to the same use as that specified.
 - b. will state:
 - 1) the extent, if any, to which the use of the proposed substitute item will necessitate a change in Contract Times,
 - 2) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - 3) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty.
 - c. will identify:
 - 1) all variations of the proposed substitute item from that specified, and

- 2) available engineering, sales, maintenance, repair, and replacement services.
- d. shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including but not limited to changes in Contract Price, shared savings, costs of redesign, and claims of other contractors affected by any resulting change.
- B. *Engineer's Evaluation and Determination:* Engineer will be allowed a reasonable time to evaluate each substitute request, and to obtain comments and direction from Owner. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No substitute will be ordered, furnished, installed, or utilized until Engineer's review is complete and Engineer determines that the proposed item is an acceptable substitute. Engineer's determination will be evidenced by a Field Order or a proposed Change Order accounting for the substitution itself and all related impacts, including changes in Contract Price or Contract Times. Engineer will advise Contractor in writing of any negative determination.
- C. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- D. *Reimbursement of Engineer's Cost:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.
- E. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute at Contractor's expense.
- F. *Effect of Engineer's Determination:* If Engineer approves the substitution request, Contractor shall execute the proposed Change Order and proceed with the substitution. The Engineer's denial of a substitution request shall be final and binding, and may not be reversed through an appeal under any provision of the Contract Documents. Contractor may challenge the scope of reimbursement costs imposed under Paragraph 7.05.D, by timely submittal of a Change Proposal.

7.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor may retain Subcontractors and Suppliers for the performance of parts of the Work. Such Subcontractors and Suppliers must be acceptable to Owner.
- B. Contractor shall retain specific Subcontractors, Suppliers, or other individuals or entities for the performance of designated parts of the Work if required by the Contract to do so.
- C. Subsequent to the submittal of Contractor's Bid or final negotiation of the terms of the Contract, Owner may not require Contractor to retain any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against which Contractor has reasonable objection.
- D. Prior to entry into any binding subcontract or purchase order, Contractor shall submit to Owner the identity of the proposed Subcontractor or Supplier (unless Owner has already deemed such proposed Subcontractor or Supplier acceptable, during the bidding process or otherwise). Such proposed Subcontractor or Supplier shall be deemed acceptable to Owner unless Owner raises a substantive, reasonable objection within five days.

- E. Owner may require the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work. Owner also may require Contractor to retain specific replacements; provided, however, that Owner may not require a replacement to which Contractor has a reasonable objection. If Contractor has submitted the identity of certain Subcontractors, Suppliers, or other individuals or entities for acceptance by Owner, and Owner has accepted it (either in writing or by failing to make written objection thereto), then Owner may subsequently revoke the acceptance of any such Subcontractor, Supplier, or other individual or entity so identified solely on the basis of substantive, reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity.
- F. If Owner requires the replacement of any Subcontractor, Supplier, or other individual or entity retained by Contractor to perform any part of the Work, then Contractor shall be entitled to an adjustment in Contract Price or Contract Times, or both, with respect to the replacement; and Contractor shall initiate a Change Proposal for such adjustment within 30 days of Owner's requirement of replacement.
- G. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of the right of Owner to the completion of the Work in accordance with the Contract Documents.
- H. On a monthly basis Contractor shall submit to Engineer a complete list of all Subcontractors and Suppliers having a direct contract with Contractor, and of all other Subcontractors and Suppliers known to Contractor at the time of submittal.
- I. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions.
- J. Contractor shall be solely responsible for scheduling and coordinating the work of Subcontractors, Suppliers, and all other individuals or entities performing or furnishing any of the Work.
- K. Contractor shall restrict all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work from communicating with Engineer or Owner, except through Contractor or in case of an emergency, or as otherwise expressly allowed herein.
- L. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- M. All Work performed for Contractor by a Subcontractor or Supplier shall be pursuant to an appropriate contractual agreement that specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer.
- N. Owner may furnish to any Subcontractor or Supplier, to the extent practicable, information about amounts paid to Contractor on account of Work performed for Contractor by the particular Subcontractor or Supplier.

O. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier, or other individual or entity; nor
2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any money due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

7.07 *Patent Fees and Royalties*

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

7.08 *Permits*

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

7.09 *Taxes*

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

7.10 *Laws and Regulations*

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

7.11 *Record Documents*

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

7.12 *Safety and Protection*

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

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, other work in progress, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify Owner; the owners of adjacent property, Underground Facilities, and other utilities; and other contractors and utility owners performing work at or adjacent to the Site, when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property or work in progress.
 - C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
 - D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
 - E. All damage, injury, or loss to any property referred to in Paragraph 7.12.A.2 or 7.12.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor at its expense (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
 - F. Contractor's duties and responsibilities for safety and protection shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 15.06.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).
 - G. Contractor's duties and responsibilities for safety and protection shall resume whenever Contractor or any Subcontractor or Supplier returns to the Site to fulfill warranty or correction obligations, or to conduct other tasks arising from the Contract Documents.

7.13 *Safety Representative*

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

7.14 *Hazard Communication Programs*

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

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

7.15 *Emergencies*

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

7.16 *Shop Drawings, Samples, and Other Submittals*

A. *Shop Drawing and Sample Submittal Requirements:*

1. Before submitting a Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated the Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - b. determined and verified all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;
 - c. determined and verified the suitability of all materials and equipment offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and
 - d. determined and verified all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto.
2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review of that submittal, and that Contractor approves the submittal.
3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be set forth in a written communication separate from the Shop Drawings or Sample submittal; and, in addition, in the case of Shop Drawings by a specific notation made on each Shop Drawing submitted to Engineer for review and approval of each such variation.

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

1. *Shop Drawings:*

- a. Contractor shall submit the number of copies required in the Specifications.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to

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

2. *Samples:*

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

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

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

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction or to safety precautions or programs incident thereto.
3. Engineer's review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
4. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 7.16.A.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer will document any such approved variation from the requirements of the Contract Documents in a Field Order.
5. Engineer's review and approval of a Shop Drawing or Sample shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 7.16.A and B.
6. Engineer's review and approval of a Shop Drawing or Sample, or of a variation from the requirements of the Contract Documents, shall not, under any circumstances, change the Contract Times or Contract Price, unless such changes are included in a Change Order.
7. Neither Engineer's receipt, review, acceptance or approval of a Shop Drawing, Sample, or other submittal shall result in such item becoming a Contract Document.

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

E. *Resubmittal Procedures:*

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

7.17 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:
 1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
 1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal;
 6. the issuance of a notice of acceptability by Engineer;
 7. any inspection, test, or approval by others; or
 8. any correction of defective Work by Owner.

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

7.18 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, and in addition to any other obligations of Contractor under the Contract or otherwise, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable.
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 7.18.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 7.18.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 - 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 - 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

7.19 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable Laws and Regulations.
- B. If professional design services or certifications by a design professional related to systems, materials, or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, and other submittals prepared by such professional. Shop

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

- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy, and completeness of the services, certifications, or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this paragraph, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 7.16.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria specified by Owner or Engineer.

ARTICLE 8 – OTHER WORK AT THE SITE

8.01 *Other Work*

- A. In addition to and apart from the Work under the Contract Documents, the Owner may perform other work at or adjacent to the Site. Such other work may be performed by Owner's employees, or through contracts between the Owner and third parties. Owner may also arrange to have third-party utility owners perform work on their utilities and facilities at or adjacent to the Site.
- B. If Owner performs other work at or adjacent to the Site with Owner's employees, or through contracts for such other work, then Owner shall give Contractor written notice thereof prior to starting any such other work. If Owner has advance information regarding the start of any utility work at or adjacent to the Site, Owner shall provide such information to Contractor.
- C. Contractor shall afford each other contractor that performs such other work, each utility owner performing other work, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, and provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected.
- D. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 8, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

8.02 *Coordination*

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

8.03 *Legal Relationships*

- A. If, in the course of performing other work at or adjacent to the Site for Owner, the Owner's employees, any other contractor working for Owner, or any utility owner causes damage to the Work or to the property of Contractor or its Subcontractors, or delays, disrupts, interferes with, or increases the scope or cost of the performance of the Work, through actions or inaction, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor must submit any Change Proposal seeking an equitable adjustment in the Contract Price or the Contract Times under this paragraph within 30 days of the damaging, delaying, disrupting, or interfering event. The entitlement to, and extent of, any such equitable adjustment shall take into account information (if any) regarding such other work that was provided to Contractor in the Contract Documents prior to the submittal of the Bid or the final negotiation of the terms of the Contract. When applicable, any such equitable adjustment in Contract Price shall be conditioned on Contractor assigning to Owner all Contractor's rights against such other contractor or utility owner with respect to the damage, delay, disruption, or interference that is the subject of the adjustment. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- B. Contractor shall take reasonable and customary measures to avoid damaging, delaying, disrupting, or interfering with the work of Owner, any other contractor, or any utility owner performing other work at or adjacent to the Site. If Contractor fails to take such measures and as a result damages, delays, disrupts, or interferes with the work of any such other contractor or utility owner, then Owner may impose a set-off against payments due to Contractor, and assign to such other contractor or utility owner the Owner's contractual rights against Contractor with respect to the breach of the obligations set forth in this paragraph.
- C. When Owner is performing other work at or adjacent to the Site with Owner's employees, Contractor shall be liable to Owner for damage to such other work, and for the reasonable direct delay, disruption, and interference costs incurred by Owner as a result of Contractor's failure to take reasonable and customary measures with respect to Owner's other work. In response to such damage, delay, disruption, or interference, Owner may impose a set-off against payments due to Contractor.

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

ARTICLE 9 – OWNER'S RESPONSIBILITIES

9.01 *Communications to Contractor*

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

9.02 *Replacement of Engineer*

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

9.03 *Furnish Data*

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

9.04 *Pay When Due*

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

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

- A. Owner's duties with respect to providing lands and easements are set forth in Paragraph 5.01.
- B. Owner's duties with respect to providing engineering surveys to establish reference points are set forth in Paragraph 4.03.
- C. Article 5 refers to Owner's identifying and making available to Contractor copies of reports of explorations and tests of conditions at the Site, and drawings of physical conditions relating to existing surface or subsurface structures at the Site.

9.06 *Insurance*

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

9.07 *Change Orders*

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

9.08 *Inspections, Tests, and Approvals*

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

9.09 *Limitations on Owner's Responsibilities*

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

9.10 *Undisclosed Hazardous Environmental Condition*

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

9.11 *Evidence of Financial Arrangements*

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

9.12 *Safety Programs*

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

ARTICLE 10 – ENGINEER'S STATUS DURING CONSTRUCTION

10.01 *Owner's Representative*

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

10.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 10.08. Particularly, but without limitation, during

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

10.03 *Project Representative*

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

10.04 *Rejecting Defective Work*

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

10.05 *Shop Drawings, Change Orders and Payments*

- A. Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, are set forth in Paragraph 7.16.
- B. Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, are set forth in Paragraph 7.19.
- C. Engineer's authority as to Change Orders is set forth in Article 11.
- D. Engineer's authority as to Applications for Payment is set forth in Article 15.

10.06 *Determinations for Unit Price Work*

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

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

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

10.08 *Limitations on Engineer's Authority and Responsibilities*

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

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 15.06.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals, that the results certified indicate compliance with the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 10.08 shall also apply to the Resident Project Representative, if any.

10.09 *Compliance with Safety Program*

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

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

11.01 *Amending and Supplementing Contract Documents*

- A. The Contract Documents may be amended or supplemented by a Change Order, a Work Change Directive, or a Field Order.
 - 1. *Change Orders:*
 - a. If an amendment or supplement to the Contract Documents includes a change in the Contract Price or the Contract Times, such amendment or supplement must be set forth in a Change Order. A Change Order also may be used to establish amendments and supplements of the Contract Documents that do not affect the Contract Price or Contract Times.
 - b. Owner and Contractor may amend those terms and conditions of the Contract Documents that do not involve (1) the performance or acceptability of the Work, (2) the design (as set forth in the Drawings, Specifications, or otherwise), or (3) other engineering or technical matters, without the recommendation of the Engineer. Such an amendment shall be set forth in a Change Order.
 - 2. *Work Change Directives:* A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the modification ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order, following negotiations by the parties as to the Work Change Directive's effect, if any, on the Contract Price and Contract Times; or, if negotiations are unsuccessful, by a determination under the terms of the Contract Documents governing adjustments, expressly including Paragraph 11.04 regarding change of Contract Price. Contractor must submit any Change Proposal seeking an

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

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

11.02 *Owner-Authorized Changes in the Work*

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

11.03 *Unauthorized Changes in the Work*

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

11.04 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Price shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment of Contract Price shall comply with the provisions of Article 12.
- B. An adjustment in the Contract Price will be determined as follows:
 1. where the Work involved is covered by unit prices contained in the Contract Documents, then by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 13.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, then by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 11.04.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and the parties do not reach mutual agreement to a lump sum, then on

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

- C. *Contractor's Fee*: When applicable, the Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 13.01.B.1 and 13.01.B.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 13.01.B.3, the Contractor's fee shall be five percent;
 - c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 11.01.C.2.a and 11.01.C.2.b is that the Contractor's fee shall be based on: (1) a fee of 15 percent of the costs incurred under Paragraphs 13.01.A.1 and 13.01.A.2 by the Subcontractor that actually performs the Work, at whatever tier, and (2) with respect to Contractor itself and to any Subcontractors of a tier higher than that of the Subcontractor that actually performs the Work, a fee of five percent of the amount (fee plus underlying costs incurred) attributable to the next lower tier Subcontractor; provided, however, that for any such subcontracted work the maximum total fee to be paid by Owner shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;
 - d. no fee shall be payable on the basis of costs itemized under Paragraphs 13.01.B.4, 13.01.B.5, and 13.01.C;
 - e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
 - f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 11.04.C.2.a through 11.04.C.2.e, inclusive.

11.05 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Change Proposal for an adjustment in the Contract Times shall comply with the provisions of Paragraph 11.06. Any Claim for an adjustment in the Contract Times shall comply with the provisions of Article 12.
- B. An adjustment of the Contract Times shall be subject to the limitations set forth in Paragraph 4.05, concerning delays in Contractor's progress.

11.06 *Change Proposals*

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

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

1. *Procedures:* Contractor shall submit each Change Proposal to Engineer promptly (but in no event later than 30 days) after the start of the event giving rise thereto, or after such initial decision. The Contractor shall submit supporting data, including the proposed change in Contract Price or Contract Time (if any), to the Engineer and Owner within 15 days after the submittal of the Change Proposal. The supporting data shall be accompanied by a written statement that the supporting data are accurate and complete, and that any requested time or price adjustment is the entire adjustment to which Contractor believes it is entitled as a result of said event. Engineer will advise Owner regarding the Change Proposal, and consider any comments or response from Owner regarding the Change Proposal.
 2. *Engineer's Action:* Engineer will review each Change Proposal and, within 30 days after receipt of the Contractor's supporting data, either deny the Change Proposal in whole, approve it in whole, or deny it in part and approve it in part. Such actions shall be in writing, with a copy provided to Owner and Contractor. If Engineer does not take action on the Change Proposal within 30 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of Engineer's inaction the Change Proposal is deemed denied, thereby commencing the time for appeal of the denial under Article 12.
 3. *Binding Decision:* Engineer's decision will be final and binding upon Owner and Contractor, unless Owner or Contractor appeals the decision by filing a Claim under Article 12.
- B. *Resolution of Certain Change Proposals:* If the Change Proposal does not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters, then Engineer will notify the parties that the Engineer is unable to resolve the Change Proposal. For purposes of further resolution of such a Change Proposal, such notice shall be deemed a denial, and Contractor may choose to seek resolution under the terms of Article 12.

11.07 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders covering:
1. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive;
 2. changes in Contract Price resulting from an Owner set-off, unless Contractor has duly contested such set-off;
 3. changes in the Work which are: (a) ordered by Owner pursuant to Paragraph 11.02, (b) required because of Owner's acceptance of defective Work under Paragraph 14.04 or Owner's correction of defective Work under Paragraph 14.07, or (c) agreed to by the parties, subject to the need for Engineer's recommendation if the change in the Work involves the design (as set forth in the Drawings, Specifications, or otherwise), or other engineering or technical matters; and
 4. changes in the Contract Price or Contract Times, or other changes, which embody the substance of any final and binding results under Paragraph 11.06, or Article 12.

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

11.08 *Notification to Surety*

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

ARTICLE 12 – CLAIMS

12.01 *Claims*

- A. *Claims Process:* The following disputes between Owner and Contractor shall be submitted to the Claims process set forth in this Article:
 - 1. Appeals by Owner or Contractor of Engineer's decisions regarding Change Proposals;
 - 2. Owner demands for adjustments in the Contract Price or Contract Times, or other relief under the Contract Documents; and
 - 3. Disputes that Engineer has been unable to address because they do not involve the design (as set forth in the Drawings, Specifications, or otherwise), the acceptability of the Work, or other engineering or technical matters.
- B. *Submittal of Claim:* The party submitting a Claim shall deliver it directly to the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto; in the case of appeals regarding Change Proposals within 30 days of the decision under appeal. The party submitting the Claim shall also furnish a copy to the Engineer, for its information only. The responsibility to substantiate a Claim shall rest with the party making the Claim. In the case of a Claim by Contractor seeking an increase in the Contract Times or Contract Price, or both, Contractor shall certify that the Claim is made in good faith, that the supporting data are accurate and complete, and that to the best of Contractor's knowledge and belief the amount of time or money requested accurately reflects the full amount to which Contractor is entitled.
- C. *Review and Resolution:* The party receiving a Claim shall review it thoroughly, giving full consideration to its merits. The two parties shall seek to resolve the Claim through the exchange of information and direct negotiations. The parties may extend the time for resolving the Claim by mutual agreement. All actions taken on a Claim shall be stated in writing and submitted to the other party, with a copy to Engineer.
- D. *Mediation:*
 - 1. At any time after initiation of a Claim, Owner and Contractor may mutually agree to mediation of the underlying dispute. The agreement to mediate shall stay the Claim submittal and response process.
 - 2. If Owner and Contractor agree to mediation, then after 60 days from such agreement, either Owner or Contractor may unilaterally terminate the mediation process, and the Claim submittal and decision process shall resume as of the date of the termination. If the mediation proceeds but is unsuccessful in resolving the dispute, the Claim

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

3. Owner and Contractor shall each pay one-half of the mediator's fees and costs.
- E. *Partial Approval*: If the party receiving a Claim approves the Claim in part and denies it in part, such action shall be final and binding unless within 30 days of such action the other party invokes the procedure set forth in Article 17 for final resolution of disputes.
- F. *Denial of Claim*: If efforts to resolve a Claim are not successful, the party receiving the Claim may deny it by giving written notice of denial to the other party. If the receiving party does not take action on the Claim within 90 days, then either Owner or Contractor may at any time thereafter submit a letter to the other party indicating that as a result of the inaction, the Claim is deemed denied, thereby commencing the time for appeal of the denial. A denial of the Claim shall be final and binding unless within 30 days of the denial the other party invokes the procedure set forth in Article 17 for the final resolution of disputes.
- G. *Final and Binding Results*: If the parties reach a mutual agreement regarding a Claim, whether through approval of the Claim, direct negotiations, mediation, or otherwise; or if a Claim is approved in part and denied in part, or denied in full, and such actions become final and binding; then the results of the agreement or action on the Claim shall be incorporated in a Change Order to the extent they affect the Contract, including the Work, the Contract Times, or the Contract Price.

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

13.01 Cost of the Work

- A. *Purposes for Determination of Cost of the Work*: The term Cost of the Work means the sum of all costs necessary for the proper performance of the Work at issue, as further defined below. The provisions of this Paragraph 13.01 are used for two distinct purposes:
 1. To determine Cost of the Work when Cost of the Work is a component of the Contract Price, under cost-plus-fee, time-and-materials, or other cost-based terms; or
 2. To determine the value of a Change Order, Change Proposal, Claim, set-off, or other adjustment in Contract Price. When the value of any such adjustment is determined on the basis of Cost of the Work, Contractor is entitled only to those additional or incremental costs required because of the change in the Work or because of the event giving rise to the adjustment.
- B. *Costs Included*: Except as otherwise may be agreed to in writing by Owner, costs included in the Cost of the Work shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 13.01.C, and shall include only the following items:
 1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, and vacation and holiday pay applicable

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

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates, and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 13.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof, whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 6.05), provided such losses and damages have resulted from causes

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

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

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

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, 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. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraph 13.01.B.

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

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

13.02 Allowances

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

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

13.03 *Unit Price Work*

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Payments to Contractor for Unit Price Work will be based on actual quantities.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.
- D. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of the following paragraph.
- E. Within 30 days of Engineer's written decision under the preceding paragraph, Contractor may submit a Change Proposal, or Owner may file a Claim, seeking an adjustment in the Contract Price if:
 - 1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement;
 - 2. there is no corresponding adjustment with respect to any other item of Work; and
 - 3. Contractor believes that it is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price, and the parties are unable to agree as to the amount of any such increase or decrease.

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

14.01 *Access to Work*

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

14.02 *Tests, Inspections, and Approvals*

- A. Contractor shall give Engineer timely notice of readiness of the Work (or specific parts thereof) for all required inspections and tests, and shall cooperate with inspection and testing personnel to facilitate required inspections and tests.
- B. Owner shall retain and pay for the services of an independent inspector, testing laboratory, or other qualified individual or entity to perform all inspections and tests expressly required by the Contract Documents to be furnished and paid for by Owner, except that costs incurred in connection with tests or inspections of covered Work shall be governed by the provisions of Paragraph 14.05.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging, obtaining, and paying for all inspections and tests required:
 - 1. by the Contract Documents, unless the Contract Documents expressly allocate responsibility for a specific inspection or test to Owner;
 - 2. to attain Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work;
 - 3. by manufacturers of equipment furnished under the Contract Documents;
 - 4. for testing, adjusting, and balancing of mechanical, electrical, and other equipment to be incorporated into the Work; and
 - 5. for acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work.

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

- E. If the Contract Documents require the Work (or part thereof) to be approved by Owner, Engineer, or another designated individual or entity, then Contractor shall assume full responsibility for arranging and obtaining such approvals.
- F. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation. Such uncovering shall be at Contractor's expense unless Contractor had given Engineer timely notice of Contractor's intention to

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

14.03 *Defective Work*

- A. *Contractor's Obligation:* It is Contractor's obligation to assure that the Work is not defective.
- B. *Engineer's Authority:* Engineer has the authority to determine whether Work is defective, and to reject defective Work.
- C. *Notice of Defects:* Prompt notice of all defective Work of which Owner or Engineer has actual knowledge will be given to Contractor.
- D. *Correction, or Removal and Replacement:* Promptly after receipt of written notice of defective Work, Contractor shall correct all such defective Work, whether or not fabricated, installed, or completed, or, if Engineer has rejected the defective Work, remove it from the Project and replace it with Work that is not defective.
- E. *Preservation of Warranties:* When correcting defective Work, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.
- F. *Costs and Damages:* In addition to its correction, removal, and replacement obligations with respect to defective Work, Contractor shall pay all claims, costs, losses, and damages arising out of or relating to defective Work, including but not limited to the cost of the inspection, testing, correction, removal, replacement, or reconstruction of such defective Work, fines levied against Owner by governmental authorities because the Work is defective, and the costs of repair or replacement of work of others resulting from defective Work. Prior to final payment, if Owner and Contractor are unable to agree as to the measure of such claims, costs, losses, and damages resulting from defective Work, then Owner may impose a reasonable set-off against payments due under Article 15.

14.04 *Acceptance of Defective Work*

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

14.05 *Uncovering Work*

- A. Engineer has the authority to require special inspection or testing of the Work, whether or not the Work is fabricated, installed, or completed.

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

14.06 *Owner May Stop the Work*

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

14.07 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, then Owner may, after seven days written notice to Contractor, correct or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 14.07, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this paragraph.
- C. All claims, costs, losses, and damages incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 14.07 will be charged against Contractor as set-offs against payments due under Article 15. Such claims, costs, losses and damages will

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

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

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

15.01 Progress Payments

- A. *Basis for Progress Payments:* The Schedule of Values established as provided in Article 2 will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed during the pay period, as determined under the provisions of Paragraph 13.03. Progress payments for cost-based Work will be based on Cost of the Work completed by Contractor during the pay period.
- B. *Applications for Payments:*
 - 1. At least 20 days before the date established in the Agreement for each progress payment (but not more often than once a month), Contractor shall submit to Engineer for review an Application for Payment filled out and signed by Contractor covering the Work completed as of the date of the Application and accompanied by such supporting documentation as is required by the Contract Documents. If payment is requested on the basis of materials and equipment not incorporated in the Work but delivered and suitably stored at the Site or at another location agreed to in writing, the Application for Payment shall also be accompanied by a bill of sale, invoice, or other documentation warranting that Owner has received the materials and equipment free and clear of all Liens, and evidence that the materials and equipment are covered by appropriate property insurance, a warehouse bond, or other arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.
 - 2. Beginning with the second Application for Payment, each Application shall include an affidavit of Contractor stating that all previous progress payments received on account of the Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.
 - 3. The amount of retainage with respect to progress payments will be as stipulated in the Agreement.
- C. *Review of Applications:*
 - 1. Engineer will, within 10 days after receipt of each Application for Payment, including each resubmittal, either indicate in writing a recommendation of payment and present the Application to Owner, or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
 - 2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

- a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 13.03, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
- a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.
4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
- a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the money paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 15.01.C.2.
6. Engineer will recommend reductions in payment (set-offs) necessary in Engineer's opinion to protect Owner from loss because:
- a. the Work is defective, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible; or

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

D. *Payment Becomes Due:*

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

E. *Reductions in Payment by Owner:*

- 1. In addition to any reductions in payment (set-offs) recommended by Engineer, Owner is entitled to impose a set-off against payment based on any of the following:
 - a. claims have been made against Owner on account of Contractor's conduct in the performance or furnishing of the Work, or Owner has incurred costs, losses, or damages on account of Contractor's conduct in the performance or furnishing of the Work, including but not limited to claims, costs, losses, or damages from workplace injuries, adjacent property damage, non-compliance with Laws and Regulations, and patent infringement;
 - b. Contractor has failed to take reasonable and customary measures to avoid damage, delay, disruption, and interference with other work at or adjacent to the Site;
 - c. Contractor has failed to provide and maintain required bonds or insurance;
 - d. Owner has been required to remove or remediate a Hazardous Environmental Condition for which Contractor is responsible;
 - e. Owner has incurred extra charges or engineering costs related to submittal reviews, evaluations of proposed substitutes, tests and inspections, or return visits to manufacturing or assembly facilities;
 - f. the Work is defective, requiring correction or replacement;
 - g. Owner has been required to correct defective Work in accordance with Paragraph 14.07, or has accepted defective Work pursuant to Paragraph 14.04;
 - h. the Contract Price has been reduced by Change Orders;
 - i. an event that would constitute a default by Contractor and therefore justify a termination for cause has occurred;
 - j. liquidated damages have accrued as a result of Contractor's failure to achieve Milestones, Substantial Completion, or final completion of the Work;
 - k. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - l. there are other items entitling Owner to a set off against the amount recommended.
- 2. If Owner imposes any set-off against payment, whether based on its own knowledge or on the written recommendations of Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and the specific amount of the reduction, and promptly pay Contractor any amount

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

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

15.02 *Contractor's Warranty of Title*

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

15.03 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete and request that Engineer issue a certificate of Substantial Completion. Contractor shall at the same time submit to Owner and Engineer an initial draft of punch list items to be completed or corrected before final payment.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a preliminary certificate of Substantial Completion which shall fix the date of Substantial Completion. Engineer shall attach to the certificate a punch list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the preliminary certificate during which to make written objection to Engineer as to any provisions of the certificate or attached punch list. If, after considering the objections to the provisions of the preliminary certificate, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the preliminary certificate to Owner, notify Contractor in writing that the Work is not substantially complete, stating the reasons therefor. If Owner does not object to the provisions of the certificate, or if despite consideration of Owner's objections Engineer concludes that the Work is substantially complete, then Engineer will, within said 14 days, execute and deliver to Owner and Contractor a final certificate of Substantial Completion (with a revised punch list of items to be completed or corrected) reflecting such changes from the preliminary certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of receipt of the preliminary certificate of Substantial Completion, Owner and Contractor will confer regarding Owner's use or occupancy of the Work following Substantial Completion, review the builder's risk insurance policy with respect to the end of the builder's risk coverage, and confirm the transition to coverage of the Work under a permanent property insurance policy held by Owner. Unless Owner and Contractor agree otherwise in writing, Owner shall bear responsibility for security, operation, protection of the Work, property insurance, maintenance, heat, and utilities upon Owner's use or occupancy of the Work.

- E. After Substantial Completion the Contractor shall promptly begin work on the punch list of items to be completed or corrected prior to final payment. In appropriate cases Contractor may submit monthly Applications for Payment for completed punch list items, following the progress payment procedures set forth above.
- F. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the punch list.

15.04 *Partial Use or Occupancy*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. At any time Owner may request in writing that Contractor permit Owner to use or occupy any such part of the Work that Owner believes to be substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 15.03.A through E for that part of the Work.
 - 2. At any time Contractor may notify Owner and Engineer in writing that Contractor considers any such part of the Work substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 15.03 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 6.05 regarding builder's risk or other property insurance.

15.05 *Final Inspection*

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

15.06 *Final Payment*

- A. *Application for Payment:*
 - 1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of

inspection, annotated record documents (as provided in Paragraph 7.11), and other documents, Contractor may make application for final payment.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents;
 - b. consent of the surety, if any, to final payment;
 - c. satisfactory evidence that all title issues have been resolved such that title to all Work, materials, and equipment has passed to Owner free and clear of any Liens or other title defects, or will so pass upon final payment.
 - d. a list of all disputes that Contractor believes are unsettled; and
 - e. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of the Work, and of Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 15.06.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (a) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (b) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien, or Owner at its option may issue joint checks payable to Contractor and specified Subcontractors and Suppliers.

B. *Engineer's Review of Application and Acceptance:*

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of final payment and present the Application for Payment to Owner for payment. Such recommendation shall account for any set-offs against payment that are necessary in Engineer's opinion to protect Owner from loss for the reasons stated above with respect to progress payments. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable, subject to the provisions of Paragraph 15.07. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

- C. *Completion of Work:* The Work is complete (subject to surviving obligations) when it is ready for final payment as established by the Engineer's written recommendation of final payment.
- D. *Payment Becomes Due:* Thirty days after the presentation to Owner of the final Application for Payment and accompanying documentation, the amount recommended by Engineer (less any further sum Owner is entitled to set off against Engineer's recommendation,

including but not limited to set-offs for liquidated damages and set-offs allowed under the provisions above with respect to progress payments) will become due and shall be paid by Owner to Contractor.

15.07 *Waiver of Claims*

- A. The making of final payment will not constitute a waiver by Owner of claims or rights against Contractor. Owner expressly reserves claims and rights arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 15.05, from Contractor's failure to comply with the Contract Documents or the terms of any special guarantees specified therein, from outstanding Claims by Owner, or from Contractor's continuing obligations under the Contract Documents.
- B. The acceptance of final payment by Contractor will constitute a waiver by Contractor of all claims and rights against Owner other than those pending matters that have been duly submitted or appealed under the provisions of Article 17.

15.08 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents, or by any specific provision of the Contract Documents), any Work is found to be defective, or if the repair of any damages to the Site, adjacent areas that Contractor has arranged to use through construction easements or otherwise, and other adjacent areas used by Contractor as permitted by Laws and Regulations, is found to be defective, then Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. correct the defective repairs to the Site or such other adjacent areas;
 - 2. correct such defective Work;
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others, or to other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others).
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this paragraph, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

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

ARTICLE 16 – SUSPENSION OF WORK AND TERMINATION

16.01 *Owner May Suspend Work*

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

16.02 *Owner May Terminate for Cause*

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

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

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

16.03 *Owner May Terminate For Convenience*

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

16.04 *Contractor May Stop Work or Terminate*

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

expenses or damage directly attributable to Contractor's stopping the Work as permitted by this paragraph.

ARTICLE 17 – FINAL RESOLUTION OF DISPUTES

17.01 *Methods and Procedures*

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

ARTICLE 18 – MISCELLANEOUS

18.01 *Giving Notice*

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:
 - 1. delivered in person, by a commercial courier service or otherwise, to the individual or to a member of the firm or to an officer of the corporation for which it is intended; or
 - 2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the sender of the notice.

18.02 *Computation of Times*

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

18.03 *Cumulative Remedies*

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

18.04 *Limitation of Damages*

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

18.05 *No Waiver*

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

18.06 *Survival of Obligations*

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

18.07 *Controlling Law*

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

18.08 *Headings*

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

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

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Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

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Issued and Published Jointly by



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1420 King Street, Alexandria, VA 22314-2794
(703) 684-2882
www.nspe.org

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

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

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2300 Wilson Boulevard, Suite 400, Arlington, VA 22201-3308
(703) 548-3118
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You may terminate the license at any time by destroying the attached EJCDC document together with all copies, modifications and merged portions in any form (except those copies already in actual project or contract use, or maintained in files or records of completed projects). It will also terminate upon conditions set forth elsewhere in this License Agreement or if you fail to comply with any term or condition of this License Agreement.

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If EJCDC has distributed this document on a compact disc, then EJCDC warrants the CD on which this document is furnished to be free from physical defects in materials and workmanship under normal use for a period of ninety (90) days from the date of delivery to you as evidenced by a copy of your receipt.

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EJCDC's entire liability and your exclusive remedy shall be:

1. the replacement of the CD (if any) distributed by EJCDC, containing this document, provided such CD does not meet EJCDC's "Limited Warranty" and is returned to EJCDC's selling agent with a copy of your receipt, or

2. if EJCDC's selling agent is unable to deliver a replacement CD which is free of defects in materials and workmanship, you may terminate this Agreement by returning EJCDC Document and your money will be refunded.

As purchaser, you assume full responsibility for determining the suitability of this document to your purposes, and for the application and use of this document for contractual or project purposes. To the fullest extent permitted by law, in no event will EJCDC, its sponsoring organizations, its committee members, attorneys, consultants, authorized vendors, or advisors, or their respective staff members, employees, agents, or contractors, be liable to you or any other party for any damages, including any lost profits, lost savings, contractual liabilities, disappointed commercial expectations, economic loss, or other direct, incidental, or consequential damages arising out of the content, unenforceability, insufficiency, inadequacy, use or inability to use the attached EJCDC document or any other **EJCDC Design and Construction Related Documents**, even if EJCDC has been advised of the possibility of such damages, or for any claim by any other party.

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This License Agreement shall be governed by the laws of the State of Virginia. If you have any questions concerning this License Agreement, or any requests or inquiries regarding the EJCDC copyright, you may contact EJCDC by writing to:

EJCDC Copyright Administrator
c/o National Society of Professional Engineers
1420 King Street
Alexandria, VA 22314
Phone: (703) 684-2845
Fax: (703) 836-4875
e-mail: aschwartz@nspe.org

You acknowledge that you have read this License Agreement, understand it and agree to be bound by its terms and conditions. You further agree that it is the complete and exclusive statement of the License Agreement and supersedes any proposal or prior agreement, oral or written, and any other communications between us relating to the subject matter of this License Agreement.

Information regarding the content of the attached EJCDC document and other **EJCDC Design and Construction Related Documents** may be obtained at ejcdc.org or from the following EJCDC sponsoring organizations:

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

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

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

Contractor's Application for Payment No.

Application Period:		Application Date:
To (Owner): Town of Richlands	From (Contractor):	Via (Engineer): McGill Associates
Project: 4.0 MGD WWTP Upgrades and Improvements	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.: 24.00343

**Application For Payment
Change Order Summary**

Approved Change Orders	1. ORIGINAL CONTRACT PRICE..... \$
Number Additions Deductions	2. Net change by Change Orders..... \$
	3. Current Contract Price (Line 1 ± 2)..... \$
	4. TOTAL COMPLETED AND STORED TO DATE
	(Column F total on Progress Estimates)..... \$
	5. RETAINAGE:
	a. X Work Completed..... \$
	b. X Stored Material..... \$
	c. Total Retainage (Line 5.a + Line 5.b)..... \$
	6. AMOUNT ELIGIBLE TO DATE (Line 4 - Line 5.c)..... \$
	7. LESS PREVIOUS PAYMENTS (Line 6 from prior Application)..... \$
	8. AMOUNT DUE THIS APPLICATION..... \$
	9. BALANCE TO FINISH, PLUS RETAINAGE
	(Column G total on Progress Estimates + Line 5.c above)..... \$
TOTALS	
NET CHANGE BY	
CHANGE ORDERS	

Contractor's Certification

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

Contractor Signature

By:	Date:

Payment of:	\$	
		(Line 8 or other - attach explanation of the other amount)
is recommended by:		
	(Engineer)	(Date)
Payment of:	\$	
		(Line 8 or other - attach explanation of the other amount)
is approved by:		
	(Owner)	(Date)
Approved by:		
	Funding or Financing Entity (if applicable)	(Date)

Progress Estimate - Lump Sum Work

Contractor's Application

[illegible]

Stored Material Summary

Contractor's Application

[illegible]

Work Change Directive

No. _____

Date of Issuance: _____ Effective Date: _____

Project: 4.0 MGD WWTP Upgrades and Improvements	Owner: Town of Richlands	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.: 24.00343

Contractor is directed to proceed promptly with the following change(s):

Item No.	Description

Attachments (list documents supporting change):

Purpose for Work Change Directive:

Authorization for Work described herein to proceed on the basis of Cost of the Work due to:

- ☐ Nonagreement on pricing of proposed change.
- ☐ Necessity to expedite Work described herein prior to agreeing to changes on Contract Price and Contract Time.

Estimated change in Contract Price and Contract Times:

Contract Price \$ _____ (increase/decrease) Contract Time _____ (increase/decrease)
days

Recommended for Approval by Engineer:	Date
Authorized for Owner by:	Date
Received for Contractor by:	Date
Received by Funding Agency (if applicable):	Date:

Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

Project: 4.0 MGD WWTP Upgrades and Improvements	Owner: Town of Richlands	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.: 24.00343

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

Description:

Attachments (list documents supporting change):

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

RECOMMENDED: By: _____ Engineer (Authorized Signature) Date: _____ Approved by Funding Agency (if applicable): _____	ACCEPTED: By: _____ Owner (Authorized Signature) Date: _____	ACCEPTED: By: _____ Contractor (Authorized Signature) Date: _____ Date: _____

Change Order

Instructions

A. GENERAL INFORMATION

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

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

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

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

B. COMPLETING THE CHANGE ORDER FORM

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

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

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

Field Order
No. _____

Date of Issuance: _____ Effective Date: _____

Project: 4.0 MGD WWTP Upgrades and Improvements	Owner: Town of Richlands	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.: 24.00343

Attention:
You are hereby directed to promptly execute this Field Order issued in accordance with Modified General Conditions Paragraph 9.04.A, for minor changes in the Work without changes in Contract Price or Contract Times. If you consider that a change in Contract Price or Contract Times is required, please notify the Engineer immediately and before proceeding with this Work.

Reference: _____
(Specification Section(s)) (Drawing(s) / Detail(s))

Description:

Attachments:

	Engineer:

Receipt Acknowledged by Contractor:	Date:

Copy to Owner

Certificate of Substantial Completion

Project: 4.0 MGD WWTP Upgrades and Improvements

Owner: Town of Richlands

Owner's Contract No.:

Contract: 4.0 MGD WWTP Upgrades and Improvements

Engineer's Project No.: 24.00343

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

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

Date of Substantial Completion

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

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

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

☐ Amended Responsibilities

☐ Not Amended

Owner's Amended Responsibilities:

Contractor's Amended Responsibilities:

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

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

Executed by Engineer	Date

Accepted by Contractor	Date

Accepted by Owner	Date

ENVIRONMENTAL AUTHORITIES

CLEAN AIR AND CLEAN WATER ACT COMPLIANCE. For contracts and subcontracts in excess of \$100,000, the Contractor agrees that:

1. Any facility to be utilized in the performance of this contract or any subcontract shall not be a facility listed on the EPA List of Violating Facilities pursuant to 40 CFR 15.20.
2. The Contractor and Subcontractors will comply with all requirements of Section 306 of the Clean Air Act, as amended, and Section 508 of the Clean Water Act, as amended, and all regulations and guidelines issued there under.
3. The Contractor will promptly notify the loan recipient and CWFAP of any notification received from the Director of the Office of Federal Activities, EPA, indicating that a facility utilized or to be utilized for the contract is under consideration to be listed on the EPA List of Violating Facilities.

ECONOMIC AND MISCELLANEOUS AUTHORITIES

UTILIZATION OF SMALL BUSINESSES IN RURAL AREAS. The contractor and its subcontractors shall maintain a small business solicitation list and make appropriate attempts to procure needed equipment, supplies, and material from small businesses in rural areas of the Commonwealth of Virginia whenever they are a practical source for solicitation.

COMPLIANCE WITH SUSPENSION AND DEBARMENT. By entering into this contract, the contractor certifies that neither it (nor he or she) nor any person or firm which has an interest in the contractor's firm is disbarred or suspended from bidding or working on a federally funded project. No part of this contract will be subcontracted to any person or firm who has been debarred or suspended from bidding or working on a federally funded project.

The contractor shall fully comply with Subpart C of 2 CFR Part 180 and 2 CFR Part 1532, entitled "Responsibilities of Participants Regarding Transactions Doing Business with Other Persons." The contractor is responsible for ensuring that any lower tier covered transaction, as described in Subpart B of 2 CFR Part 180 and 2 CFR Part 1532, entitled "Covered Transactions," includes a term or condition requiring compliance with Subpart C. The contractor is responsible for further requiring the inclusion of a similar term or condition in any subsequent lower tier covered transactions. The contractor acknowledges that failing to disclose the information required under 2 CFR 180.335 may result in the delay or negation of this assistance agreement, or pursuance of legal remedies, including suspension and debarment.

When the contractor enters into a covered transaction with another person at the next lower tier, he or she must verify that the person with whom they intend to do business is not excluded or disqualified. Do this by:

1. Checking the Excluded Parties List System (EPLS); or
2. Collecting a certification from that person; or
3. Adding a clause or condition to the covered transaction with that person.

The contractor may access the EPLS at <https://sam.gov/search/> or successor website.

The contractor may access the Virginia Department of General Services Debarment & Prohibited list at <https://dgs.virginia.gov/procurement/resources/debarment--suspension-list/> or successor website.

DRUG-FREE WORKPLACE ACT. In accordance with 41 USC 81 and Public Law 100-690, for every contract over \$10,000 the contractor must maintain a drug-free workplace. During the performance of this

contract, the contractor agrees to (1) provide a drug-free workplace for the contractor's employees; (2) post in conspicuous places, available to employees and applicants for employment, a statement notifying employees that the unlawful manufacture, sale, distribution, dispensation, possession, or use of a controlled substance or marijuana is prohibited in the contractor's workplace and specifying the actions that will be taken against employees for violations of such prohibition; (3) state in all solicitations or advertisements for employees placed by or on behalf of the contractor that the contractor maintains a drug-free workplace; and (4) include the provisions of the foregoing clauses in every subcontract or purchase order of over \$10,000, so that the provisions will be binding upon each subcontractor or vendor.

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

CIVIL RIGHTS AND NONDISCRIMINATION REQUIREMENTS

CERTIFICATION OF NONSEGREGATED FACILITIES. Bidders and offerors are cautioned as follows: By signing this bid or offer, the bidder or offeror will be deemed to have signed and agreed to the provisions of the "Certification of Nonsegregated Facilities" in this solicitation. The certification provides that the bidder or offeror does not maintain or provide for his employee's facilities which are segregated on a basis of race, creed, color, or national origin, whether such facilities are segregated by directive or on a *de facto* basis. The certification also provides that bidders or offerors will not maintain such segregated facilities.

CIVIL RIGHTS OBLIGATIONS. Contractor shall comply with the following federal non-discrimination requirements:

1. Title VI of the Civil Rights Act of 1964, which prohibits discrimination based on race, color, and national origin, including limited English proficiency (LEP). (42 USC 2000D, et. seq).
2. Section 504 of the Rehabilitation Act of 1973, which prohibits discrimination against persons with disabilities. (29 USC 794, supplemented by EO 11914, 41 FR 17871, April 29, 1976 and EO 11250, 30 FR 13003, October 13, 1965).
3. The Age Discrimination Act of 1975, which prohibits age discrimination. (42 USC 6101 et. seq).
4. Section 13 of the Federal Water Pollution Control Act Amendments of 1972, which prohibits discrimination on the basis of sex.
5. 40 CFR Part 7 and Part 33, as it relates to the foregoing.

DISADVANTAGED BUSINESS ENTERPRISES. The Contractor shall not discriminate on the basis of race, color, national origin or sex in the performance of this Contract. The Contractor shall carry out applicable requirements of 40 CFR Part 33 in the award and administration of contracts awarded. Failure by the Contractor to carry out these requirements is a material breach of this Contract which may result in the termination of this Contract or other legally available remedies. The Contractor, including one exempted from applying the fair share objective requirements, is required to make the following good faith efforts whenever procuring construction, equipment, services and supplies under an EPA financial assistance agreement, even if it has achieved its fair share objectives:

1. Ensure Disadvantaged Business Enterprises (DBEs) are made aware of contracting opportunities to the fullest extent practicable through outreach and recruitment activities. For Indian Tribal, State, and Local Government recipients, this will include placing DBEs on solicitation lists and soliciting them whenever they are potential sources.
2. Make information on forthcoming opportunities available to DBEs and arrange time frames for contracts and

establish delivery schedules, where the requirements permit, in a way that encourages and facilitates participation by DBEs in the competitive process. This includes, whenever possible, posting solicitations for bids or proposals for a minimum of 30 calendar days before the bid or proposal closing date.

3. Consider in the contracting process whether firms competing for large contracts could subcontract with DBEs. For Indian Tribal, State, and Local Government recipients, this will include dividing total requirements when economically feasible into smaller tasks or quantities to permit maximum participation by DBEs in the competitive process.

4. Encourage contracting with a consortium of DBEs when a contract is too large for one of these firms to handle individually.

5. Use the services and assistance of the Small Business Administration (SBA) and the Minority Business Development Agency of the Department of Commerce.

6. If the prime Contractor awards subcontracts, require the prime Contractor to take the steps in items 1 through 5.

LABOR LAWS AND STANDARDS

DAVIS-BACON LABOR STANDARDS-TERMS AND CONDITIONS

1. Program Applicability

- a. Program Name: Clean Water State Revolving Fund
- b. Statute requiring compliance with Davis-Bacon: Section 602(b)(6) of the Clean Water Act
- c. Activities subject to Davis-Bacon: Treatment works constructed in whole or in part with assistance made available by a state water pollution control revolving fund authorized under Title VI of the Clean Water Act.
- d. The recipient must work with the appropriate authorities to determine wage classifications for the specific project(s) or activities subject to Davis Bacon under this grant (or cooperative agreement).

2. Davis-Bacon and Related Acts

[Davis-Bacon and Related Acts \(DBRA\)](#) is a collection of labor standards provisions administered by the Department of Labor, that are applicable to grants involving construction. These labor standards include the:

- Davis-Bacon Act, which requires payment of prevailing wage rates for laborers and mechanics on construction contracts of \$2,000 or more
- Copeland “Anti-Kickback” Act, which prohibits a contractor or subcontractor from inducing an employee into giving up any part of the compensation to which he or she is entitled; and
- Contract Work Hours and Safety Standards Act, which requires overtime wages to be paid for over 40 hours of work per week, under contracts in excess of \$100,000

3. Recipient Responsibilities When Entering Into and Managing Contracts:

a. Solicitation and Contract Requirements:

i. Include the Correct Wage Determinations in Bid Solicitations and Contracts: Recipients are responsible for complying with the procedures provided in [29 CFR 1.6](#) when soliciting bids and awarding contracts.

ii. Include DBRA Requirements in All Contracts: Include the following text on all contracts under this grant:

“By accepting this contract, the contractor acknowledges and agrees to the terms provided in the [DBRA Requirements for Contractors and Subcontractors Under EPA Grants](#) as shown in Section 9- Davis-Bacon and Related Acts Requirements for Contractors and Subcontractors below.”

b. After Award of Contract:

i. Approve and Submit Requests for Additional Wages Rates: Work with contractors to request additional wage rates if required for contracts under this grant, as provided in [29 CFR 5.5\(a\)\(1\)\(iii\)](#).

ii. Provide Oversight of Contractors to Ensure Compliance with DBRA Provisions: Ensure contractor compliance with the terms of the contract, as required by [29 CFR 5.6](#).

4. Recipient Responsibilities When Establishing and Managing Additional Subawards:

a. Include DBRA Requirements in All Subawards (including Loans):

Include the following text on all subawards under this grant:

“By accepting this contract, the contractor acknowledges and agrees to the terms provided in the [DBRA Requirements for Contractors and Subcontractors Under EPA Grants](#) as shown in Section 9- Davis-Bacon and Related Acts Requirements for Contractors and Subcontractors below.”

b. Provide Oversight to Ensure Compliance with DBRA Provisions: Recipients are responsible for oversight of subrecipients and must ensure subrecipients comply with the requirements in [29 CFR 5.6](#).

5. The contract clauses set forth in this Term & Condition, along with the correct wage determinations, will be considered to be a part of every prime contract covered by Davis-Bacon and Related Acts (see [29 CFR 5.1](#)), and will be effective by operation of law, whether or not they are included or incorporated by reference into such contract, unless the Department of Labor grants a variance, tolerance, or exemption. Where the clauses and applicable wage determinations are effective by operation of law under this paragraph, the prime contractor must be compensated for any resulting increase in wages in accordance with applicable law.

DAVIS-BACON AND RELATED ACTS REQUIREMENTS FOR CONTRACTORS AND SUBCONTRACTORS.

The contractor acknowledges that by entering into this contract with a contracting agency, funded by an Environmental Protection Agency assistance agreement (grant), the contractor agrees to comply with the following terms and conditions in accordance with 29 CFR 5.5, if this contractor is for activities covered under

Davis-Bacon and Related Acts (DBRA) and exceeds (or will exceed) \$2,000. Definitions for many of the terms used below are provided in 29 CFR 5.2.

For the purposes of this clause, non-federal entities that enter into contracts with contractors are considered “contracting agencies”. Contracting agencies may be EPA grant recipients and/or subrecipients at any tier (including borrowers). “Contracting officers” work for contracting agencies.

(a) Required Contract Clauses

(1) Minimum wages

(i) Wage rates and fringe benefits.

All laborers and mechanics employed or working upon the site of the work (or otherwise working in construction or development of the project under a development statute), will be paid unconditionally and not less often than once a week, and without subsequent deduction or rebate on any account (except such payroll deductions as are permitted by regulations issued by the Secretary of Labor under the Copeland Act (29 CFR part 3)), the full amount of basic hourly wages and bona fide fringe benefits (or cash equivalents thereof) due at time of payment computed at rates not less than those contained in the wage determination of the Secretary of Labor which is attached hereto and made a part hereof, regardless of any contractual relationship which may be alleged to exist between the contractor and such laborers and mechanics. As provided in paragraphs (D) and (E) of this section, the appropriate wage determinations are effective by operation of law even if they have not been attached to the contract.

Contributions made or costs reasonably anticipated for bona fide fringe benefits under the Davis-Bacon Act (40 USC 3141(2)(B)) on behalf of laborers or mechanics are considered wages paid to such laborers or mechanics, subject to the provisions of paragraph (a)(1)(v) of this section; also, regular contributions made or costs incurred for more than a weekly period (but not less often than quarterly) under plans, funds, or programs which cover the particular weekly period, are deemed to be constructively made or incurred during such weekly period. Such laborers and mechanics must be paid the appropriate wage rate and fringe benefits on the wage determination for the classification(s) of work actually performed, without regard to skill, except as provided in paragraph (a)(4) of this section.

Laborers or mechanics performing work in more than one classification may be compensated at the rate specified for each classification for the time actually worked therein; *Provided*, That the employer's payroll records accurately set forth the time spent in each classification in which work is performed. The wage determination (including any additional classifications and wage rates conformed under paragraph (a)(1)(iii) of this section) and the Davis-Bacon poster (WH-1321) must be posted at all times by the contractor and its subcontractors at the site of the work in a prominent and accessible place where it can be easily seen by the workers.

(ii) Frequently recurring classifications

(A) In addition to wage and fringe benefit rates that have been determined to be prevailing under the procedures set forth in 29 CFR Part 1, a wage determination may contain, pursuant to § 1.3(f), wage and fringe benefit rates for classifications of laborers and mechanics for which conformance requests are regularly submitted pursuant to paragraph (a)(1)(iii) of this section, provided that:

- (1) The work performed by the classification is not performed by a classification in the wage determination for which a prevailing wage rate has been determined;
- (2) The classification is used in the area by the construction industry; and
- (3) The wage rate for the classification bears a reasonable relationship to the

prevailing wage rates contained in the wage determination.

- (B) The Administrator will establish wage rates for such classifications in accordance with paragraph (a)(1)(iii)(A)(3) of this section. Work performed in such a classification must be paid at no less than the wage and fringe benefit rate listed on the wage determination for such classification.

(iii) **Conformance**

- (A) The contracting officer must require that any class of laborers or mechanics, including helpers, which is not listed in the wage determination and which is to be employed under the contract be classified in conformance with the wage determination. Conformance of an additional classification and wage rate and fringe benefits is appropriate only when the following criteria have been met:
 - (1) The work to be performed by the classification requested is not performed by a classification in the wage determination; and
 - (2) The classification is used in the area by the construction industry; and
 - (3) The proposed wage rate, including bona fide fringe benefits, bears a reasonable relationship to the wage rates contained in the wage determination.
- (B) The conformance process may not be used to split, subdivide, or otherwise avoid application of classifications listed in the wage determination.
- (C) If the Contractor and the laborers and mechanics to be employed in the classification (if known), or their representatives, and the contracting officer agree on the classification and wage rate (including the amount designated for fringe benefits where appropriate), a report of the action taken will be sent by the contracting officer by email to DBAconformance@dol.gov. The Administrator, or an authorized representative, will approve, modify, or disapprove every additional classification action within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
- (D) In the event the contractor, the laborers or mechanics to be employed in the classification or their representatives, and the contracting officer do not agree on the proposed classification and wage rate (including the amount designated for fringe benefits, where appropriate), the contracting officer will, by email to DBAconformance@dol.gov, refer the questions, including the views of all interested parties and the recommendation of the contracting officer, to the Administrator for determination. The Administrator, or an authorized representative, will issue a determination within 30 days of receipt and so advise the contracting officer or will notify the contracting officer within the 30-day period that additional time is necessary.
- (E) The contracting officer must promptly notify the contractor of the action taken by the Wage and Hour Division (WHD) under paragraphs (a)(1)(iii)(C) and (D) of this section. The contractor must furnish a written copy of such determination to each affected worker, or it must be posted as a part of the wage determination. The wage rate (including fringe benefits where appropriate) determined pursuant to paragraph (a)(1)(iii)(C) or (D) of this section must be paid to all workers performing work in the classification under this contract from the first day on which work is performed in the classification.

(iv) **Fringe benefits not expressed as an hourly rate**

Whenever the minimum wage rate prescribed in the contract for a class of laborers or mechanics includes a fringe benefit which is not expressed as an hourly rate, the contractor may either pay the benefit as stated in the wage determination or may pay another bona fide fringe benefit or an hourly cash equivalent thereof.

(v) Unfunded plans

If the contractor does not make payments to a trustee or other third person, the contractor may consider as part of the wages of any laborer or mechanic the amount of any costs reasonably anticipated in providing bona fide fringe benefits under a plan or program, *Provided*, That the Secretary of Labor has found, upon the written request of the contractor, in accordance with the criteria set forth in Section 5.28, that the applicable standards of the Davis-Bacon Act have been met. The Secretary of Labor may require the contractor to set aside in a separate account, assets for the meeting of obligations under the plan or program.

(vi) Interest

In the event of a failure to pay all or part of the wages required by the contract, the contractor will be required to pay interest on any underpayment of wages.

(2) Withholding

(i) Withholding requirements

The EPA, grant recipient, subrecipient at any tier, and/or contracting agency may, upon its own action, or must, upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to satisfy the liabilities of the prime contractor or any subcontractor for the full amount of wages and monetary relief, including interest, required by the clauses set forth in paragraph (a) of this section for violations of this contract, or to satisfy any such liabilities required by any other Federal contract, or federally assisted contract subject to Davis-Bacon labor standards, that is held by the same prime contractor (as defined in Section 5.2). The necessary funds may be withheld from the contractor under this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract that is subject to Davis-Bacon labor standards requirements and is held by the same prime contractor, regardless of whether the other contract was awarded or assisted by the same agency, and such funds may be used to satisfy the contractor liability for which the funds were withheld. In the event of a contractor's failure to pay any laborer or mechanic, including any apprentice or helper working on the site of the work (or otherwise working in construction or development of the project under a development statute) all or part of the wages required by the contract, or upon the contractor's failure to submit the required records as discussed in paragraph (a)(3)(iv) of this section, the EPA, grant recipient, subrecipient at any tier, and/or contracting agency may on its own initiative and after written notice to the contractor, sponsor, applicant, owner, or other entity, as the case may be, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds until such violations have ceased.

(ii) Priority to withheld funds

The Department has priority to funds withheld or to be withheld in accordance with paragraph (a)(2)(i) or (b)(3)(i) of this section, or both, over claims to those funds by:

- (A) A contractor's surety(ies), including without limitation performance bond sureties and payment bond sureties;
- (B) A contracting agency for its procurement costs;
- (C) A trustee(s) (either a court-appointed trustee or a U.S. trustee, or both) in bankruptcy of a contractor, or a contractor's bankruptcy estate;
- (D) A contractor's assignee(s);
- (E) A contractor's successor(s);
- (F) A claim asserted under the Prompt Payment Act, 31 USC 3901–3907.

(3) Records and certified payrolls-

(i) Basic record requirements

(A) Length of record retention

All regular payrolls and other basic records must be maintained by the contractor and any subcontractor during the course of the work and preserved for all laborers and mechanics working at the site of the work (or otherwise working in construction or development of the project under a development statute) for a period of at least 3 years after all the work on the prime contract is completed.

(B) Information required

Such records must contain the name; Social Security number; last known address, telephone number, and email address of each such worker; each worker's correct classification(s) of work actually performed; hourly rates of wages paid (including rates of contributions or costs anticipated for bona fide fringe benefits or cash equivalents thereof of the types described in 40 USC 3141(2)(B) of the Davis-Bacon Act); daily and weekly number of hours actually worked in total and on each covered contract; deductions made; and actual wages paid.

(C) Additional records relating to fringe benefits

Whenever the Secretary of Labor has found under paragraph (a)(1)(v) of this section that the wages of any laborer or mechanic include the amount of any costs reasonably anticipated in providing benefits under a plan or program described in 40 USC 3141(2)(B) of the Davis-Bacon Act, the contractor must maintain records which show that the commitment to provide such benefits is enforceable, that the plan or program is financially responsible, and that the plan or program has been communicated in writing to the laborers or mechanics affected, and records which show the costs anticipated or the actual cost incurred in providing such benefits.

(D) Additional records relating to apprenticeship

Contractors with apprentices working under approved programs must maintain written evidence of the registration of apprenticeship programs, the registration of the apprentices, and the ratios and wage rates prescribed in the applicable programs.

(ii) Certified payroll requirements

(A) Frequency and method of submission

The contractor or subcontractor must submit weekly, for each week in which any DBA- or Related Acts-covered work is performed, certified payrolls to the contracting agency if the agency is a party to the contract, but if the agency is not such a party, the contractor will submit the certified payrolls to the applicant, sponsor, owner, or other entity, as the case may be, that maintains such records, for transmission to the contracting agency. The prime contractor is responsible for the submission of all certified payrolls by all subcontractors. A contracting agency or prime contractor may permit or require contractors to submit certified payrolls through an electronic system, as long as the electronic system requires a legally valid electronic signature; the system allows the contractor, the contracting agency, and the Department of Labor to access the certified payrolls upon request for at least 3 years after the work on the prime contract has been completed; and the contracting agency or prime contractor permits other methods of submission in situations where the contractor is unable or limited in its ability to use or access the electronic system.

(B) Information required

The certified payrolls submitted must set out accurately and completely all of the information required to be maintained under paragraph (a)(3)(i)(B) of this section, except that full Social Security numbers and last known addresses, telephone numbers, and email addresses must not be included on weekly transmittals. Instead, the certified payrolls need only include an individually identifying number for each worker (e.g., the last four digits of the worker's Social Security number). The required weekly certified payroll information may be submitted using Optional Form WH-347 (Attachment #3) or in any other format desired. Optional Form WH-347 is available for this purpose from the website at

<https://www.dol.gov/agencies/whd/government-contracts/construction/payroll-certification/> or its successor website. It is not a violation of this section for a prime contractor to require a subcontractor to provide full Social Security numbers and last known addresses, telephone numbers, and email addresses to the prime contractor for its own records, without weekly submission by the subcontractor to the sponsoring government agency (or the applicant, sponsor, owner, or other entity, as the case may be, that maintains such records).

(C) Statement of Compliance

Each certified payroll submitted must be accompanied by a “Statement of Compliance,” signed by the contractor or subcontractor, or the contractor's or subcontractor's agent who pays or supervises the payment of the persons working on the contract, and must certify the following:

- (1) That the certified payroll for the payroll period contains the information required to be provided under paragraph (a)(3)(ii) of this section, the appropriate information and basic records are being maintained under paragraph (a)(3)(i) of this section, and such information and records are correct and complete;
- (2) That each laborer or mechanic (including each helper and apprentice) working on the contract during the payroll period has been paid the full weekly wages earned, without rebate, either directly or indirectly, and that no deductions have been made either directly or indirectly from the full wages earned, other than permissible deductions as set forth in 29 CFR Part 3; and
- (3) That each laborer or mechanic has been paid not less than the applicable wage rates and fringe benefits or cash equivalents for the classification(s) of work actually performed, as specified in the applicable wage determination incorporated into the contract.

(D) Use of Optional Form WH-347

The weekly submission of a properly executed certification set forth on the reverse side of Optional Form WH-347 (Attachment #3) will satisfy the requirement for submission of the “Statement of Compliance” required by paragraph (a)(3)(ii)(C) of this section.

(E) Signature

The signature by the contractor, subcontractor, or the contractor's or subcontractor's agent must be an original handwritten signature or a legally valid electronic signature.

(F) Falsification

The falsification of any of the above certifications may subject the contractor or subcontractor to civil or criminal prosecution under 18 USC 1001 and 31 USC 3729.

(G) Length of certified payroll retention

The contractor or subcontractor must preserve all certified payrolls during the course of the work and for a period of 3 years after all the work on the prime contract is completed.

(iii) Contracts, subcontracts, and related documents.

The contractor or subcontractor must maintain this contract or subcontract and related documents including, without limitation, bids, proposals, amendments, modifications, and extensions. The contractor or subcontractor must preserve these contracts, subcontracts, and related documents during the course of the work and for a period of 3 years after all the work on the prime contract is completed.

(iv) Required disclosures and access

(A) Required disclosures and access to workers

The contractor or subcontractor must make the records required under paragraphs (a)(3)(i) through (iii) of this section, and any other documents that the EPA, recipient, or subrecipient at any tier, and/or contracting agency, or the Department of Labor deems necessary to determine compliance with the labor standards provisions of any of the applicable statutes referenced by Section 5.1, available for inspection, copying, or transcription by authorized representatives of the EPA, recipient, or subrecipient at any tier, and/or contracting agency, or the Department of Labor, and must permit such representatives to interview workers during working hours on the job.

(B) Sanctions for non-compliance with records and worker access requirements

If the contractor or subcontractor fails to submit the required records or to make them available, or refuses to permit worker interviews during working hours on the job, the Federal agency may, after written notice to the contractor, sponsor, applicant, owner, or other entity, as the case may be, that maintains such records or that employs such workers, take such action as may be necessary to cause the suspension of any further payment, advance, or guarantee of funds. Furthermore, failure to submit the required records upon request or to make such records available, or to permit worker interviews during working hours on the job, may be grounds for debarment action pursuant to Section 5.12. In addition, any contractor or other person that fails to submit the required records or make those records available to WHD within the time WHD requests that the records be produced will be precluded from introducing as evidence in an administrative proceeding under 29 CFR Part 6 any of the required records that were not provided or made available to WHD. WHD will take into consideration a reasonable request from the contractor or person for an extension of the time for submission of records. WHD will determine the reasonableness of the request and may consider, among other things, the location of the records and the volume of production.

(C) Required information disclosures

Contractors and subcontractors must maintain the full Social Security number and last known address, telephone number, and email address of each covered worker, and must provide them upon request to the Environmental Protection Agency if the agency is a party to the contract, or to the Wage and Hour Division of the Department of Labor. If the Federal agency is not such a party to the contract, the contractor, subcontractor, or both, must, upon request, provide the full Social Security number and last known address, telephone number, and email address of each covered worker to the applicant, sponsor, owner, or other entity, as the case may be, that maintains such records, for transmission to the EPA, recipient, or subrecipient at any tier, contracting agency, the contractor, or the Wage and Hour Division of the Department of Labor for purposes of an investigation or other compliance action.

(4) Apprentices and Equal Employment Opportunity

(i) Apprentices

(A) Rate of pay

Apprentices will be permitted to work at less than the predetermined rate for the work they perform when they are employed pursuant to and individually registered in a bona fide apprenticeship program registered with the U.S. Department of Labor, Employment and Training Administration, Office of Apprenticeship (OA), or with a State Apprenticeship Agency recognized by the OA. A person who is not individually registered in the program, but who has been certified by the OA or a State Apprenticeship Agency (where appropriate) to be eligible for probationary employment as an apprentice, will be permitted to work at less than the predetermined rate for the work they perform in the first 90 days of probationary employment as an apprentice in such a program. In the event the OA or a State Apprenticeship Agency recognized by the OA withdraws approval of an apprenticeship program, the contractor will no longer be permitted to use apprentices at less than the applicable predetermined rate for the work performed until an acceptable program is approved.

(B) Fringe benefits

Apprentices must be paid fringe benefits in accordance with the provisions of the apprenticeship program. If the apprenticeship program does not specify fringe benefits, apprentices must be paid the full amount of fringe benefits listed on the wage determination for the applicable classification. If the Administrator determines that a different practice prevails for the applicable apprentice classification, fringe benefits must be paid in accordance with that determination.

(C) Apprenticeship ratio

The allowable ratio of apprentices to journey workers on the job site in any craft classification must not be greater than the ratio permitted to the contractor as to the entire work force under the registered

program or the ratio applicable to the locality of the project pursuant to paragraph (a)(4)(i)(D) of this section. Any worker listed on a payroll at an apprentice wage rate, who is not registered or otherwise employed as stated in paragraph (a)(4)(i)(A) of this section, must be paid not less than the applicable wage rate on the wage determination for the classification of work actually performed. In addition, any apprentice performing work on the job site in excess of the ratio permitted under this section must be paid not less than the applicable wage rate on the wage determination for the work actually performed.

(D) Reciprocity of ratios and wage rates

Where a contractor is performing construction on a project in a locality other than the locality in which its program is registered, the ratios and wage rates (expressed in percentages of the journey worker's hourly rate) applicable within the locality in which the construction is being performed must be observed. If there is no applicable ratio or wage rate for the locality of the project, the ratio and wage rate specified in the contractor's registered program must be observed.

- (ii) **Equal employment opportunity.** The use of apprentices and journey workers under this part must be in conformity with the equal employment opportunity requirements of Executive Order 11246, as amended, and 29 CFR Part 30.

(5) is reserved

(6) Subcontracts

The contractor or subcontractor must insert in any subcontracts the clauses contained in paragraphs (a)(1) through (11) of this section or a link to the DBRA Requirements for Contractors and Subcontractors Under EPA Grants document on EPA's Contract Provisions for Davis-Bacon and Related Acts webpage, along with the applicable wage determination(s) and such other clauses or contract modifications as the Environmental Protection Agency may by appropriate instructions require, and a clause requiring the subcontractors to include these clauses and wage determination(s) in any lower tier subcontracts. The prime contractor is responsible for the compliance by any subcontractor or lower tier subcontractor with all the contract clauses in this section. In the event of any violations of these clauses, the prime contractor and any subcontractor(s) responsible will be liable for any unpaid wages and monetary relief, including interest from the date of the underpayment or loss, due to any workers of lower-tier subcontractors, and may be subject to debarment, as appropriate.

(7)-(9) are reserved

(10) Certification of Eligibility

- (i) By entering into this contract, the contractor certifies that neither it nor any person or firm who has an interest in the contractor's firm is a person or firm ineligible to be awarded Government contracts by virtue of 40 USC 3144(b) or Section 5.12(a).
- (ii) No part of this contract shall be subcontracted to any person or firm ineligible for award of a Government contract by virtue of 40 USC 3144(b) or Section 5.12(a).
- (iii) The penalty for making false statements is prescribed in the U.S. Code, Title 18 Crimes and Criminal Procedure, 18 USC 1001.

(11) Anti-Retaliation

It is unlawful for any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, or to cause any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, any worker or job applicant for:

- (i) Notifying any contractor of any conduct which the worker reasonably believes constitutes a violation of the DBA, Related Acts, this part, or 29 CFR Part 1 or Part 3;
- (ii) Filing any complaint, initiating or causing to be initiated any proceeding, or otherwise

asserting or seeking to assert on behalf of themselves or others any right or protection under the DBA, Related Acts, this part, or 29 CFR Part 1 or Part 3;

- (iii) Cooperating in any investigation or other compliance action, or testifying in any proceeding under the DBA, Related Acts, this part, or 29 CFR Part 1 or Part 3; or
- (iv) Informing any other person about their rights under the DBA, Related Acts, this part, or 29 CFR Part 1 or Part 3.

Under the DBRA, all Contracts awarded under EPA assistance agreements (grants) in excess of \$100,000 that involve the employment of mechanics or laborers require Contractors and subcontractors to comply with the overtime provisions of the Contract Wage Hours and Safety Standards Act (CWHSSA) at 40 USC 3702 and 3704, as supplemented by Department of Labor regulations in 29 CFR Part 5 and 2 CFR 200 Appendix II(E). By accepting this Contract, you agree to comply with the requirements of CWHSSA described below, in addition to the DBRA Requirements for Contractors Under EPA Grants.

These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence. For the purposes of this provision, the terms “laborers and mechanics” include watchpersons and guards.

(b) Contract Work Hours and Safety Standards Act

(1) Overtime requirements

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

(2) Violation; Liability for Unpaid Wages; Liquidated Damages

In the event of any violation of the clause set forth in paragraph (b)(1) of this section the contractor and any subcontractor responsible therefor shall be liable for the unpaid wages and interest from the date of the underpayment. In addition, such contractor and subcontractor shall be liable to the United States (in the case of work done under contract for the District of Columbia or a territory, to such District or to such territory), for liquidated damages. Such liquidated damages shall be computed with respect to each individual laborer or mechanic, including watchpersons and guards, employed in violation of the clause set forth in paragraph (b)(1) of this section, in the sum of \$31 for each calendar day on which such individual was required or permitted to work in excess of the standard workweek of forty hours without payment of the overtime wages required by the clause set forth in paragraph (b)(1).

(3) Withholding for Unpaid Wages and Liquidated Damages

(i) Withholding process The EPA, recipient, or subrecipient at any tier, and/or contracting agency may, upon its own action, or must, upon written request of an authorized representative of the Department of Labor, withhold or cause to be withheld from the contractor so much of the accrued payments or advances as may be considered necessary to satisfy the liabilities of the prime contractor or any subcontractor for any unpaid wages; monetary relief, including interest; and liquidated damages required by the clauses set forth in this paragraph (b) on this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract subject to the Contract Work Hours and Safety Standards Act that is held by the same prime contractor (as defined in Section 5.2). The necessary funds may be withheld from the contractor under this contract, any other Federal contract with the same prime contractor, or any other federally assisted contract that is subject to the Contract Work Hours and Safety Standards Act and is held by the same prime contractor, regardless of whether the other contract was awarded or assisted by the same agency, and such funds may be used to satisfy the contractor liability for which the funds were withheld.

- (ii) **Priority to withheld funds** The Department has priority to funds withheld or to be withheld in accordance with paragraph (a)(2)(i) or (b)(3)(i) of this section, or both, over claims to those funds by:
 - (A) A contractor's surety(ies), including without limitation performance bond sureties and payment bond sureties;
 - (B) A contracting agency for its procurement costs;
 - (C) A trustee(s) (either a court-appointed trustee or a U.S. trustee, or both) in bankruptcy of a contractor, or a contractor's bankruptcy estate;
 - (D) A contractor's assignee(s);
 - (E) A contractor's successor(s); or
 - (F) A claim asserted under the Prompt Payment Act, 31 USC 3901–3907.

(4) **Subcontracts**

The contractor or subcontractor must insert in any subcontracts the clauses set forth in paragraphs (b)(1) through (5) of this section and a clause requiring the subcontractors to include these clauses in any lower tier subcontracts. The prime contractor is responsible for compliance by any subcontractor or lower tier subcontractor with the clauses set forth in paragraphs (b)(1) through (5). In the event of any violations of these clauses, the prime contractor and any subcontractor(s) responsible will be liable for any unpaid wages and monetary relief, including interest from the date of the underpayment or loss, due to any workers of lower-tier subcontractors, and associated liquidated damages and may be subject to debarment, as appropriate.

(5) **Anti-Retaliation**

It is unlawful for any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, or to cause any person to discharge, demote, intimidate, threaten, restrain, coerce, blacklist, harass, or in any other manner discriminate against, any worker or job applicant for:

- (i) Notifying any contractor of any conduct which the worker reasonably believes constitutes a violation of the Contract Work Hours and Safety Standards Act (CWHSSA) or its implementing regulations in this part;
- (ii) Filing any complaint, initiating or causing to be initiated any proceeding, or otherwise asserting or seeking to assert on behalf of themselves or others any right or protection under CWHSSA or this part;
- (iii) Cooperating in any investigation or other compliance action, or testifying in any proceeding under CWHSSA or this part; or
- (iv) Informing any other person about their rights under CWHSSA or this part.

CONTRACT WORK HOURS. All contracts awarded by the non-Federal entity in excess of \$100,000 that involve the employment of mechanics or laborers must include a provision for compliance with 40 USC 3702 and 3704, as supplemented by Department of Labor regulations (29 CFR Part 5). Under 40 USC 3702 of the Act, each contractor must be required to compute the wages of every mechanic and laborer on the basis of a standard work week of 40 hours. Work in excess of the standard work week is permissible provided that the worker is compensated at a rate of not less than one and a half times the basic rate of pay for all hours worked in excess of 40 hours in the work week. The requirements of 40 USC 3704 are applicable to construction work and provide that no laborer or mechanic must be required to work in surroundings or under working conditions which are unsanitary, hazardous, or dangerous. These requirements do not apply to the purchases of supplies or materials or articles ordinarily available on the open market, or contracts for transportation or transmission of intelligence.

FEDERAL REQUIREMENTS

PROHIBITION OF CERTAIN TELECOMMUNICATIONS AND VIDEO SURVEILLANCE SERVICES OR EQUIPMENT.

The John S. McCain National Defense Authorization Act for Fiscal Year 2019 (P.L. 115- 232), at Section 889, prohibits EPA financial assistance recipients, including WIFIA borrowers, from expending loan funds to procure or obtain; extend or renew a contract to procure or obtain; or enter into a contract (or extend or renew a contract) to procure or obtain equipment, services, or systems that use covered telecommunications equipment or services as a substantial or essential component of any system, or as critical technology as part of any system. As described in the Act, “covered telecommunications equipment or services” means:

1. Telecommunications equipment produced by Huawei Technologies Company or ZTE Corporation (or any subsidiary or affiliate of such entities).
2. For the purpose of public safety, security of government facilities, physical security surveillance of critical infrastructure, and other national security purposes, video surveillance and telecommunications equipment produced by Hytera Communications Corporation, Hangzhou Hikvision Digital Technology Company, or Dahua Technology Company (or any subsidiary or affiliate of such entities).
3. Telecommunications or video surveillance services provided by such entities or using such equipment.
4. Telecommunications or video surveillance equipment or services produced or provided by an entity that the Secretary of Defense, in consultation with the Director of the National Intelligence or the Director of the Federal Bureau of Investigation, reasonably believes to be an entity owned or controlled by, or otherwise connected to, the government of a covered foreign country.

The Act does not prohibit:

1. Procuring with an entity to provide a service that connects to the facilities of a third-party, such as backhaul, roaming, or interconnection arrangements.
2. Telecommunications equipment that cannot route or redirect user data traffic or permit visibility into any user data or packets that such equipment transmits or otherwise handles.

AMERICAN IRON AND STEEL.¹ The Consolidated Appropriations Act of 2014, includes an American Iron and Steel (AIS) requirement in Public Law 113-76, Section 436 that requires the use of iron and steel products that are produced in the United States for projects for the construction, alteration, maintenance, or repair of a public water system or treatment works.

All projects funded by the State Revolving Loan Fund must use iron and steel products that are produced in the United States for the construction, alteration, maintenance, or repair of a public water system or treatment works. Projects must comply with the AIS requirement, an iron or steel product of one of the following made primarily of iron or steel that is permanently incorporated into the public water system or treatment works which includes lined or unlined pipes and fittings, manhole covers and other municipal castings, hydrants, tanks, flanges, pipe clamps and restraints, valves, structural steel, reinforced precast concrete, and construction materials.

If the listed products are permanently incorporated into the Project and are primarily iron and steel material, then the Owner should obtain and keep a record of the manufacturer’s certification of AIS compliance for that product. If a product does not fall within one of the listed product categories, it does not need to comply with the AIS requirement.

¹ EPA Provides information and guidance on AIS compliance, implementation, and any applicable waiver. See EPA website for guidance.

The statute allows EPA to grant waivers in specific circumstances: (1) if the requirement is inconsistent with the public interest; (2) if the products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or (3) if the products will increase the cost of the project by 25% or more. Waivers should only be sought when all avenues of procuring AIS-compliant products have been exhausted. A waiver request form (Attachment #5) must be provided and must include proper and sufficient documentation to support the request; refer to Attachment #6 to ensure that all appropriate and necessary information is submitted to EPA. It will be sent to EPA Headquarters to determine whether the application properly and adequately documents and justifies the statutory basis cited for the waiver, that it is quantitatively and qualitatively sufficient, and to determine whether or not to grant the waiver. The prime contractor must certify that the contractor understands all iron and steel products permanently incorporated as part of the project must satisfy AIS requirements except those waived by EPA. The contractor must include the AIS requirements in any subcontract or purchase agreement made by the prime contractor and require subcontractors or suppliers of AIS products to also require their subcontractors or suppliers to include AIS requirements in any subcontracts or purchase agreements they enter into; Attachment #4 is required.

NOTE: Compliance with AIS requirements for iron and steel products will satisfy a subset of the Build America, Buy America (BABA) requirements (those pertaining to iron and steel); however, BABA also includes requirements pertaining to manufactured goods and construction materials, which must be met. Projects in compliance with BABA are also in compliance with AIS.

The prime contractor must provide manufacturer certifications to the owner that all iron and steel products are produced in the United States. The prime contractor is responsible for gathering all manufacturer certifications for all components supplied or installed by subcontractors, and for submitting these to the owner. As noted above, the contractor will provide a final certification statement (Attachment #7) with their final payment request attesting that all American Iron and Steel requirements of this subpart have been met.

All manufacturer certifications must contain, at a minimum, the following information: **(1) project name and location; (2) a list/description of the iron/steel material(s) used on this project; (3) manufacturing location(s) (City, State, USA); (4) a statement that says that the material is compliant with EPA's American Iron and Steel requirements; and (5) a signature by an approved representative of the manufacturer (on company letterhead and signature can be electronic).**

~~**BUILD AMERICA, BUY AMERICA ACT.**² Congress enacted the Investment in Infrastructure and Jobs Act (IIJA) (Public Law 117-58). As part of the IIJA, the BABA Act (Title IX of Public Law 117-58) establishes domestic preference requirements to maximize the purchase of goods produced in the United States.~~

~~BABA requirements specify domestic preference requirements in three product categories: iron and steel, manufactured products, and construction materials. The iron and steel product category includes products that are primarily iron and steel (greater than 50 percent). Construction materials include an article, material, or supply that consists primarily of non-ferrous metals, plastic or polymer-based products, glass, lumber, or drywall. All products used in water infrastructure projects will fall under one of the three product categories, except for cement and cementitious materials; aggregates such as stone, sand, or gravel; or aggregate binding agents or additives, which are specifically excepted by the BABA statute. Therefore, manufactured goods cover the remaining products that are not excepted or not classified in the iron and steel and construction materials product categories.~~

² ~~EPA Provides information on BABA compliance, implementation, and any applicable waivers. See EPA website for guidance.~~

~~If the product is permanently incorporated on a project that is subject to BABA, these products must be produced in the United States and have accompanying BABA compliance documentation for the products. The criteria for “produced in the United States” are separately defined for each product category.~~

- ~~1. All iron and steel items used in covered projects must be produced in the United States. This means all manufacturing processes, from the initial melting state through the application of coatings, occurred in the United States.~~
- ~~2. All manufactured products used in covered projects must be produced in the United States. This means that manufactured product was manufactured in the United States, and the cost of the components of the manufactured product that are mined, produced, or manufactured in the United States is greater than 55 percent of the total cost of all components of the manufactured product.~~
- ~~3. All construction materials used in covered projects must be manufactured in the United States. This means that all manufacturing processes for the construction material occurred in the United States.~~

~~Owner should obtain and keep a record of the manufacturer’s certification of BABA compliance for the products and construction materials. If a product or construction material does not fall within one of the listed product categories, it does not need to comply with the BABA requirement.~~

~~The statute permits EPA to issue waivers in specific circumstances where EPA finds (1) that applying these requirements would be inconsistent with the public interest (a “public interest waiver”); (2) types of iron, steel, manufactured products, or construction materials are not produced in the United States in sufficient and reasonably available quantities or of a satisfactory quality (a “nonavailability waiver”); or (3) inclusion of iron, steel, manufactured products, or construction materials produced in the United States will increase the cost of the overall Project by more than 25 percent (an “unreasonable cost waiver”). Waivers should only be sought when all avenues of procuring BABA-compliant products have been exhausted. The waiver request must include proper and sufficient documentation to support the request and refer to Guidance from the Office of Management and Budget and Made in America Office Memorandum (M-24-02) released on October 23, 2023, Section VI. Issuing Buy America Waivers starting on page 6. See attachment #9 and #10 for the waiver request form and checklist.~~

~~The prime Contractor must certify that the Contractor understands all iron and steel items, all manufactured products, and all construction materials permanently incorporated as part of the Project must satisfy BABA requirements except those waived by EPA. The contractor shall submit to the owner (funding recipient) the certification included as Attachment# 8 (BABA Initial Certification Statement). At the conclusion of the project, the contractor will certify with their final payment request that the original certification is still valid or document any changes or substitutions. For this certification, the contractor should submit to the owner Attachment# 11 (BABA Final Certification Statement). If changes or substitutions are disallowed by EPA, part or all of the funding may be forfeited by the owner. As State or Federal law permits the owner may seek damages from the contractor.~~

~~NOTE: BABA requirements for primarily iron and steel products are equivalent to the requirements for covered iron and steel products listed under AIS. Compliance documentation for covered iron and steel products under AIS will also satisfy the BABA requirements, which eases implementation for Projects that are subject to both AIS and BABA requirements.~~

**THE VIRGINIA PUBLIC PROCUREMENT ACT (the “ACT”)
PROCUREMENT REQUIREMENTS FOR SMALL PURCHASES**

The Virginia Clean Water Revolving Loan Fund requires all loan recipients to follow the provisions of the Act. **Section 2.2-4303 (G) of the Act** allows for the establishment of purchase procedures, if adopted in writing, not requiring competitive sealed bids or competitive negotiation for single or term contracts for goods and services other than professional services if the aggregate or the sum of all phases is not expected to exceed \$200,000; however, such small purchase procedures shall provide for competition wherever practicable. For local public bodies, such purchase procedures may allow for single or term contracts for professional services without requiring competitive negotiation, provided the aggregate or the sum of all phases is not expected to exceed \$80,000. Completion and signing of this document acknowledge adoption and compliance with the Act and following conforming procedures.

Project Name: _____ **Project Number:** _____

Contract Information

Name and Address of Bidder/Offeror Selected: _____

Amount of Contract: _____ Date of Contract: _____

Describe goods or services to be provided:

Documentation of Procurement Efforts

List bidders/offerors. Written informal solicitation of a minimum of four bidders/offerors is required. Also, date contacted, method of solicitation (e.g., written informal letter, fax or e-mail describing goods or services to be purchased with bid request or informal solicitation via telephone), and whether a response was given to the solicitation. Indicate price quoted for goods and services if a response was received. It is noted that the Act requires that you solicit bidders/offerors; the Act does not require that you receive a response to your solicitation.

Bidder/Offeror	Date Contacted	Method of Solicitation	Response? (Yes or No)	Price (If Applicable)

DBE firms must be included as part of the solicitations. Attach documentation to support direct solicitations and price information received, if available.

For professional services contracts only: Indicate at least three criteria (other than cost) considered in your selection of the firm/offeror (e.g., knowledge of facility, past record of performance at your facility, experience of key persons assigned to the project, etc.). Please attach additional information.

Attachment #2

WAGE DETERMINATION(S)

Applicable wage determinations for the construction trade and geographic area of the project are provided in the next few pages (Source: <https://sam.gov/content/wage-determinations> or successor website). Loan recipient is to add the correct wage determination(s) in this attachment prior to bid.

See Davis-Bacon Instructions and Wage Rate
Determinations following Bid Bond.

Attachment #3

Davis-Bacon Payroll Certification, Form WH-347

The fillable DOL form WH-347 is below.

Refer to the U.S. Department of Labor's webpage for additional information:
<https://www.dol.gov/agencies/whd/forms/wh347> or successor website.

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PAYROLL

For contractor's optional use; see instructions at dol.gov/agencies/whd/forms/wh347

Persons are not required to respond to the collection of information unless it displays a currently valid OMB control number.

NAME OF CONTRACTOR ☐ OR SUBCONTRACTOR ☐										ADDRESS										OMB No. 1235-0008 Expires 09/30/2026				
PAYROLL NO.				FOR WEEK ENDING						PROJECT AND LOCATION						PROJECT OR CONTRACT NO.								
(1)		(2)	(3)	OT OR ST	(4) DAY AND DATE							(5)	(6)	(7)	(8) DEDUCTIONS					(9)				
NAME AND INDIVIDUAL IDENTIFYING NUMBER (e.g., LAST FOUR DIGITS OF SOCIAL SECURITY NUMBER) OF WORKER		NO. OF WITHHOLDING EXEMPTIONS	WORK CLASSIFICATION		HOURS WORKED EACH DAY							TOTAL HOURS	RATE OF PAY	GROSS AMOUNT EARNED	FICA	WITH- HOLDING TAX			OTHER	TOTAL DEDUCTIONS	NET WAGES PAID FOR WEEK			
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While completion of Form WH-347 is optional, it is mandatory for covered contractors and subcontractors performing work on Federally financed or assisted construction contracts to respond to the information collection contained in 29 C.F.R. §§ 3.3, 5.5(a). The Copeland Act (40 U.S.C. § 3145) contractors and subcontractors performing work on Federally financed or assisted construction contracts to "furnish weekly a statement with respect to the wages paid each employee during the preceding week." U.S. Department of Labor (DOL) regulations at 29 C.F.R. § 5.5(a)(3)(ii) require contractors to submit weekly a copy of all payrolls to the Federal agency contracting for or financing the construction project, accompanied by a signed "Statement of Compliance" indicating that the payrolls are correct and complete and that each laborer or mechanic has been paid not less than the proper Davis-Bacon prevailing wage rate for the work performed. DOL and federal contracting agencies receiving this information review the information to determine that employees have received legally required wages and fringe benefits.

Public Burden Statement

We estimate that it will take an average of 55 minutes to complete this collection, including time for reviewing instructions, searching existing data sources, gathering and maintaining the data needed, and completing and reviewing the collection of information. If you have any comments regarding these estimates or any other aspect of this collection, including suggestions for reducing this burden, send them to the Administrator, Wage and Hour Division, U.S. Department of Labor, Room S3502, 200 Constitution Avenue, N.W. Washington, D.C. 20210

Date _____

I, _____
(Name of Signatory Party) (Title)

do hereby state:

(1) That I pay or supervise the payment of the persons employed by _____ on the _____
(Contractor or Subcontractor)
_____ ; that during the payroll period commencing on the _____
(Building or Work)
_____ day of _____, _____, and ending the _____ day of _____, _____,
all persons employed on said project have been paid the full weekly wages earned, that no rebates have
been or will be made either directly or indirectly to or on behalf of said
_____ from the full
(Contractor or Subcontractor)
weekly wages earned by any person and that no deductions have been made either directly or indirectly
from the full wages earned by any person, other than permissible deductions as defined in Regulations, Part
3 (29 C.F.R. Subtitle A), issued by the Secretary of Labor under the Copeland Act, as amended (48 Stat. 948,
63 Stat. 108, 72 Stat. 967; 76 Stat. 357; 40 U.S.C. § 3145), and described below:

(2) That any payrolls otherwise under this contract required to be submitted for the above period are
correct and complete; that the wage rates for laborers or mechanics contained therein are not less than the
applicable wage rates contained in any wage determination incorporated into the contract; that the classifications
set forth therein for each laborer or mechanic conform with the work he performed.

(3) That any apprentices employed in the above period are duly registered in a bona fide apprenticeship
program registered with a State apprenticeship agency recognized by the Bureau of Apprenticeship and
Training, United States Department of Labor, or if no such recognized agency exists in a State, are registered
with the Bureau of Apprenticeship and Training, United States Department of Labor.

(4) That:
(a) WHERE FRINGE BENEFITS ARE PAID TO APPROVED PLANS, FUNDS, OR PROGRAMS

☐ – in addition to the basic hourly wage rates paid to each laborer or mechanic listed in
the above referenced payroll, payments of fringe benefits as listed in the contract
have been or will be made to appropriate programs for the benefit of such employees,
except as noted in section 4(c) below.

(b) WHERE FRINGE BENEFITS ARE PAID IN CASH

☐ – Each laborer or mechanic listed in the above referenced payroll has been paid,
as indicated on the payroll, an amount not less than the sum of the applicable
basic hourly wage rate plus the amount of the required fringe benefits as listed
in the contract, except as noted in section 4(c) below.

(c) EXCEPTIONS

EXCEPTION (CRAFT)	EXPLANATION

REMARKS:

NAME AND TITLE	SIGNATURE

THE WILLFUL FALSIFICATION OF ANY OF THE ABOVE STATEMENTS MAY SUBJECT THE CONTRACTOR OR
SUBCONTRACTOR TO CIVIL OR CRIMINAL PROSECUTION. SEE SECTION 1001 OF TITLE 18 AND SECTION 3729 OF
TITLE 31 OF THE UNITED STATES CODE.

AMERICAN IRON AND STEEL (AIS) INITIAL CERTIFICATION STATEMENT

Upon execution of this certification, the selected Contractor, Subcontractor, Materials Supplier, or Service Provider hereby certifies that all of the iron and steel products used in the project are produced in the United States or appropriate waiver(s) has been approved by the U.S. Environmental Protection Agency.

A waiver may be requested from the American Iron and Steel requirements if one of the following exceptions apply in a particular case:

1. Applying the American Iron and Steel (AIS) requirements of the Consolidated Appropriations Act would be inconsistent with the public interest;
2. Iron and steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
3. Inclusion of iron and steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

If the owner (loan recipient) requests a waiver, documentation of at least one of the cases above must be provided with a list of the materials that cannot comply with the American Iron and Steel (AIS) requirements of the Consolidated Appropriations Act of 2014. Waiver requests are not official until approved by EPA Headquarters.

This statement relates to a proposed contract between _____ (*Contractor*)
and _____ (*Owner*) or between _____ (*Contractor*)
and _____ (*Subcontractor*) in conjunction
with _____ (*Project Name*) to be funded with monies made
available by the Virginia Clean Water Revolving Loan Fund.

Print Name and Title of Signer

Signature

Date

AMERICAN IRON AND STEEL (AIS) WAIVER REQUEST

A waiver from the American Iron and Steel (AIS) requirements of the Consolidated Appropriations Act of 2014 is requested for the following reason(s):

- ☐ Applying the American Iron and Steel (AIS) requirements of the VCWRLF would be inconsistent with the public interest;
- ☐ Iron, steel, and relevant manufactured goods are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality; or
- ☐ Inclusion of iron and steel products produced on the United States will increase cost of the overall project by more than 25%.

Relevant documentation to this request is enclosed. No materials will be installed prior to approval of this waiver request by EPA.

☐ Additional sheets attached.

This statement relates to a proposed contract between _____ (*Contractor*)
and _____ (*Owner*) in conjunction
with _____ (*Project Name*) to be funded with monies made
available by the Virginia Clean Water Revolving Loan Fund.

Print Name and Title of Signer

Signature

Date

Attachment 6-AIS Waiver Form

The purpose of this checklist is to help ensure that all appropriate and necessary information is submitted to EPA. EPA recommends that States review this checklist carefully and provide all appropriate information to EPA. This checklist is for informational purposes only and does not need to be included as part of a waiver application.

Items	ü	Notes
General • Waiver request includes the following information: — Description of the foreign and domestic construction materials — Unit of measure — Quantity — Price — Time of delivery or availability — Location of the construction project — Name and address of the proposed supplier — A detailed justification for the use of foreign construction materials • Waiver request was submitted according to the instructions in the memorandum • Assistance recipient made a good faith effort to solicit bids for domestic iron and steel products, as demonstrated by language in requests for proposals, contracts, and communications with the prime contractor	☐ ☐ ☐	
Cost Waiver Requests • Waiver request includes the following information: — Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products — Relevant excerpts from the bid documents used by the contractors to complete the comparison — Supporting documentation indicating that the contractor made a reasonable survey of the market, such as a description of the process for identifying suppliers and a list of contacted suppliers	☐	
Availability Waiver Requests • Waiver request includes the following supporting documentation necessary to demonstrate the availability, quantity, and/or quality of the materials for which the waiver is requested: — Supplier information or pricing information from a reasonable number of domestic suppliers indicating availability/delivery date for construction materials — Documentation of the assistance recipient’s efforts to find available domestic sources, such as a description of the process for identifying suppliers and a list of contacted suppliers. — Project schedule — Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of construction materials • Waiver request includes a statement from the prime contractor and/or supplier confirming the non-availability of the domestic construction materials for which the waiver is sought • Has the State received other waiver requests for the materials described in this waiver request, for comparable projects?	☐ ☐ ☐	

Appendix E: HQ Review Checklist for Waiver Request

Instructions: To be completed by EPA. Review all waiver requests using the questions in the checklist, and mark the appropriate box as Yes, No or N/A. Marks that fall inside the shaded boxes may be grounds for denying the waiver. If none of your review markings fall into a shaded box, the waiver is eligible for approval if it indicates that one or more of the following conditions applies to the domestic product for which the waiver is sought:

1. The iron and/or steel products are not produced in the United States in sufficient and reasonably available quantities and of a satisfactory quality.
2. The inclusion of iron and/or steel products produced in the United States will increase the cost of the overall project by more than 25 percent.

Review Items	Yes	No	N/A	Comments
Cost Waiver Requests				
• Does the waiver request include the following information?				
— Comparison of overall cost of project with domestic iron and steel products to overall cost of project with foreign iron and steel products				
— Relevant excerpts from the bid documents used by the contractors to complete the comparison				
— A sufficient number of bid documents or pricing information from domestic sources to constitute a reasonable survey of the market				
• Does the Total Domestic Project exceed the Total Foreign Project Cost by more than 25%?				
Availability Waiver Requests				
• Does the waiver request include supporting documentation sufficient to show the availability, quantity, and/or quality of the iron and/or steel product for which the waiver is requested?				
— Supplier information or other documentation indicating availability/delivery date for materials				
— Project schedule				
— Relevant excerpts from project plans, specifications, and permits indicating the required quantity and quality of materials				
• Does supporting documentation provide sufficient evidence that the contractors made a reasonable effort to locate domestic suppliers of materials, such as a description of the process for identifying suppliers and a list of contacted suppliers?				
• Based on the materials delivery/availability date indicated in the supporting documentation, will the materials be unavailable when they are needed according to the project schedule? (By item, list schedule date and domestic delivery quote date or other relevant information)				
• Is EPA aware of any other evidence indicating the non-availability of the materials for which the waiver is requested?				
Examples include:				
— Multiple waiver requests for the materials described in this waiver request, for comparable projects in the same State				
— Multiple waiver requests for the materials described in this waiver request, for comparable projects in other States				
— Correspondence with construction trade associations indicating the non-availability of the materials				
• Are the available domestic materials indicated in the bid documents of inadequate quality compared those required by the project plans, specifications, and/or permits?				

AMERICAN IRON AND STEEL (AIS) FINAL CERTIFICATION STATEMENT

Upon execution of this certification, the selected Contractor, Subcontractor, Materials Supplier, or Service Provider hereby certifies that all of the iron and steel products used in the project were produced in the United States or appropriate waiver(s) have been approved by the U.S. Environmental Protection Agency and that no changes or substitutions to the individual certifications provided by the contractor were made.

This statement relates to a proposed contract between_____ (*Contractor*)
and_____ (*Owner*) or between_____ (*Contractor*)
and_____ (*Subcontractor*) in conjunction
with_____ (*Project Name*) to be funded with monies made
available by the Virginia Clean Water Revolving Loan Fund.

Print Name and Title of Signer

Signature

Date

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Standard General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes:
 - 1. Project information.
 - 2. Work covered by Contract Documents.
 - 3. Work restrictions.
 - 4. Specification and drawing conventions.

1.3 PROJECT INFORMATION

- A. Project Identification: **4.0 MGD WWTP Upgrades and Improvements**
- B. (McGill Associates Project No. **24.00343**)
- C. Project Location: **Town of Richlands WWTP**
- D. Owner: **Town of Richlands**
 - 1. Owner's Representative: **Ron Holt, Town Manager**
- E. Engineer: McGill Associates, PA, **4950 Brambleton Ave SW, Suite A, Roanoke, VA 24018**

1.4 WORK COVERED BY CONTRACT DOCUMENTS

- A. The Work of the Project is defined by the Contract Documents and consists of the following:

1. THE PROJECT GENERALLY CONSISTS OF improvements to the existing pretreatment building including replacement of screening equipment, grit equipment, pumps and blowers (including VFDs), influent sampler(s), flow meter(s), gates and valves, and associated piping along with renovation of existing pre-engineered metal building (including HVAC improvements), installation of new bollards, and electrical improvements; improvements to existing primary and secondary clarifiers including replacement of clarifier equipment, rehabilitation of access bridges, valve replacement, and associated electrical and piping improvements; and improvements to the existing shop building including replacement of the existing sludge belt press and polymer feed system, pumps and blowers (including VFDs), valves, associated piping and electrical improvements, and building modifications including wall penetration(s) and belt press foundation.

- B. Type of Contract

Project will be constructed under a single prime contract.

1.5 WORK RESTRICTIONS

- A. Work Restrictions, General: Comply with restrictions on construction operations.

1. Comply with limitations on use of public streets and other requirements of authorities having jurisdiction.

- B. On-Site Work Hours: Limit working hours as required by local regulations and noise ordinances. All other work on site shall be conducted in accordance with the requirements of the Modified General Conditions.

- C. Existing Utility Interruptions: Do not interrupt utilities serving facilities occupied by Owner or others unless permitted under the following conditions and then only after providing temporary utility services according to requirements indicated:

1. Notify Engineer not less than three (3) business days in advance of proposed utility interruptions.
2. Obtain Engineer's written permission before proceeding with utility interruptions.

- D. Noise, Vibration, and Odors: Coordinate operations that may result in high levels of noise and vibration, odors, or other disruption to Owner occupancy with Owner.

1. Notify Engineer not less than 3 business days in advance of proposed disruptive operations.
2. Obtain Engineer's written permission before proceeding with disruptive operations.

1.6 SPECIFICATION AND DRAWING CONVENTIONS

- A. Specification Format: The Specifications are organized into Divisions and Sections using CSI/CSC's "Master Format" numbering system.
 1. Section Identification: The Specifications use Section numbers and titles to help cross-referencing in the Contract Documents. Sections in the Project Manual are in numeric sequence; however, the sequence is incomplete because all available Section numbers are not used. Consult the table of contents at the beginning of the Project Manual to determine numbers and names of Sections in the Contract Documents.
 2. Division 01: Sections in Division 01 govern the execution of the Work of all Sections in the Specifications.
- B. Specification Content: The Specifications use certain conventions for the style of language and the intended meaning of certain terms, words, and phrases when used in particular situations. These conventions are as follows:
 1. Abbreviated Language: Language used in the Specifications and other Contract Documents is abbreviated. Words and meanings shall be interpreted as appropriate. Words implied, but not stated, shall be inferred as the sense requires. Singular words shall be interpreted as plural and plural words shall be interpreted as singular where applicable as the context of the Contract Documents indicates.
 2. Imperative mood and streamlined language are generally used in the Specifications. Requirements expressed in the imperative mood are to be performed by Contractor. Occasionally, the indicative or subjunctive mood may be used in the Section Text for clarity to describe responsibilities that must be fulfilled indirectly by Contractor or by others when so noted.
 - a. The words "shall," "shall be," or "shall comply with," depending on the context, are implied where a colon (:) is used within a sentence or phrase.

- C. Drawing Coordination: Requirements for materials and products identified on the Drawings are described in detail in the Specifications. One or more of the following are used on the Drawings to identify materials and products:
1. Terminology: Materials and products are identified by the typical generic terms used in the individual Specifications Sections.
 2. Abbreviations: Materials and products are identified by common industry abbreviations.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 011000

PART 1: GENERAL**1.1 SUMMARY OF WORK**

- A. The Project generally consists of improvements to the existing pretreatment building including replacement of screening equipment, grit equipment, pumps and blowers (including VFDs), influent sampler(s), flow meter(s), gates and valves, and associated piping along with renovation of existing pre-engineered metal building (including HVAC improvements), installation of new bollards, and electrical improvements; improvements to existing primary and secondary clarifiers including replacement of clarifier equipment, rehabilitation of access bridges, valve replacement, and associated electrical and piping improvements; and improvements to the existing shop building including replacement of the existing sludge belt press and polymer feed system, pumps and blowers (including VFDs), valves, associated piping and electrical improvements, and building modifications including wall penetration(s) and belt press foundation.

PART 2: PRODUCTS**2.1 EQUIPMENT AND MATERIAL STANDARDS**

- A. All equipment and materials of construction described in this specification shall meet the more stringent requirements of the applicable codes listed below:
1. OSHA - Occupational Safety and Health Administration.
 2. ASTM - American Society for Testing Materials.
 3. ANSI - American National Standards Institute.
 4. AGMA - American Gear Manufacturers Association.
 5. AISC - American Institute of Steel Construction.
 6. AWS - American Welding Society.
 7. NEC - National Electric Code.
 8. NEMA - National Electrical Manufacturers Association.
 9. API - American Petroleum Institute.

2.2 INDUSTRY STANDARDS

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. In all cases, the standards referenced within these Contract Documents shall be construed to reference the most current version, amendment or applicable replacement pertaining to the work.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

2.3 QUALITY ASSURANCE

- A. All equipment shall, after installation by the Contractor, shall be inspected, tested and started up by a qualified representative of the equipment manufacturer. The Contractor and the manufacturer's representative shall complete the "Equipment Start-up Form" provided at the end of this section and submit the completed form to the Engineer.
- B. The listing of a manufacturer in the specifications does not necessarily imply that the manufacturer's standard equipment meets the requirements of the specifications, but that the manufacturer listed has the capability to meet the requirements of the specifications.

PART 3: EXECUTION

3.1 SPECIAL REQUIREMENTS

- A. Limits of Construction: The Contractor shall confine all operations and personnel to the limits of construction as shown on the plans. There shall be no disturbance whatsoever of any areas outside the limits of construction nor shall the workmen be allowed to travel at will through the surrounding private property.
- B. Construction Superintendent: The Contractor shall place in charge of the work a competent and reliable superintendent, who shall have the authority

to act for the Contractor and who shall be accountable to the Engineer. The Contractor shall, at all times, employ labor and equipment sufficient to accomplish the several classes of work to full completion in the manner and time specified.

C. Site Conditions:

1. The Contractor shall maintain the work and project grounds free from rubbish, debris and waste materials during all phases of the work.
2. Immediately upon completion of the work and prior to final acceptance, the Contractor shall remove all rubbish, debris, temporary structures, equipment, excess or waste materials and shall leave the work and project grounds in a neat and orderly condition that is satisfactory to the Engineer and Owner.

D. Right of Entry: The Engineer and his representative will at all times have access to the work. In addition, authorized representatives and agents of any participating Federal or State agency shall be permitted to inspect all work, materials, payrolls, records of personnel, invoices of materials, and other relevant data and records.

E. Temporary Construction Services and Facilities: The Contractor shall obtain all necessary permits, licenses, etc. and shall pay all costs incident to the furnishing, installing and maintenance of temporary utility services and facilities required for the duration of the work.

F. Utility Coordination: The Contractor shall make all necessary arrangements with private and public utility companies to avoid any possible damage to or interruption of utility equipment or service. The Contractor shall be responsible for all inquiries concerning locations of utility lines. Repair of any damage to public or private utilities resulting from this work shall be the responsibility of the Contractor.

G. Construction Surveying: All work shall be constructed in accordance with the lines, grades and elevations shown on the plans or as given by the Engineer in the field. The Contractor shall be fully responsible for maintaining alignment and grade. All principal controlling points and base lines for locating the principal components of the work together with a suitable number of benchmarks adjacent to the work will be provided by the Engineer. From this information, the Contractor shall verify benchmarks and develop and make all detail surveys needed for construction. The Contractor shall protect and safeguard all points, stakes, grade marks, monuments, and benchmarks at the site of the work and shall re-establish, at his own expense, any marks which are removed or destroyed due to his construction operations.

H. Laying Out Work:

1. It is imperative that the Contractor work within the shown rights of way or easements at all times, unless approved otherwise by the property owner and the Engineer.
2. The Contractor shall, at his expense, provide competent engineering survey services and shall provide and maintain accurate, detailed, survey work.
3. The plans and supplementary drawings shall not be scaled, and the Contractor must verify all dimensions and elevations at the site prior to proceeding with the work. The Contractor shall also verify existing utility locations prior to purchasing materials affected by these locations.

J. Safety and Health Regulations:

1. The Contractor shall comply with all Federal, State and Local Safety and Health Regulations including the Department of Labor Safety and Health Regulations for construction promulgated under the Occupational Safety and Health Act of 1970 (P.L. 91 - 596) and under Section 107 of the Contract Work Hours and Safety Standards Act (P.L. 91-54).
2. The Contractor shall provide continuous, safe access to all properties, both public and private, along the project in all cases where such access will be provided by the completed facility and shall conduct his operations in such a manner that inconvenience to the property owners will be held to a minimum.
3. All chemicals used during project construction, whether herbicide, pesticide, disinfectant, polymer, reactant or of other classification, must show approval of either EPA or USDA. Use of all such chemicals and disposal of residues shall be in conformance with instructions.
- 4.

K. Equipment and Material Storage: The Contractor shall plan his activities so that all materials and equipment can be stored within the project limits. There shall be no disturbance whatsoever of any areas outside the project limits without the prior approval of the Engineer.

L. Disturbed Areas: All areas disturbed as a result of the work of the Contractor shall be restored to the original or better condition. Reasonable care shall be taken during construction to avoid damage to the Owner's property or that of any adjacent property owner(s).

- M. Temporary Sanitary Facilities: The Contractor shall be solely responsible for furnishing and maintaining temporary sanitary facilities during the construction period. Such facilities shall include but not be limited to, potable water supply and toilet facilities. Such facilities shall be in compliance with all applicable state and local laws, codes, and ordinances and shall be placed convenient to work stations and secluded from public observation. Once the project is completed all temporary sanitary facilities shall be removed by the Contractor.
- N. Traffic Maintenance:
1. The Contractor shall provide, erect, and maintain all necessary barricades, suitable and sufficient warning lights, danger signals, and signs, shall provide a sufficient number of flagmen to direct the traffic and shall take all necessary precautions for the protection of the work and the safety of the public.
 2. All barricades and obstructions or hazardous conditions shall be illuminated as necessary to provide for safe traffic conditions.
 3. Warning and caution signs shall be posted throughout the length of any portion of the project where traffic flow is restricted.
- O. Material Demolition and Disposal: At Owner's direction, Contractor shall salvage and return to Owner all pieces of equipment scheduled for demolition. Any items not to be retained by Owner shall be disposed in accordance with Section 017419.

END OF SECTION 011200

PART 1 - GENERAL**1.1 SUMMARY****A. Section includes:**

1. Requirements for coordinating with Owner's water system during the work and completion of the work without impacting Owner's water system except as allowed in this section.

B. Definitions:

1. Shutdown – When a portion of the Owner's facility which is normally in operation has to be temporarily taken out of service for the performance of the Work.

C. Related Sections:

1. Division 01 Section "Project Management and Coordination"
2. Division 01 Section "Submittals"
3. Division 02 Section "Demolition"
4. Division 33 Section "Sewage Bypass Pumping"
5. Division 40 - Process Integration
6. Division 41 - Material Processing And Handling Equipment
7. Division 43 - Process Gas And Liquid Handling, Purification And Storage Equipment
8. Division 46 – Water and Wastewater Equipment

D. General Requirements

1. The Contractor shall schedule work to ensure that the Richlands WWTP remains in service at all times during construction. All work shall be closely coordinated with the Owner and Engineer. Work shall be scheduled and conducted such that the execution of the work does not: impede Owner's production or processes, reduce process efficacy, create hazards to persons or property, or create nuisance conditions. Any activities that require lines or facilities to be taken out of service shall be scheduled with the Owner and the Engineer a minimum of two (2) weeks in advance.
2. Work not included in this section may, generally, be completed at any time during regular working hours in accordance with the General Conditions.
3. Contractor may, at their own expense, provide temporary facilities for the purpose of mitigating or eliminating constraints provided that said temporary facilities: do not create hazards to persons or property, adversely affect the Owner's ability to comply with any and all applicable regulations, or create nuisance conditions.

4. All shutdowns shall be coordinated with Owner and Engineer. Contractor shall schedule and conduct a meeting with Owner and Engineer prior to scheduling shutdown.
5. Do not shutdown or disconnect existing utility lines unless accepted by Engineer in writing.
6. The Contractor shall be responsible for providing all labor, materials, and equipment necessary to complete the work. The contractor's bid price shall include all applicable sales tax.
7. The Contractor shall at all times work in a clean and safe manner.
8. The Contractor shall provide all safety equipment related to the performance of the Work including that necessary for work in confined spaces.

1.2 SEQUENCE AND SCHEDULE

- A. Work shall be performed in the sequence specified. Execution of the Work may require work outside of regular business hours. With acceptance of Owner and Engineer, Work may be accelerated from a later stage to an earlier stage provided that Owner's operations are not adversely affected by the sequencing change.
 1. All changes to the specified construction sequence must be submitted in writing to the Engineer at least thirty (30) working days before the implicated work is/was to begin.
- B. Stages specified in this section are to be completed sequentially in the order prescribed.
- C. Work that may interrupt Owner's normal operations shall be accomplished at times convenient to and approved by Owner.
- D. Contractor shall furnish tools, equipment, spare parts, and materials (both permanent and temporary) necessary to complete all work requiring shutdown in close proximity to the shutdown and tie-in work areas. To the extent possible, Contractor shall prefabricate piping and other assemblies prior to the shutdown, and demonstrate to the Engineer's satisfaction that the Contractor has complied with these requirements, before the any shutdown may begin.
- E. If Contractor's operations cause an unscheduled interruption of Owner's operations, Contractor shall, at his own expense, re-establish satisfactory operation for Owner.
 1. Any and all penalties or fines issued by jurisdictional authorities resulting from unscheduled shutdowns or interruptions of normal operation of Owner's facilities shall be paid solely by Contractor if, in Engineer's opinion, Contractor did not conform to the requirements of the Contract Documents, was negligent in the performance of the Work, or did not take proper precautions in performing the Work.

1.3 PROPOSED SEQUENCE OF WORK

- A. Scope of Work: the following construction sequence plan is being provided as a guide for the Contractor to follow. Some items may be performed concurrently if approved by the Engineer. Any deviation from this sequence requires prior approval by the Engineer.

1. Site Work:

- a. Erosion and Sedimentation Control
- b. Locate all existing utilities within the project area.
- c. Clear only the areas necessary to install perimeter erosion control measures.
- d. Install temporary measures.

2. General:

- a. Contractor shall coordinate and complete all preliminary work prior to beginning construction. preliminary work shall include, but not be limited to, advanced utility exploration, RFI submittals arising from the advanced utility exploration, project schedule submittal, pre-construction photos/videos, construction survey, temporary business access plan, etc.
- b. Contractor to test and verify all existing gates and valves to be used are functioning properly prior to beginning construction.
- c. Contractor will coordinate with the Owner to notify property owners, at least one (1) week prior to beginning construction. The contractor shall maintain access to buildings throughout the entirety of the WWTP for the duration of the project.
- d. Contractor shall provide bypass pumping for all processes and equipment scheduled for rehabilitation or replacement. Bypassing shall be in accordance with Section 333210.
- e. For processes with redundant units, Contractor shall perform work in only one unit at a time and maintain at least one unit in operation for the duration of the work.
- f. For non-essential processes without redundant units, Contractor shall bypass units for the duration of the work.
- g. For essential processes without redundant units, Contractor shall provide temporary equipment that meet or exceeds the capacity of the existing process units for the duration of the work.
- h. Contractor shall notify Engineer should any existing conditions render work methodology detailed in 2.e through 2.g above infeasible. Contractor shall coordinate all bypassing with Owner and Engineer.
- i. Any asphalt disturbance shall conform to the specified limits shown on the design plans (either trench cut or complete removal). The contractor shall not disturb any existing asphalt surfaces beyond the limits of disturbance represented on the plans.
- j. Complete all remaining construction activities within the project area. Request final approval from Engineer and Owner for all work.

3. Demolition Requirements:

- a. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public. Refer to Division 02 Section "Demolition" for specific requirements.
- b. Provide construction fencing, temporary barricades, portable drums, or other devices to separate demolition work areas from existing roadway, buildings, and parking lots.
- c. Protect all existing facilities and utilities to remain and repair/replace to new condition any damage thereto.
- d. Follow all sequencing requirements described in the general construction sequence.
- e. Verify all utilities to be demolished or abandoned with Owner prior to removal or demolition. Properly abandon utilities as required.
- f. Remove and dispose offsite all demolition debris resulting from the work required to complete the project.
- g. Relocate utilities as required to provide a complete and operational project. Dispose offsite all utility piping and structures to be demolished and removed.
- h. Salvage or dispose of all demolished equipment in accordance with Section 011216 "Work Sequence" and Section 011200 "Special Conditions".
- i. Perform all backfill and restoration work in accordance with the requirements of Division 31 and 32 specifications.

4. Restoration

- a. Perform final clean-up work, grassing, seeding, and all required restoration of surfaces in accordance with the plans and specifications.
- b. Contractor shall repair all disturbed areas to equal or better condition than the original site.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 DETAILED SHUTDOWN REQUIREMENTS:

A. Prior to Typical Shutdown:

- 1. Obtain Engineer's written acceptance of properly submitted Shutdown Request.
- 2. Obtain Engineer's written acceptance of all applicable shop drawings.

3. Coordinate with timing of shutdown with Owner and Engineer and provide required notice.
4. Assist Owner's preparations to take applicable systems out of service.
5. Install, test, and ensure proper function of systems.

END OF SECTION

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for substitutions.
- B. Related Sections:
 - 1. Division 01 Section "Allowances" for products selected under an allowance.
 - 2. Division 01 Section "Alternates" for products selected under an alternate.
 - 3. Division 01 Section "Product Requirements" for requirements for submitting comparable product submittals for products by listed manufacturers.
 - 4. Divisions 02 through 40 Sections for specific requirements and limitations for substitutions.

1.3 DEFINITIONS

- A. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
 - 1. Substitutions for Cause: Changes proposed by Contractor that are required due to changed Project conditions, such as unavailability of product, regulatory changes, or unavailability of required warranty terms.
 - 2. Substitutions for Convenience: Changes proposed by Contractor or Owner that are not required in order to meet other Project requirements but may offer advantage to Contractor and/or Owner.

1.4 SUBMITTALS

- A. Substitution Requests: Submit three (3) copies of each request for consideration. Identify product or fabrication or installation method to be replaced. Include Specification and title and Drawing numbers and titles.
 - 1. Substitution Request Form: Use form acceptable to Engineer.
 - 2. Documentation: Show compliance with substitution requirements contained in the Modified General Conditions.

3. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation of a request for substitution. Engineer will notify Contractor of acceptance or rejection of proposed substitution.
 - a. Forms of Acceptance: Change Order, Construction Change Directive, or Engineer's Supplemental Instructions for minor changes in the Work.
 - b. Use product specified if Engineer does not issue a decision on use of a proposed substitution within time necessary to avoid delay.

1.5 QUALITY ASSURANCE

- A. Compatibility of Substitutions: Investigate and document compatibility of proposed substitution with related products and materials. Engage qualified testing agency to perform compatibility tests recommended by manufacturers.

1.6 PROCEDURES

- A. Coordination: Modify or adjust affected work as necessary to integrate work of the approved substitutions.

PART 2 - PRODUCTS

2.1 SUBSTITUTIONS

- A. Substitutions for Cause: Submit requests for substitution immediately upon discovery of need for change.
 1. Conditions: Engineer will consider Contractor's request for substitution when the conditions described in the Modified General Conditions are satisfied. If the conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with requirements:
- B. Substitutions for Convenience: Engineer will consider requests for substitution if received within 60 days after the Notice to Proceed. Requests received after that time may be considered or rejected at discretion of Engineer.
 1. Conditions: Engineer will consider Contractor's request for substitution when the conditions described in the Modified General Conditions are satisfied. If these conditions are not satisfied, Engineer will return requests without action, except to record noncompliance with requirements:

PART 3 - EXECUTION (Not Used)

END OF SECTION 012500

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for handling and processing Contract modifications.

1.3 MINOR CHANGES IN THE WORK

- A. Engineer will issue supplemental instructions authorizing minor changes in the Work, not involving adjustment to the Contract Sum or the Contract Time.

1.4 PROPOSAL REQUESTS

- A. Owner-Initiated Proposal Requests: Engineer will issue a detailed description of proposed changes in the Work that may require adjustment to the Contract Sum or the Contract Time. If necessary, the description will include supplemental or revised Drawings and Specifications.
 - 1. Proposal Requests issued by Engineer are not instructions either to stop work in progress or to execute the proposed change.
 - 2. Within time specified in Proposal Request or 15 days, when not otherwise specified, after receipt of Proposal Request, submit a quotation estimating cost adjustments to the Contract Sum and the Contract Time necessary to execute the change.
 - a. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - b. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - c. Include costs of labor and supervision directly attributable to the change.

- d. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - e. Quotation Form: Use forms acceptable to Engineer.
- B. Contractor-Initiated Proposals: If latent or changed conditions require modifications to the Contract, Contractor may initiate a claim by submitting a request for a change to Engineer.
 - 1. Include a statement outlining reasons for the change and the effect of the change on the Work. Provide a complete description of the proposed change. Indicate the effect of the proposed change on the Contract Sum and the Contract Time.
 - 2. Include a list of quantities of products required or eliminated and unit costs, with total amount of purchases and credits to be made. If requested, furnish survey data to substantiate quantities.
 - 3. Indicate applicable taxes, delivery charges, equipment rental, and amounts of trade discounts.
 - 4. Include costs of labor and supervision directly attributable to the change.
 - 5. Include an updated Contractor's construction schedule that indicates the effect of the change, including, but not limited to, changes in activity duration, start and finish times, and activity relationship. Use available total float before requesting an extension of the Contract Time.
 - 6. Comply with requirements in Division 01 Section "Substitution Procedures" if the proposed change requires substitution of one product or system for product or system specified.
 - 7. Proposal Request Form: Use form acceptable to Engineer.

1.5 CHANGE ORDER PROCEDURES

- A. On Owner's approval of a Proposal Request, Engineer will issue a Change Order for signatures of Owner and Contractor.

1.6 WORK CHANGE DIRECTIVE

- A. Work Change Directive: Engineer may issue a Work Change Directive. Work Change Directive instructs Contractor to proceed with a change in the Work, for subsequent inclusion in a Change Order.
 - 1. Work Change Directive contains a complete description of change in the Work. It also designates method to be followed to determine change in the Contract Sum or the Contract Time.
- B. Documentation: Maintain detailed records on a time and material basis of work required by the Work Change Directive.
 - 1. After completion of change, submit an itemized account and supporting data necessary to substantiate cost and time adjustments to the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012600

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section specifies administrative and procedural requirements necessary to prepare and process Applications for Payment.
- B. Related Sections:
 - 1.
 - 2. Division 01 Section "Contract Modification Procedures" for administrative procedures for handling changes to the Contract.
 - 3.
 - 4. Division 01 Section "Submittal Procedures" for administrative requirements governing the preparation and submittal of the submittal schedule.

1.3 SCHEDULE OF VALUES

- A. Coordination: Coordinate preparation of the Schedule of Values with preparation of Contractor's Construction Schedule. A cost-loaded Critical Path Method Schedule may serve to satisfy requirements for the Schedule of Values.
 - 1. Correlate line items in the Schedule of Values with other required administrative forms and schedules, including the following:
 - a. Application for Payment forms with continuation sheets.
 - b. Submittal schedule.
 - c. Items required to be indicated as separate activities in Contractor's Construction Schedule.
 - 2. Submit the Schedule of Values to Engineer at earliest possible date but no later than 7 days prior to the date scheduled for submittal of the initial Applications for Payment.

3. Sub-schedules for Phased Work: Where the Work is separated into phases requiring separately phased payments, provide sub-schedules showing values correlated with each phase of payment.
 4. Sub-schedules for Separate Elements of Work: Where the Contractor's construction schedule defines separate elements of the Work, provide sub-schedules showing values correlated with each element.
- B. Format and Content: Use the Project Manual table of contents as a guide to establish line items for the Schedule of Values.
1. Identification: Include the following Project identification on the schedule of values:
 - a. Project name and location.
 - b. Name of Engineer.
 - c. Engineer's project number.
 - d. Contractor's name and address.
 - e. Date of submittal.
 2. Arrange the schedule of values in tabular form with separate columns to indicate the following for each item listed:
 - a. Related Specification Section or Division.
 - b. Description of the Work.
 - c. Name of subcontractor.
 - d. Name of manufacturer or fabricator.
 - e. Name of supplier.
 - f. Dollar value as a percentage of the Contract Sum to nearest one-hundredth percent, adjusted to total 100 percent.
 3. Provide a breakdown of the Contract Sum in enough detail to facilitate continued evaluation of Applications for Payment and progress reports. Coordinate with the Project Manual table of contents. Provide multiple line items for principal contract amounts as appropriate which include separate costs for items such as shop drawings, and project closeout items such as, but not limited to demobilization, project restoration and final cleanup, furnishing Operation and Maintenance manuals, punch list activities, equipment demonstration, operator training and Project Record Documents.
 4. Round amounts to nearest whole dollar; total shall equal the Contract Sum.
 5. Provide a separate line item in the schedule of values for each part of the Work where Applications for Payment may include materials or equipment purchased or fabricated and stored, but not yet installed.
 - a. Differentiate between items stored on-site and items stored off-site. If required, include evidence of insurance.

6. Provide separate line items in the schedule of values for initial cost of materials, for each subsequent stage of completion, and for total installed value of that part of the Work.
7. Each item in the schedule of values and Applications for Payment shall be complete. Include total cost and proportionate share of general overhead and profit for each item.
 - a. Temporary facilities and other major cost items that are not direct cost of actual work-in-place shall be proportionately applied to other line items in the Schedule of Values.
8. Schedule Updating: Update and resubmit the Schedule of Values before the next Applications for Payment when Change Orders or Construction Change Directives result in a change in the Contract Sum.

1.4 APPLICATIONS FOR PAYMENT

- A. Each Application for Payment shall be consistent with previous applications and payments as certified by Engineer and paid for by Owner.
 1. Initial Application for Payment, Application for Payment at time of Substantial Completion, and final Application for Payment involve additional requirements.
- B. Payment Application Times: Progress payments shall be submitted to Engineer by a specific day of the month to be established at the pre-construction conference. The period covered by each Application for Payment is one month, ending on the specific day of the month that is established at the pre-construction conference.
- C. Application for Payment Forms: Use forms provided in Contract Documents.
- D. Application Preparation: Complete every entry on form. Execute by a person authorized to sign legal documents on behalf of Contractor. Engineer will return incomplete applications without action.
 1. Entries shall match data on the schedule of values and Contractor's Construction Schedule. Use updated schedules if revisions were made.
 2. Include amounts for all work completed since the previous Application for Payment by including amounts for all work completed on the project and subtracting those quantities included on previous Applications for Payment. Include only amounts for work completed through the cut-off date established at the pre-construction conference.
 3. Include amounts of Change Orders and Construction Change Directives issued before last day of construction period covered by application.

- E. **Stored Materials:** Include in Application for Payment amounts applied for materials or equipment purchased or fabricated and stored, but not yet installed.
1. Provide certificate of insurance, evidence of transfer of title to Owner, and consent of surety to payment, for stored materials.
 2. Provide supporting documentation that verifies amount requested, such as paid invoices. Match amount requested with amounts indicated on documentation; do not include overhead and profit on stored materials.
 3. Provide summary documentation for stored materials indicating the following:
 - a. Materials previously stored and included in previous Applications for Payment.
 - b. Work completed for this Application utilizing previously stored materials.
 - c. Additional materials stored with this Application.
 - d. Total materials remaining stored, including materials with this Application.
 4. Reimbursement for stored materials shall not exceed 50 percent of the unit price bid for the associated line item or as shown in the Schedule of Values for that portion of the work, unless otherwise agreed upon by the Engineer and Owner .
- F. **Retainage:** The Owner may retain a portion of the amount otherwise due the Contractor. Except as provided elsewhere, the amount retained by the Owner shall be limited to the following:
1. Withholding of not more than 5 percent of the payment claimed until work is 50 percent complete.
 2. When the contract is 50 percent complete no further retainage shall be withheld from periodic payments. However, the Owner may reinstate retainage (up to 5 percent) if they feel the work is unsatisfactory. The Owner may withhold additional retainage as necessary from periodic payments in a sum necessary to maintain total retainage of 2.5 percent of contract cost through the completion of the project.
 3. When the work is substantially complete (operational or beneficial occupancy), the withheld amount shall be further reduced below 5 percent to only that amount necessary to assure completion.
 4. The Owner may accept securities negotiable without recourse, conditions or restrictions, a release of retainage bond or an irrevocable letter of credit provided by the Contractor in lieu of all or part of the cash retainage.
- G. **Sales Tax Statement:** When requested by the Owner, each request for progress payment submitted by the Contractor shall include a sales tax reimbursement statement. The Contractor shall utilize the form provided with the Contract

Documents, or a similar form that provides the required information and certification.

- H. Transmittal: Submit three (3) signed and notarized original copies of each Application for Payment to Engineer by a method ensuring receipt. One copy shall include waivers of lien and similar attachments if required.
 - 1. Transmit each copy with a transmittal form listing attachments and recording appropriate information about application.
- I. Waivers of Mechanic's Lien: With each Application for Payment, submit waivers of mechanic's lien from entities lawfully entitled to file a mechanic's lien arising out of the Contract and related to the Work covered by the payment.
 - 1. Submit partial waivers on each item for amount requested in previous application, after deduction for retainage, on each item.
 - 2. When an application shows completion of an item, submit conditional final or full waivers.
 - 3. Owner reserves the right to designate which entities involved in the Work must submit waivers.
 - 4. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
 - 5. Waiver Forms: Submit waivers of lien on forms, executed in a manner acceptable to Owner.
- J. Initial Application for Payment: Administrative actions and submittals that must precede or coincide with submittal of first Application for Payment include the following:
 - 1. List of subcontractors.
 - 2. Schedule of Values.
 - 3. Contractor's construction schedule.
 - 4. Sales tax statement (as necessary)
 - 5. Combined Contractor's construction schedule incorporating Work of multiple contracts, with indication of acceptance of schedule by each Contractor.
 - 6. Products list.
 - 7. Schedule of unit prices.
 - 8. Submittal schedule.
 - 9. List of Contractor's staff assignments.
 - 10. List of Contractor's principal consultants.
 - 11. Copies of building permits.
 - 12. Copies of authorizations and licenses from authorities having jurisdiction for performance of the Work.
 - 13. Any other requirements described in the Modified General Conditions of the Contract.

- K. Progress Applications for Payment: Administrative actions and submittals that must precede or coincide with submittal of each Progress Application for Payment include the following:
1. Updated Schedule of Values.
 2. Updated Contractor's construction schedule.
 3. Sales tax statements (as necessary).
 4. Certified payroll statements (as necessary).
 5. Summary of stored materials.
 6. Any other requirements described in the Modified General Conditions of the Contract.
- L. Application for Payment at Substantial Completion: After issuing the Certificate of Substantial Completion, submit an Application for Payment showing 100 percent completion for portion of the Work claimed as substantially complete.
1. Include documentation supporting claim that the Work is substantially complete and a statement showing an accounting of changes to the Contract Sum.
 2. This application shall reflect Certificates of Partial Substantial Completion issued previously for Owner occupancy of designated portions of the Work.
 3. Any other requirements described in the Modified General Conditions of the Contract.
- M. Final Payment Application: Submit final Application for Payment with releases and supporting documentation not previously submitted and accepted, including, but not limited, to the following:
1. Evidence of completion of Project closeout requirements.
 2. Insurance certificates for products and completed operations where required and proof that taxes, fees, and similar obligations were paid.
 3. Updated final statement, accounting for final changes to the Contract Sum (Final Adjusting Change Order issued by Engineer).
 4. Contractor's Affidavit of Release of Liens.
 5. Consent of Surety to Final Payment.
 6. Evidence that claims have been settled.
 7. Final meter readings for utilities, a measured record of stored fuel, and similar data as of date of Substantial Completion or when Owner took possession of and assumed responsibility for corresponding elements of the Work.
 8. Final liquidated damages settlement statement.
 9. Record Documents.
 10. General warranty letter.
 11. Sales tax statements (as necessary).
 12. Any other requirements described in the Modified General Conditions of the Contract.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 012900

SECTION 013100 PROJECT MANAGEMENT AND COORDINATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative provisions for coordinating construction operations on Project including, but not limited to, the following:
 - 1. General project coordination procedures.
 - 2. Administrative and supervisory personnel.
 - 3. Coordination drawings.
 - 4. Requests for Information (RFIs).
 - 5. Project meetings.
- B. Related Sections:
 - 1. Division 01 Section "Execution Requirements" for procedures for coordinating general installation and field-engineering services, including establishment of benchmarks and control points.
 - 2. Division 01 Section "Closeout Procedures" for coordinating closeout of the Contract.

1.3 DEFINITIONS

- A. RFI (Request for Information): Request from Contractor seeking information and clarification from the Engineer during construction.

1.4 COORDINATION

- A. Coordination: The Contractor shall coordinate its construction operations with those of others to ensure efficient and orderly installation of each part of the Work.

The Contractor shall be responsible for the coordination of each of their subcontractors' schedules. Contractor and each subcontractor shall coordinate its operations with operations included in different Sections that depend on each other for proper installation, connection, and operation.

1. Schedule construction operations in sequence required to obtain the best results where installation of one part of the Work depends on installation of other components, before or after its own installation.
 2. Coordinate installation of different components with other contractors to ensure maximum performance and accessibility for required maintenance, service, and repair.
 3. Make adequate provisions to accommodate items scheduled for later installation.
 4. Where availability of space is limited, coordinate installation of different components to ensure maximum performance and accessibility for required maintenance, service, and repair of all components.
- B. Prepare memoranda for distribution to each party involved, outlining special procedures required for coordination. Include such items as required notices, reports, and list of attendees at meetings.
1. Prepare similar memoranda for Owner and separate contractors if coordination of their Work is required.

1.5 REQUESTS FOR INFORMATION (RFIs)

- A. General: Immediately upon discovery of the need for additional information, interpretation, or clarification of the Contract Documents, Contractor shall prepare and submit an RFI.
1. RFIs shall originate with Contractor. Engineer will return RFIs submitted to Engineer by other entities controlled by Contractor with no response.
 2. Coordinate and submit RFIs in a prompt manner so as to avoid delays in Contractor's work or work of subcontractors.
- B. Content of the RFI: Include a detailed, legible description of item needing information or interpretation and the following:
1. Project name, including Owner.
 2. Date.
 3. Name of Contractor.

4. Name of Engineer.
 5. RFI number, numbered sequentially.
 6. RFI subject.
 7. Specification Section number and title and related paragraphs, as appropriate.
 8. Drawing number and detail references, as appropriate.
 9. Field dimensions and conditions, as appropriate.
 10. Contractor's suggested resolution. If Contractor's solution(s) impacts the Contract Time or the Contract Sum, Contractor shall state impact in the RFI.
 11. Contractor's signature.
 12. Attachments: Include sketches, descriptions, measurements, photos, Product Data, Shop Drawings, coordination drawings, and other information necessary to fully describe items needing interpretation.
 - a. Include dimensions, thicknesses, structural grid references, and details of affected materials, assemblies, and attachments on attached sketches.
- C. RFI Forms: Software-generated form acceptable to Engineer.
- D. Engineer's Action: Engineer will review each RFI, determine action required, and respond. Allow seven (7) working days for Engineer's response for each RFI. RFIs received by Engineer after 1:00 p.m. will be considered as received the following working day.
1. The following RFIs will be returned without action:
 - a. Requests for approval of submittals.
 - b. Requests for approval of substitutions.
 - c. Requests for coordination information already indicated in the Contract Documents.
 - d. Requests for adjustments in the Contract Time or the Contract Sum.
 - e. Requests for interpretation of Engineer's actions on submittals.
 - f. Incomplete RFIs or inaccurately prepared RFIs.

2. Engineer's action may include a request for additional information, in which case Engineer's time for response will date from time of receipt of additional information.
 3. Engineer's action on RFIs that may result in a change to the Contract Time or the Contract Sum may be eligible for Contractor to submit Change Proposal according to Division 01 Section "Contract Modification Procedures."
 - a. If Contractor believes the RFI response warrants change in the Contract Time or the Contract Sum, notify Engineer in writing within 10 days of receipt of the RFI response.
- E. Upon receipt of Engineer's action, update the RFI log and immediately distribute the RFI response to affected parties. Review response and notify Engineer within seven (7) days if Contractor disagrees with response.
- F. RFI Log: Prepare, maintain, and submit a tabular log of RFIs organized by the RFI number. Contractor shall be prepared to discuss the log and the status of pending RFIs at all Progress or Coordination Meetings.
- G. Improper or Frivolous RFI: Improper and/or Frivolous RFI's shall be defined as RFI's that request information that is clearly indicated on or reasonably inferable from Contract Documents.
1. Will be returned unanswered, will be removed from the Contractor's RFI log, and the number assigned will be assigned to subsequent RFI.
 2. At the Contractor's request, after notification by Engineer that a RFI is improper or frivolous, the RFI will be processed with processing costs charged to Contractor as follows:
 - a. The Contractor shall reimburse the Owner for the Engineer's account for time spent in processing improper or frivolous RFI's at the rate of the Engineer's current standard hourly fee schedule for personnel and associated expenses.

1.6 PROJECT MEETINGS

- A. General: Engineer will schedule and conduct meetings and conferences at Project site, unless otherwise indicated.
1. Attendees: Inform participants and others involved, and individuals whose presence is required, of date and time of each meeting. Notify Owner and Contractor of scheduled meeting dates and times.

2. Agenda: Engineer will prepare the meeting agenda and distribute to all invited attendees.
 3. Minutes: Engineer will record significant discussions and agreements achieved and distribute the meeting minutes to everyone concerned, including Owner and Contractor.
- B. Preconstruction Conference: Engineer will schedule and conduct a preconstruction conference before starting construction, at a time convenient to Owner and Engineer, but no later than 15 days after execution of the Agreement.
1. Conduct the conference to review responsibilities and personnel assignments.
 2. Attendees: Authorized representatives of Owner, Engineer, and their consultants; Contractor and its superintendent; major subcontractors; suppliers; and other concerned parties shall attend the conference. Participants at the conference shall be familiar with Project and authorized to conclude matters relating to the Work.
 3. Agenda: Discuss items of significance that could affect progress of the work.
 4. Minutes: Engineer will record and distribute meeting minutes.
- C. Coordination Meetings: Engineer will conduct Project Coordination meetings as necessary. Project coordination meetings are in addition to specific meetings held for other purposes, such as progress meetings.
1. Attendees: In addition to representatives of Owner and Engineer, each contractor, subcontractor, supplier, and other entity concerned with current progress or involved in planning, coordination, or performance of future activities shall be represented at these meetings. All participants at the meetings shall be familiar with Project and authorized to conclude matters relating to the Work.
 2. Agenda: Review and correct or approve minutes of the previous Coordination Meeting. Review other items of significance that could affect progress. Topics for discussion at these meetings will be determined as necessary based on the status of Project.
 3. Contractor's Construction Schedule: Review progress since the last Coordination Meeting. Determine whether contract is on time, ahead of schedule, or behind schedule, in relation to Contractor's Construction Schedule. Determine how construction behind schedule will be expedited; secure commitments from parties involved to do so. Discuss whether schedule revisions are required to ensure that current and subsequent activities will be completed within the Contract Time.

- a. Schedule Updating: Revise combined Contractor's construction schedule after each coordination meeting where revisions to the schedule have been made or recognized. Issue revised schedule concurrently with report of each meeting.
 - b. Review present and future needs of each entity present, including the following:
 - 1) Interface requirements.
 - 2) Sequence of operations.
 - 3) Status of submittals.
 - 4) Deliveries.
 - 5) Off-site fabrication.
 - 6) Access.
 - 7) Site utilization.
 - 8) Temporary facilities and controls.
 - 9) Work hours.
 - 10) Hazards and risks.
 - 11) Progress cleaning.
 - 12) Quality and work standards.
 - 13) Change Orders.
4. Reporting: Engineer shall record meeting results and distribute copies to everyone in attendance and to others affected by decisions or actions resulting from each meeting.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 013100

SECTION 013200 CONSTRUCTION PROGRESS DOCUMENTATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for documenting the progress of construction during performance of the Work, including the following:
 - 1. Contractor's Construction Schedule.
 - 2. Submittals schedule.
 - 3. Field condition reports.
 - 4. Start-up construction schedule.
 - 5. Special reports.
- B. Related Sections:
 - 1. Division 1 Section "Payment Procedures" for submitting the Schedule of Values.
 - 2. Division 1 Section "Project Management and Coordination" for submitting and distributing meeting and conference minutes.
 - 3. Division 1 Section "Submittal Procedures" for submitting schedules and reports.
 - 4. Division 1 Section "Quality Requirements" for submitting a schedule of tests and inspections.

1.3 DEFINITIONS

- A. Activity: A discrete part of a project that can be identified for planning, scheduling, monitoring, and controlling the construction project. Activities included in a construction schedule consume time and resources.
 - 1. Critical Activity: An activity on the critical path that must start and finish on the planned early start and finish times.
 - 2. Predecessor Activity: An activity that precedes another activity in the network.

- 3. Successor Activity: An activity that follows another activity in the network.
- B. Cost Loading: The allocation of the Schedule of Values for the completion of an activity as scheduled. The sum of costs for all activities must equal the total Contract Sum, unless otherwise approved by Engineer.
- C. CPM: Critical Path Method, which is a method of planning and scheduling a construction project where activities are arranged based on activity relationships. Network calculations determine when activities can be performed and the critical path of the Project.
- D. Critical Path: The longest connected chain of interdependent activities through the network schedule that establishes the minimum overall Project duration and contains no float.
- E. Event: The starting or ending point of an activity.
- F. Float: The measure of leeway in starting and completing an activity.
 - 1. Float time is not for the exclusive use or benefit of either Owner or Contractor, but is a jointly owned, expiring Project resource available to both parties as needed to meet schedule milestones and Contract completion date. No claims shall arise from the use of float by either party.
 - 2. Free float is the amount of time an activity can be delayed without adversely affecting the early start of the successor activity.
 - 3. Total float is the measure of leeway in starting or completing an activity without adversely affecting the planned Project completion date.
- G. Resource Loading: The allocation of manpower and equipment necessary for the completion of an activity as scheduled.

1.4 SUBMITTALS

- A. Format for Submittals: Submit indicated submittals in accordance with Section 013300.
- B. Construction Schedule: Initial schedule, of size required to legibly display entire schedule for entire construction period.
- C. Submittals Schedule: Arrange the following information in a tabular format:
 - 1. Scheduled date for initial submittals.
 - 2. Specification Section number and title.
 - 3. Submittal category (action or informational).
 - 4. Description of the Work covered.

- 5. Scheduled date for Engineer's final release or approval.
- D. Field Condition Reports: Submit at time of discovery of differing conditions.
- E. Start-up construction schedule.
 - 1. Approval of cost-loaded start-up construction schedule will not constitute approval of schedule of values for cost-loaded activities.
- F. Special Reports: Submit at time of unusual event.

1.5 COORDINATION

- A. Contractor shall coordinate preparation and processing of schedules and reports with performance of construction activities and with scheduling and reporting of subcontractors.
- B. Contractor shall coordinate Construction Schedule with the Schedule of Values, subcontractors, submittal schedule, progress reports, payment requests, and other required schedules and reports.
 - 1. Secure time commitments for performing critical elements of the Work from entities involved.
 - 2. Coordinate each construction activity in the network with other activities and schedule them in proper sequence.

PART 2 - PRODUCTS

2.1 CONTRACTOR'S CONSTRUCTION SCHEDULE (CPM METHOD)

- A. CPM Schedule: Prepare Contractor's construction schedule using a cost-loaded, time-scaled CPM network analysis diagram for the Work.
- B. Time Frame: Extend schedule from date established for the Notice to Proceed to date of final completion.
 - 1. Contract completion date shall not be changed by submission of a schedule that shows an early completion date, unless specifically authorized by Change Order.
- C. Activities: Treat each aspect of the work as a separate numbered activity for each principal element of the Work. Comply with the following:
 - 1. Activity Duration: Define activities such that no activity is longer than 20 days, unless specifically allowed by Engineer.

2. Procurement Activities: Include procurement process activities for long lead items and major items, requiring a cycle of more than 60 days, as separate activities in schedule. Procurement cycle activities include, but are not limited to, submittals, approvals, purchasing, fabrication, and delivery.
 3. Submittal Review Time: Include review and resubmittal times indicated in Division 01 Section "Submittal Procedures" in schedule. Coordinate submittal review times in Construction Schedule with submittal schedule.
 4. Startup and Testing Time: Within the Construction Schedule, include an appropriate number of days for startup and testing based on the scope of the project.
 5. Substantial Completion: Indicate completion in advance of date established for Substantial Completion, and allow time for administrative procedures necessary for certification of Substantial Completion.
 6. Punch List and Final Completion: Include not more than 30 days for punch list and final completion.
- D. Constraints: Include constraints and work restrictions indicated in the Contract Documents and as follows in schedule, and show how the sequence of the Work is affected.
1. Phasing: Arrange list of activities on schedule by phase.
 2. Work by Owner: Include a separate activity for each portion of the Work performed by Owner, if applicable.
 3. Products Ordered in Advance: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date.
 4. Owner-Furnished Products: Include a separate activity for each product. Include delivery date indicated in Division 01 Section "Summary." Delivery dates indicated stipulate the earliest possible delivery date, if applicable.
 5. Work Restrictions: Construction Schedule shall account for and show the effect of the following items on the schedule:
 - a. Coordination with existing construction.
 - b. Limitations of continued occupancies.
 - c. Uninterruptible services.
 - d. Partial use/occupancy before Substantial Completion.
 - e. Use of premises restrictions.
 - f. Seasonal variation/restrictions.
 - g. Environmental control.
 6. Work Stages: Indicate important stages of construction for each major portion of the Work, including, but not limited to, the following:
 - a. Subcontract awards.
 - b. Submittals.

- c. Purchases.
 - d. Fabrication.
 - e. Sample testing.
 - f. Deliveries.
 - g. Installation.
 - h. Tests and inspections.
 - i. Adjusting.
 - j. Curing.
 - k. Startup and placement into final use and operation.
7. Construction Areas: Identify each major area of construction for each major portion of the Work. Indicate where each construction activity within a major area must be sequenced or integrated with other construction activities to provide for items including, but not limited to the following:
- a. Structural completion.
 - b. Permanent space enclosure.
 - c. Completion of mechanical installation.
 - d. Completion of electrical installation.
 - e. Substantial Completion.
- E. Milestones: Include milestones indicated in the Contract Documents in schedule, including, but not limited to, the Notice to Proceed, Substantial Completion, Final Completion and other project-specific milestones.
- F. Cost Correlation: At the head of schedule, provide a cost correlation line, indicating planned and actual costs. On the line, show dollar volume of the Work performed as of dates used for preparation of payment requests.
- 1. Refer to Division 01 Section "Payment Procedures" for cost reporting and payment procedures.
- G. Upcoming Work Summary: At monthly intervals, prepare a summary report indicating activities scheduled to occur or commence prior to submittal of the next schedule update. Summarize the following:
- 1. Unresolved issues.
 - 2. Unanswered RFIs.
 - 3. Rejected or unreturned submittals.
 - 4. Notations on returned submittals.
- H. Recovery Schedule: When periodic update indicates the Work is 14 or more calendar days behind the current approved schedule, submit a separate recovery schedule indicating means by which Contractor intends to regain compliance with the schedule. Indicate changes to working hours, working days, crew sizes, and equipment required to achieve compliance, and date by which recovery will be accomplished.

- I. Computer Scheduling Software: Prepare schedules using a software program that has been developed specifically to manage construction schedules.

2.2 SUBMITTALS SCHEDULE

- A. Preparation: Submit a schedule of submittals, arranged in chronological order by dates required by Progress schedule. Include time required for review, resubmittal, ordering, manufacturing, fabrication, and delivery when establishing dates.
 1. Coordinate Submittals Schedule with list of subcontracts, the Schedule of Values, and Contractor's Progress Schedule.
 2. Submittal: Submit concurrently with the first complete submittal of Contractor's Construction Schedule.

2.3 FIELD CONDITION REPORTS

- A. Immediately upon discovery of a difference between field conditions and the Contract Documents, notify Engineer to discuss these differences. Based on those conversations, prepare and submit a detailed report. Submit with a Request for Information. Include a detailed description of the differing conditions, together with recommendations for changing the Contract Documents.

2.4 START-UP CONSTRUCTION SCHEDULE

- A. In conjunction with the initial submittal of a Construction Schedule, submit an equipment start-up schedule which includes information detailing the start-up of each piece of equipment on the Project.

2.5 SPECIAL REPORTS

- A. General: Submit special reports to Engineer within one day of an occurrence. Distribute copies of report to parties affected by the occurrence.
- B. Reporting Unusual Events: When an event of an unusual and significant nature occurs at Project site, whether or not related directly to the Work, prepare and submit a special report. List chain of events, persons participating, response by Contractor's personnel, evaluation of results or effects, and similar pertinent information. Advise Engineer in advance when these events are known or predictable.

PART 3 - EXECUTION

3.1 CONTRACTOR'S CONSTRUCTION SCHEDULE

- A. Contractor's Construction Schedule Updating: At monthly intervals, update schedule to reflect actual construction progress and activities. Issue updated schedule one week prior to each regularly scheduled progress meeting or prior to submission of Application for Payment.
 - 1. Revise schedule immediately after each meeting or other activity where revisions have been recognized or made. Issue updated schedule concurrently with the report of each such meeting.
 - 2. Include a report with updated schedule that indicates every change, including, but not limited to, changes in logic, durations, actual starts and finishes, and activity durations.
 - 3. As the Work progresses, indicate final completion percentage for each activity.
- B. Distribution: Distribute copies of approved schedule to Engineer, Owner, subcontractors, testing and inspecting agencies, and other parties identified by Contractor with a need-to-know schedule responsibility.
 - 1. Post copies in Project meeting rooms and temporary field offices.
 - 2. When revisions are made, distribute updated schedules to the same parties and post in the same locations. Delete parties from distribution when they have completed their assigned portion of the Work and are no longer involved in performance of construction activities.

END OF SECTION 013200

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final completion construction photographs.
 - 4. Preconstruction video recordings.
 - 5. Periodic construction video recordings.
- B. Related Sections:
 - 1. Division 01 Section "Submittal Procedures" for submitting photographic documentation.
 - 2. Division 01 Section "Closeout Procedures" for submitting photographic documentation as project record documents at Project closeout.
 - 3. Division 01 Section "Demonstration and Training" for submitting video recordings of demonstration of equipment and training of Owner's personnel.
 - 4. Division 02 Section "Demolition" for photographic documentation before building demolition operations commence.
 - 5. Division 31 Section "Site Clearing" for photographic documentation before site clearing operations commence.

1.3 COSTS

- A. The cost for photographic documentation services shall be considered incidental to the work and shall be included in the bid. No separate payment will be made for photographic documentation.

1.4 INFORMATIONAL SUBMITTALS

- A. Construction Photographs: Submit two (2) copies of each photographic view within seven (7) days of taking photographs.
 - 1. Format: Submit all photographs in a digital format acceptable to Engineer on a CD.
 - 2. Identification: Each CD shall be labeled with the following information:
 - a. Name of Project.
 - b. Name of Contractor.
 - c. Date(s) photographs were taken.
 - 3. The digital file for each photograph shall include the following:
 - a. Date stamp by camera.
 - b. File names indicative of the description of the photographs.
 - c. Unique sequential identifier (as necessary).
- B. Video Recordings: Submit video recordings within seven (7) days of recording.
 - 1. Submit video recordings in digital video disc format acceptable to Engineer.
 - 2. Identification: With each submittal, provide the following information:
 - a. Name of Project.
 - b. Name of Contractor.
 - c. Date video recording was recorded.
 - d. Description of vantage point, indicating location, direction (by compass point), and elevation or story of construction.
 - e. Weather conditions at time of recording.
 - 3. The digital file for each video shall include the following:
 - a. Date stamp by video camera.
 - b. File names indicative of the description of the videos.
 - c. Unique sequential identifier (as necessary).

1.5 USAGE RIGHTS

- A. Contractor shall transfer copyright usage rights to Owner for unlimited reproduction of photographic documentation.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in JPG format, produced by a digital camera with minimum sensor size of 8 megapixels, and at an image resolution of not less than 1600 by 1200 pixels and 400 dpi.
- B. Digital Video Recordings: Provide high-resolution, digital video disc in format acceptable to Engineer.

PART 3 - EXECUTION

3.1 CONSTRUCTION PHOTOGRAPHS

- A. General: Take photographs using the maximum range of depth of field, and that are in focus, to clearly show the Work. Photographs with blurry or out-of-focus areas will not be accepted.
 - 1. Maintain key plan with each set of construction photographs that identifies each photographic location.
- B. Digital Images: Submit digital images exactly as originally recorded in the digital camera, without alteration, manipulation, editing, or modifications using image-editing software.
 - 1. Date and Time: Include date and time in file name for each image.
 - 2. Field Office Images: Maintain one set of images accessible in the field office at Project site, available at all times for reference. Identify images in the same manner as those submitted to Engineer.
- C. Preconstruction Photographs: Before starting construction, take photographs of Project site and surrounding properties, including existing items to remain during construction, from different vantage points, as directed by Engineer.
 - 1. Flag construction limits before taking construction photographs.
 - 2. Take photographs necessary to show existing conditions adjacent to property before starting the Work.
 - 3. Take photographs of existing buildings either on or adjoining property as necessary to accurately record physical conditions at the start of construction.
 - 4. Take additional photographs as required to record settlement or cracking of adjacent structures, pavements, and improvements.

- D. Periodic Construction Photographs: Take photographs monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show the status of construction and progress since the last photographs were taken.
- E. Engineer-Directed Construction Photographs: From time to time, Engineer will instruct Contractor about number and frequency of photographs and general directions on vantage points. Select actual vantage points and take photographs to show the status of construction and progress since the last photographs were taken.
- F. Final Completion Construction Photographs: Take photographs after date of Substantial Completion for submission as project record documents. Engineer will inform Contractor of desired vantage points.
- G. Additional Photographs: Engineer may request photographs in addition to periodic photographs specified.
 - 1. Three days' notice will be given, where feasible.
 - 2. In emergency situations, take additional photographs within 24 hours of request.
 - 3. Circumstances that could require additional photographs include, but are not limited to, the following:
 - a. Special events planned at Project site.
 - b. Immediate follow-up when on-site events result in construction damage or losses.
 - c. Photographs to be taken at fabrication locations away from Project site. These photographs are not subject to unit prices or unit-cost allowances.
 - d. Substantial Completion of a major phase or component of the Work.
 - e. Extra record photographs at time of final acceptance.
 - f. Owner's request for special publicity photographs.

3.2 CONSTRUCTION VIDEO RECORDINGS

- A. Recording: Mount camera on tripod before starting recording, unless otherwise necessary to show area of construction. Display continuous running time and date. At the start of each video recording, record weather conditions from local newspaper or television and the actual temperature reading at Project site.
- B. Narration: Describe scenes on video recording by audio narration by microphone while video recording is recorded. Include description of items being viewed, recent events, and planned activities. At each change in location, describe vantage point, location, direction (by compass point), and elevation or story of construction.

1. Confirm date and time at beginning and end of recording.
 2. Begin each video recording with the name of Project, Contractor's name, and Project location.
- C. Preconstruction Video Recording: Before starting construction, record video recording of Project site and surrounding properties from different vantage points, as directed by Engineer.
1. Flag construction limits before recording construction video recordings.
 2. Show existing conditions adjacent to Project site before starting the Work.
 3. Show existing buildings either on or adjoining Project site to accurately record physical conditions at the start of construction.
 4. Show protection efforts by Contractor.
- D. Periodic Construction Video Recordings: Record video recording monthly, coinciding with the cutoff date associated with each Application for Payment. Select vantage points to show status of construction and progress since last video recordings were recorded.

END OF SECTION 013233

PART 1 - GENERAL**1.1 REQUIREMENTS**

- A. This section specifies the methods and requirements for the submissions applicable to Shop drawings, Working drawings, Product data, Samples, Request for substitutions, Test procedures, and Construction and Submittal schedules. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Specification Sections, apply to this Section.
- B. All submittals shall be clearly identified by reference to the Specification Section, Paragraph, Drawing number, or Detail as applicable.
- C. All submittals shall be submitted by the Contractor and the Contractor shall be solely responsible for the coordination and management of all submittals. No submittals received directly from material/equipment suppliers or subcontractors will be accepted unless otherwise agreed upon by all parties. The Engineer's review comments and markup submittals will be returned to the Contractor who shall promptly coordinate and return the comments and markup submittals to the appropriate parties.
- D. The Contractor shall submit to the Engineer a detailed submittal schedule in accordance with the Modified General Conditions.
- E. The Contractor shall be responsible for the accuracy and completeness of the information contained in each submittal and shall assure that the material, equipment, and method of work shall be as described in the submittal. Submittal documents shall be edited to clearly show only those items to be included in the contract. All extraneous materials shall be crossed out or otherwise obliterated. The Contractor shall be solely responsible for the coordination of submittals so that work will not be delayed. Different categories of submittals shall be scheduled so that one will not be delayed for lack of coordination or approval of another. No extensions of time will be allowed because of failure to properly schedule or manage submittals.

1.2 SUMMARY

- A. Related Sections:
 - 1. Division 01 Section "Payment Procedures" for submitting Applications for Payment and the schedule of values.
 - 2. Division 01 Section "Project Record Documents" for submitting record Drawings, record Specifications, and record Product Data.

1.3 DEFINITIONS

- A. Action Submittals: Written and graphic information and physical samples that require Engineer's responsive action. Action submittals are those submittals indicated in individual Specification Sections as action submittals or those inferred by the work shown on the drawings or detailed in the project documents.
- B. Informational Submittals: Written and graphic information and physical samples that do not require Engineer's responsive action. Informational submittals are those submittals indicated in individual Specification Sections as informational submittals.
- C. File Transfer Protocol (FTP): Communications protocol that enables transfer of files to and from another computer over a network and that serves as the basis for standard Internet protocols. An FTP site is a portion of a network located outside of network firewalls within which internal and external users are able to access files.
- D. Portable Document Format (PDF): An open standard file format licensed by Adobe Systems used for representing documents in a device-independent and display resolution-independent fixed-layout document format.
- E. Time/Days: Where days are referenced as a measurement of time the unit shall be calendar days.

1.4 SUBMITTALS SCHEDULE

- A. Submit a schedule of submittals, arranged in chronological order by dates required by construction schedule. Include time required for review, ordering, manufacturing, fabrication, and delivery when establishing dates. Include additional time required for making corrections or modifications to submittals noted by the Engineer and additional time for handling and reviewing submittals required by those corrections.
 - 1. Coordinate submittal schedule with list of subcontracts, the schedule of values, and Contractor's construction schedule.
 - 2. Format: Arrange the following information in a tabular format:
 - a. Scheduled date for first submittal.
 - b. Specification Section number and title.
 - c. Submittal category: Action, informational.
 - d. Name of subcontractor, if applicable.

- e. Description of the Work covered.
 - f. Scheduled date for Engineer's final release or approval.
 - g. Scheduled dates for purchasing.
 - h. Scheduled dates for installation.
 - i. Activity or event number from Construction Schedule.
- B. Submit revised submittal schedule as necessary to reflect changes in current status and timing for submittals.

1.5 SUBMITTAL ADMINISTRATIVE REQUIREMENTS

- A. Engineer's Digital Data Files: Electronic copies of the Contract Drawings and project specifications may be provided by Engineer for Contractor's use in preparing submittals only if detailed in other Sections of the Contract Documents. In cases where Engineer provides electronic copies of these documents, Engineer makes no representations as to the accuracy or completeness of digital data files as they relate to the Contract Drawings. Please refer to the Modified General Conditions for more details regarding the use of the Engineer's digital data files.
- B. Coordination: Coordinate preparation and processing of submittals with performance of construction activities.
- 1. Coordinate each submittal with fabrication, purchasing, testing, delivery, other submittals, and related activities that require sequential activity.
 - 2. Submit all submittal items required for each Specification Section concurrently unless partial submittals for portions of the Work are indicated on approved submittal schedule.
 - 3. Submit action submittals and informational submittals required by the same Specification Section as separate packages under separate transmittals.
 - 4. Coordinate transmittal of different types of submittals for related parts of the Work so processing will not be delayed because of need to review submittals concurrently for coordination.
- C. Engineer reserves the right to withhold action on a submittal requiring coordination with other submittals until related submittals are received.
- D. Processing Time: Allow time for submittal review, including time for resubmittals, as follows. Time for review shall commence on Engineer's receipt of submittal. No extension of the Contract Time will be authorized

because of failure to transmit submittals enough in advance of the Work to permit processing, including resubmittals.

1. Initial Review: Based on the complexity of the submittal, allow 7 to 21 days for initial review of each submittal. Allow additional time if coordination with subsequent submittals is required. Engineer will advise Contractor when a submittal being processed must be delayed for coordination.
 2. Intermediate Review: If intermediate submittal is necessary, process it in same manner as initial submittal.
 3. Resubmittal Review: Based on the complexity of the submittal, allow 7 to 21 days for review of each resubmittal.
 4. Sequential Review: Where sequential review of submittals by Engineer's consultants, Owner, or other parties is indicated, allow 21 days for initial review of each submittal.
- E. Each submittal shall be accompanied by the transmittal cover contained in this section. The cover sheet shall be printed in a bright unique color of paper (color selected per project) and affixed to paper copies of each submittal. The information required for each submittal is contained on the cover sheet and shall be furnished for each submittal.
- F. Submittal Identification Number: A unique four (4) character number shall be assigned by the Contractor and shall be noted on the transmittal cover sheet accompanying each submittal. Submittal numbers shall have the following format:
1. The first character shall be a SD, W, S, or M, which represents Shop Drawing Data (SD), Working Drawing (W), Sample (S), or Operating/Maintenance Manual (M).
 2. The next digits shall be the specification section number.
 3. The next digits shall be a three digit number (001 – 999) assigned to sequentially number each submittal.
 4. The last character is a letter, A-Z, indicating the submission, or resubmission of the same data, i.e., A – 1st submittal, B- 2nd submittal, etc.

5. A typical submittal number would be:

SD-15800-013-A

where:

SD = shop drawing

15800 = technical specification section 15800

013 = contractor's submittal number 013

A = 1st submittal

- G. Deviations: All deviations from the Contract Documents shall be identified on submittals.
- H. Paper and Electronic Copies: Unless additional copies are required for final submittal, and unless Engineer observes noncompliance with provisions in the Contract Documents, initial submittal may serve as final submittal.
- I. Transmittal: Assemble each submittal individually and appropriately for transmittal and handling. Engineer will discard submittals received from sources other than Contractor.
- J. Resubmittals: Make resubmittals in same form and number of copies as initial submittal.
 - 1. Note date and content of previous submittal.
 - 2. Note date and content of revision and clearly indicate extent of revision.
 - 3. Resubmit submittals until they are marked with approval notation from Engineer.
- K. Distribution: Furnish copies of final submittals to manufacturers, subcontractors, suppliers, fabricators, installers, authorities having jurisdiction, and others as necessary for performance of construction activities. Show distribution on transmittal forms.
- L. Use for Construction: Use only final submittals that are marked with approval notation from Engineer.

PART 2 - PRODUCTS

2.1 SUBMITTAL PROCEDURES

- A. General Submittal Procedure Requirements: Prepare and submit submittals required by individual Specification Sections. Types of submittals are indicated in individual Specification Sections.
 - 1. Submittals: Submit two (2) paper copies and one electronic copy in a PDF format of each submittal, unless otherwise indicated. Engineer will return one (1) copy.
 - 2. All submittals shall include a copy of the specification section, with addendum updates included, and all referenced and applicable sections, and each paragraph shall be check-marked to indicate that the submitted material is in compliance with the specification or marked to indicate requested deviations from the specified requirements. If deviations are noted and/or requested each deviation shall be underlined and denoted by a number in the margin to the right with a detailed description of the deviation on a separate sheet.
- B. Product Data: Collect information into a single submittal for each element of construction and type of product or equipment.
 - 1. Mark each copy of each submittal to show which products and options are applicable.
 - 2. As a minimum, include the following information, as applicable. Include other information as required by the applicable product specification sections:
 - a. Manufacturer's catalog cuts.
 - b. Manufacturer's product specifications.
 - c. Standard color charts.
 - d. Statement of compliance or variations with specified referenced standards.
 - e. Testing by recognized testing agency.
 - f. Application of testing agency labels and seals.
 - g. Notation of coordination requirements.
 - h. Availability and delivery time information.

3. For equipment, include the following in addition to the above, as applicable:
 - a. Wiring diagrams showing factory-installed wiring.
 - b. Printed performance curves.
 - c. Operational range diagrams.
 - d. Clearances required to other construction, if not indicated on accompanying Shop Drawings.
 4. Submit Product Data before or concurrent with Samples.
 5. Submit Product Data in the following format:
 - a. Submit two (2) paper copies and one electronic copy in a PDF format of each submittal, unless otherwise indicated. Engineer will return one (1) copy.
- C. Shop Drawings: Prepare Project-specific information, drawn accurately to scale. Do not base Shop Drawings on reproductions of the Contract Documents or standard printed data.
1. Preparation: Fully illustrate requirements in the Contract Documents. Include the following information, as applicable:
 - a. Identification of products.
 - b. Schedules.
 - c. Compliance and variation with specified standards.
 - d. Notation of coordination requirements.
 - e. Notation of dimensions established by field measurement.
 - f. Relationship and attachment to adjoining construction clearly indicated.
 - g. Seal and signature of professional engineer if specified.
 2. Sheet Size: Except for templates, patterns, and similar full-size drawings, submit Shop Drawings on sheets at least 8-1/2 by 11 inches but no larger than 24 by 36 inches.
- D. Samples: Submit Samples for review of kind, color, pattern, and texture for a check of these characteristics with other elements and for a comparison of these

characteristics between submittal and actual component as delivered and installed.

1. Transmit Samples that contain multiple, related components such as accessories together in one submittal package.
2. Identification: Attach label on unexposed side of Samples that includes the following:
 - a. Generic description of Sample.
 - b. Product name and name of manufacturer.
 - c. Sample source.
 - d. Number and title of applicable Specification Section.
3. Disposition: Maintain sets of approved Samples at Project site, available for quality-control comparisons throughout the course of construction activity. Sample sets may be used to determine final acceptance of construction associated with each set.
 - a. Samples that may be incorporated into the Work are indicated in individual Specification Sections. Such Samples must be in an undamaged condition at time of use.
 - b. Samples not incorporated into the Work, or otherwise designated as Owner's property, are the property of Contractor.
4. Samples for Initial Selection: Submit manufacturer's color charts consisting of units or sections of units showing the full range of colors, textures, and patterns available.
 - a. Number of Samples: Submit 2 full sets of available choices where color, pattern, texture, or similar characteristics are required to be selected from manufacturer's product line. Engineer will return one (1) submittal with options selected.
- E. Contractor's Construction Schedule: Send preliminary schedule for Owner's approval prior to starting construction. Submit updated schedules as requested by the Owner.
- F. Application for Payment: Comply with requirements specified in Division 01 Section "Payment Procedures."
- G. Schedule of Values: Comply with requirements specified in Division 01 Section "Payment Procedures."

- H. Subcontract List: Prepare a written summary identifying individuals or firms proposed for each portion of the Work, including those who are to furnish products or equipment. Include the following information in tabular form:
 - 1. Name, address, and telephone number of entity performing subcontract or supplying products.
 - 2. Number and title of related Specification Section(s) covered by subcontract.
 - 3. Drawing number and detail references, as appropriate, covered by subcontract.
 - 4. Submit subcontract list in the following format:
 - a. Submit two (2) paper copies and one electronic copy in a PDF format, unless otherwise indicated.
- I. Coordination Drawings: Comply with requirements specified in Division 01 Section "Project Management and Coordination."
- J. Equipment Manufacturer Certificates: Submit written statements on manufacturer's letterhead certifying that the manufacturer has reviewed the Contract drawings and specifications, including all addendums, and that the equipment and related accessories included in the shop drawing submittal are suitable for installation in the applications proposed for the project. Include evidence of manufacturing experience where required.
- K. Maintenance Data: Comply with requirements specified in Division 01 Section "Closeout Procedures".
- L. Design Data: Prepare and submit written and graphic information, including, but not limited to, performance and design criteria, list of applicable codes and regulations, and calculations. Include list of assumptions and other performance and design criteria and a summary of loads. Include load diagrams if applicable. Provide name and version of software, if any, used for calculations. Include page numbers.

PART 3 - EXECUTION

3.1 CONTRACTOR'S REVIEW

- A. Action and Informational Submittals: Review each submittal and check for coordination with other Work of the Contract and for compliance with the Contract Documents. Note corrections and field dimensions. Mark with approval stamp before submitting to Engineer.

- B. Project Closeout and Maintenance/Material Submittals: Refer to requirements in Division 01 Section "Closeout Procedures."
- C. Submittal Transmittal: Contractor shall include with each submittal a transmittal form as contained at the end of this section. Include all information required by the form including Project name and location, submittal number, Specification Section title and number, name of reviewer, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with the Contract Documents.

3.2 **ENGINEER'S ACTION**

- A. Engineer will not review submittals that do not bear required cover sheet and ***Contractor's approval and signature*** and will return them without action.
- B. Engineer will review each submittal, make marks to indicate corrections or modifications required, and return it. The transmittal form included in this section contains a copy of the review stamp to be completed by the Engineer. The Engineer will complete the stamp for each submittal and will mark stamp appropriately to indicate action.
- C. Informational Submittals: Engineer will review each submittal and will not return it or will return it if it does not comply with requirements. Engineer will forward each submittal to appropriate party.
- D. Incomplete submittals are not acceptable, will be considered nonresponsive, and will be returned without review.
- E. Submittals not required by the Contract Documents may not be reviewed and may be discarded.
- F. Submittals will be returned to the Contractor under one of the following codes.

Code 1 – FURNISH AS SUBMITTED, No Exceptions – The review indicates that the material, equipment or work method complies with the project documents. In this event the contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal.

Code 2 – FURNISH AS SUBMITTED, Make corrections noted – The review indicates that there are limited corrections required for the material, equipment or work method. In this event the contractor may begin to implement the work method or incorporate the material or equipment covered by the submittal in accordance with the noted corrections.

Code 3 – NOT APPROVED (See Notes), Revise and resubmit – The review indicates that the submittal is insufficient or contains incorrect data, copies or other information. Except at his own risk, the Contractor shall not undertake work covered by this submittal until such time as it is revised and meets the requirements of code 1 or 2.

Code 4 – NOT APPROVED, Rejected – The review indicates that the submittal does not comply with the project documents and is unacceptable for incorporation into the project. Except at his own risk, the Contractor shall not undertake work covered by this submittal until such time as it is revised and meets the requirements of code 1 or 2.

Code 5 – Receipt Acknowledged – The review indicates that the material is for information purposes only and the Engineer has taken no action as none is required.

3.3 EFFECT OF REVIEW OF CONTRACTOR'S SUBMITTALS

- A. The Engineer's review of submittal information provided by the Contractor based upon his review of the drawings, specifications, other project documents and proposed methods of work or information regarding materials or equipment shall not relieve the Contractor of his responsibility for errors therein and shall not be regarded as an assumption of risks or liability by the Owner or the Engineer, or by any officer or employee thereof, and the Contractor shall have no claim under the contract on the account of the failure, or partial failure, of the method of work, material, or equipment so reviewed. A mark of "No Exceptions" or "Make Corrections Noted" shall mean that the Owner has no objection to the Contractor, upon his own responsibility, using the plan or method of work proposed, or providing the materials or equipment proposed.

3.4 COSTS FOR REVIEW OF RESUBMITTALS

- A. The Contractor shall be responsible for the completeness of each submittal and identifying deviations from the project requirements. Any submittal that may require more than two (2) reviews by the Engineer shall be assessed a review charge for time spent in processing shop drawings at the rate of the Engineer's current standard hourly fee schedule for personnel assigned to the shop drawing review and associated expenses. This charge, covering the cost of engineering and administration, shall be assessed against progress payments.

3.5 SUBMITTAL LOG

- A. Prepare, maintain, and submit a tabular log of submittals organized by the submittal number. Contractor shall be prepared to discuss the log and the status of pending submittals at all Progress or Coordination Meetings.

3.6 CONTRACTOR'S APPROVAL COVER SHEET

- A. To be printed on a bright unique color of paper selected for this project and used to designate a Shop Drawing or Informational Submittal and permanently attached or made a part of each submittal.

CONTRACTOR'S SUBMITTAL TRANSMITTAL

Submittal # _____

McGILL ASSOCIATES, P.A.OWNER: TOWN OF RICHLANDS☒ 4950 Brambleton Ave SW, Suite A
Roanoke, Virginia 24018ADDRESS: 200 WASHINGTON SQUARE
RICHLANDS, VIRGINIA 23860

Date: March 12, 2019		Engineer's Project No:
Project: Richlands WWTP Upgrades and Improvements		Spec. Reference:
Contractor:		Drawing Reference:
TO:	CONTRACTOR'S SUBMITTAL NO: (Check One): ☐ An Original Submittal ☐ A 2 nd Submittal of (original Submittal No.) ☐ A Submittal of (original Submittal No.) ☐ Product Data for Information Only ☐ An O&M Submittal for Information Only	
ATTN:		
FROM:		
Item #	Subject of Submittal / Equipment Supplier	Equipment Designations(s) / Specification Section(s):
Complete Either (a) or (b) below: (a) We have verified that the material, equipment or other information contained in this submittal meets all the requirements specified or shown (no exceptions). (b) We have verified that the material, equipment or other information contained in this submittal meets all the requirements specified or shown, except for the following deviations (list deviations): 		
<u>Notes/Comments:</u> <i>By this submittal, I hereby represent that I have determined and verified all field measurements and dimensions, field construction criteria, materials, dimensions, catalog numbers and similar data and I have checked and coordinated each item with other applicable shop drawings, equipment, trades and all Contract requirements.</i> _____ <i>Signature of Contractor's Authorized Representative</i> _____ <i>Date</i>		

3.6 ENGINEER'S APPROVAL COVER SHEET

To be attached to each submittal.

SHOP DRAWING REVIEW

ENGINEER'S REVIEW	RESPONSE REQUIRED OF CONTRACTOR
☐ Furnish As Submitted, No Exceptions ☐ Furnish As Submitted, Make Corrections Noted ☐ Not Approved (See Notes), Revise And Resubmit ☐ Not Approved, Rejected, See Notes	☐ Confirm ☐ Resubmit
☐ Receipt Acknowledged (Not subject to Engineer's Review or Approval)	

The Engineer's review of this shop drawing is for general conformance with the design concept, contract documents, specifications and drawings. Markings or comments shall not be construed as relieving the Contractor from compliance with the project plans and specifications, nor departures there from, and does not relieve the Contractor from errors and omissions in the submittal or from the Contractor's responsibility of addressing any deviations from the contract documents, specifications and drawings. The Contractor remains solely responsible for details and accuracy, for confirming and correlating and verifying all quantities and dimensions at the jobsite, for selecting fabrication processes, for the means, methods, techniques, and sequence of construction, coordinating work with other trades, and performing all work in a safe manner. Engineer's approval shall not relieve Contractor of its obligation to perform construction in accordance with the Contract Documents. Any approval by Engineer shall not constitute an approved change or substitution unless Contractor has previously advised Engineer in writing of such proposed change or substitution and obtained Engineers written approval of such change or substitution.

McGill Associates, P. A.

By: _____

Date: _____

END OF SECTION 013300

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for quality assurance and quality control.
- B. Testing and inspecting services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Document requirements.
 - 1. Specific quality-assurance and control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
 - 2. Specified tests, inspections, and related actions do not limit Contractor's other quality assurance and control procedures that facilitate compliance with the Contract Document requirements.
 - 3. Requirements for Contractor to provide quality-assurance and control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.
- C. Related Sections:
 - 1. Divisions 02 through 46 Sections for specific test and inspection requirements.

1.3 DEFINITIONS

- A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and substantiate that proposed construction will comply with requirements.
- B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that actual products incorporated into the Work and completed construction comply with

requirements. Services do not include contract enforcement activities performed by Engineer.

- C. Product Testing: Tests and inspections that are performed by a Nationally Recognized Testing Laboratory (NRTL), a National Voluntary Laboratory Accreditation Program (NVLAP), or a testing agency qualified to conduct product testing and acceptable to authorities having jurisdiction, to establish product performance and compliance with specified requirements.
- D. Source Quality-Control Testing: Tests and inspections that are performed at the source, i.e., plant, mill, factory, or shop.
- E. Field Quality-Control Testing: Tests and inspections that are performed on-site for installation of the Work and for completed Work.
- F. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratory shall mean the same as testing agency.
- G. Installer/Applicator/Erector: Contractor or another entity engaged by Contractor as an employee, Subcontractor, or Sub-subcontractor, to perform a particular construction operation, including installation, erection, application, and similar operations.
 - 1. Use of trade-specific terminology in referring to a trade or entity does not require that certain construction activities be performed by accredited or unionized individuals, or that requirements specified apply exclusively to specific trade or trades.
- H. Experienced: When used with an entity or individual, "experienced" means having successfully completed a minimum of five previous projects similar in size and scope to this Project; being familiar with special requirements indicated; and having complied with requirements of authorities having jurisdiction.

1.4 CONFLICTING REQUIREMENTS

- A. Referenced Standards: If compliance with two or more standards is specified and the standards establish different or conflicting requirements for minimum quantities or quality levels, comply with the most stringent requirement. Refer uncertainty and requirements that are different, but apparently equal, to Engineer for a decision before proceeding.
- B. Minimum Quantity or Quality Levels: The quantity or quality level shown or specified shall be the minimum provided or performed. The actual installation may comply exactly with the minimum quantity or quality specified, or it may exceed the minimum within reasonable limits. To comply with these requirements, indicated numeric values are minimum or maximum, as appropriate, for the context of requirements. Refer uncertainties to Engineer for a decision before proceeding.

1.5 QUALITY ASSURANCE

- A. General: Qualifications paragraphs in this article establish the minimum qualification levels required; individual Specification Sections specify additional requirements.
- B. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- C. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.
- D. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.
- E. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.
- F. Manufacturer's Technical Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to observe and inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

1.6 QUALITY CONTROL

- A. Owner Responsibilities: Where quality-control services are indicated as Owner's responsibility, Owner will engage a qualified testing agency to perform these services.
 - 1. Owner will furnish Contractor with names, addresses, and telephone numbers of testing agencies engaged and a description of types of testing and inspecting they are engaged to perform.
 - 2. Payment for these services will be made either directly by the Owner or from testing and inspecting allowances, as authorized by the Contract documents, if such allowances are include in the Contractor's construction contract.
 - 3. Costs for retesting and re-inspecting construction that replaces or is necessitated by work that failed to comply with the Contract Documents will be charged to Contractor.

- B. Contractor Responsibilities: Tests and inspections not explicitly assigned to Owner are the Contractor's responsibility. Perform additional quality-control activities required to verify that the Work complies with requirements, whether specified or not.
1. Unless otherwise indicated, provide quality-control services specified and those required by authorities having jurisdiction. Perform quality-control services required of Contractor by authorities having jurisdiction, whether specified or not.
 2. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
 - a. Contractor shall not employ same entity engaged by Owner, unless agreed to in writing by Owner.
 3. Notify testing agencies at least 96 hours in advance of time when Work that requires testing or inspecting will be performed.
 4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
 5. Testing and inspecting requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
 6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.
- C. Retesting/Re-inspecting: Regardless of whether original tests or inspections were Contractor's responsibility, Contractor shall provide quality-control services, including retesting and re-inspecting, for construction that replaced Work that failed to comply with the Contract Documents.
- D. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.
1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
 2. Determine the location from which test samples will be taken and in which in-situ tests are conducted.
 3. Conduct and interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.

4. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
 5. Do not release, revoke, alter, or increase the Contract Document requirements or approve or accept any portion of the Work.
 6. Do not perform any duties of Contractor.
- E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:
1. Access to the Work.
 2. Incidental labor and facilities necessary to facilitate tests and inspections.
 3. Adequate quantities of representative samples of materials that require testing and inspecting. Assist agency in obtaining samples.
 4. Facilities for storage and field curing of test samples.
 5. Preliminary design mix proposed for use for material mixes that require control by testing agency.
 6. Security and protection for samples and for testing and inspecting equipment at Project site.
- F. Coordination: Coordinate sequence of activities to accommodate required quality assurance and control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspecting.
1. Schedule times for tests, inspections, obtaining samples, and similar activities.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 REPAIR AND PROTECTION

- A. General: On completion of testing, inspecting, sample taking, and similar services, repair damaged construction and restore substrates and finishes.
1. Provide materials and comply with installation requirements specified in other Specification Sections or matching existing substrates and finishes. Restore patched areas and extend restoration into adjoining areas with durable seams that are as invisible as possible. Comply with the Contract

Document requirements for cutting and patching in Division 01 Section "Execution Requirements."

- B. Protect construction exposed by or for quality control service activities.
- C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality control services.

END OF SECTION 014000

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 DEFINITIONS

- A. General: Basic Contract definitions are included in the Conditions of the Contract.
- B. "Approved": When used to convey Engineer's action on Contractor's submittals, applications, and requests, "approved" is limited to Engineer's duties and responsibilities as stated in the Conditions of the Contract.
- C. "Directed": A command or instruction by Engineer. Other terms including "requested," "authorized," "selected," "required," and "permitted" have the same meaning as "directed."
- D. "Indicated": Requirements expressed by graphic representations or in written form on Drawings, in Specifications, and in other Contract Documents. Other terms including "shown," "noted," "scheduled," and "specified" have the same meaning as "indicated."
- E. "Regulations": Laws, ordinances, statutes, and lawful orders issued by authorities having jurisdiction, and rules, conventions, and agreements within the construction industry that control performance of the Work.
- F. "Furnish": Supply and deliver to Project site, ready for unloading, unpacking, assembly, installation, and similar operations.
- G. "Install": Operations at Project site including unloading, temporarily storing, unpacking, assembling, erecting, placing, anchoring, applying, working to dimension, finishing, curing, protecting, cleaning, and similar operations.
- H. "Provide": Furnish and install, complete and ready for the intended use.
- I. "Project Site": Space available for performing construction activities. The extent of Project site is shown on Drawings and may or may not be identical with the description of the land on which Project is to be built.

1.3 **INDUSTRY STANDARDS**

- A. Applicability of Standards: Unless the Contract Documents include more stringent requirements, applicable construction industry standards have the same force and effect as if bound or copied directly into the Contract Documents to the extent referenced. Such standards are made a part of the Contract Documents by reference. In all cases, the standards referenced within these Contract Documents shall be construed to reference the most current version, amendment or applicable replacement pertaining to the work.
- B. Publication Dates: Comply with standards in effect as of date of the Contract Documents unless otherwise indicated.
- C. Copies of Standards: Each entity engaged in construction on Project should be familiar with industry standards applicable to its construction activity. Copies of applicable standards are not bound with the Contract Documents.
 - 1. Where copies of standards are needed to perform a required construction activity, obtain copies directly from publication source.

1.4 **ABBREVIATIONS AND ACRONYMS**

- A. Industry Organizations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

AA	Aluminum Association, Inc. (The) www.aluminum.org	(703) 358-2960
AASHTO	American Association of State Highway and Transportation Officials www.transportation.org	(202) 624-5800
ACI	American Concrete Institute www.concrete.org	(248) 848-3700
ACPA	American Concrete Pipe Association www.concrete-pipe.org	(972) 506-7216
AGC	Associated General Contractors of America (The) www.agc.org	(703) 548-3118
AI	Asphalt Institute www.asphaltinstitute.org	(859) 288-4960

AISC	American Institute of Steel Construction www.aisc.org	(800) 644-2400 (312) 670-2400
AISI	American Iron and Steel Institute www.steel.org	(202) 452-7100
AITC	American Institute of Timber Construction www.aitc-glulam.org	(303) 792-9559
ALCA	Associated Landscape Contractors of America (Now PLANET - Professional Landcare Network)	(301) 972-1700
ALSC	American Lumber Standard Committee, Incorporated www.alsc.org	(301) 972-1700
ANSI	American National Standards Institute www.ansi.org	(202) 293-8020
APA	APA - The Engineered Wood Association www.apawood.org	(253) 565-6600
API	American Petroleum Institute www.api.org	(202) 682-8000
ARMA	Asphalt Roofing Manufacturers Association www.asphaltroofing.org	(202) 207-0917
ASCE	American Society of Civil Engineers www.asce.org	(800) 548-2723 (703) 295-6300
ASCE/SEI	American Society of Civil Engineers/Structural Engineering Institute (See ASCE)	
ASME	ASME International (American Society of Mechanical Engineers International) www.asme.org	(800) 843-2763 (973) 882-1170
ASTM	ASTM International (American Society for Testing and Materials International) www.astm.org	(610) 832-9500

AWS	American Welding Society www.aws.org	(800) 443-9353 (305) 443-9353
AWWA	American Water Works Association www.awwa.org	(800) 926-7337 (303) 794-7711
BHMA	Builders Hardware Manufacturers Association www.buildershardware.com	(212) 297-2122
BIA	Brick Industry Association (The) www.bia.org	(703) 620-0010
CLFMI	Chain Link Fence Manufacturers Institute www.chainlinkinfo.org	(301) 596-2583
CPPA	Corrugated Polyethylene Pipe Association www.plasticpipe.org	(800) 510-2772 (202) 462-9607
CRSI	Concrete Reinforcing Steel Institute www.crsi.org	(847) 517-1200
CSA	Canadian Standards Association	(800) 463-6727 (416) 747-4000
CSA	CSA International (Formerly: IAS - International Approval Services) www.csa-international.org	(866) 797-4272 (416) 747-4000
CSI	Construction Specifications Institute (The) www.csinet.org	(800) 689-2900 (703) 684-0300
DHI	Door and Hardware Institute www.dhi.org	(703) 222-2010
EIA	Electronic Industries Alliance www.eia.org	(703) 907-7500
EJCDC	Engineers Joint Contract Documents Committee www.ejdc.org	(703) 295-5000
FM Approvals	FM Approvals LLC www.fmglobal.com	(781) 762-4300
FM Global	FM Global (Formerly: FMG - FM Global) www.fmglobal.com	(401) 275-3000

FMRC	Factory Mutual Research Corporation (Now FM Global)	
GA	Gypsum Association www.gypsum.org	(202) 289-5440
GSI	Geosynthetic Institute www.geosynthetic-institute.org	(610) 522-8440
HI	Hydraulic Institute www.pumps.org	(973) 267-9700
ICEA	Insulated Cable Engineers Association, Inc. www.icea.net	(770) 830-0369
ICRI	International Concrete Repair Institute, Inc. www.icri.org	(847) 827-0830
IEC	International Electrotechnical Commission www.iec.ch	41 22 919 02 11
IEEE	Institute of Electrical and Electronics Engineers, Inc. (The) www.ieee.org	(212) 419-7900
IES	Illuminating Engineering Society www.ies.org	(212) 248-5000
IESNA	Illuminating Engineering Society of North America (Now IES)	
IENT	Institute of Environmental Sciences and Technology www.ient.org	(847) 981-0100
ISO	International Organization for Standardization www.iso.ch	41 22 749 01 11
	Available from ANSI www.ansi.org	(202) 293-8020
ITS	Intertek Testing Service NA (Now ETL SEMCO)	(972) 238-5591
ITU	International Telecommunication Union	41 22 730 51 11

www.itu.int/home

LPI	Lightning Protection Institute www.lightning.org	(800) 488-6864
MBMA	Metal Building Manufacturers Association www.mbma.com	(216) 241-7333
MFMA	Metal Framing Manufacturers Association, Inc. www.metalframingmfg.org	(312) 644-6610
MH	Material Handling (Now MHIA)	
MHIA	Material Handling Industry of America www.mhia.org	(800) 345-1815 (704) 676-1190
MPI	Master Painters Institute www.paintinfo.com	(888) 674-8937 (604) 298-7578
MSS	Manufacturers Standardization Society of The Valve and Fittings Industry Inc. www.mss-hq.com	(703) 281-6613
NACE	NACE International (National Association of Corrosion Engineers International) www.nace.org	(800) 797-6623 (281) 228-6200
NCMA	National Concrete Masonry Association www.ncma.org	(703) 713-1900
NCTA	National Cable & Telecommunications Association www.ncta.com	(202) 775-2300
NECA	National Electrical Contractors Association www.necanet.org	(301) 657-3110
NeLMA	Northeastern Lumber Manufacturers' Association www.nelma.org	(207) 829-6901
NEMA	National Electrical Manufacturers Association www.nema.org	(703) 841-3200

NESC	National Electrical Safety Code http://standards.ieee.org/nesc/	(212) 419-7900
NETA	InterNational Electrical Testing Association www.netaworld.org	(888)300-6382 (303) 697-8441
NFPA	National Fire Protection Association www.nfpa.org	(800) 344-3555 (617) 770-3000
NLGA	National Lumber Grades Authority www.nlga.org	(604) 524-2393
NRCA	National Roofing Contractors Association www.nrca.net	(800) 323-9545 (847) 299-9070
NRMCA	National Ready Mixed Concrete Association www.nrmca.org	(888) 846-7622 (301) 587-1400
NSF	NSF International (National Sanitation Foundation International) www.nsf.org	(800) 673-6275 (734) 769-8010
NSSGA	National Stone, Sand & Gravel Association www.nssga.org	(800) 342-1415 (703) 525-8788
NWWDA	National Wood Window and Door Association (Now WDMA)	
PCI	Precast/Prestressed Concrete Institute www.pci.org	(312) 786-0300
PDI	Plumbing & Drainage Institute www.pdionline.org	(800) 589-8956 (978) 557-0720
PGI	PVC Geomembrane Institute http://pgi-tp.cee.uiuc.edu	(217) 333-3929
PLANET	Professional Landcare Network www.landcarenetwork.org	(800) 395-2522 (703) 736-9666
PTI	Post-Tensioning Institute www.post-tensioning.org	(602) 870-7540
RCSC	Research Council on Structural Connections www.boltcouncil.org	

SDI	Steel Deck Institute www.sdi.org	(847) 458-4647
SDI	Steel Door Institute www.steeldoor.org	(440) 899-0010
SEI/ASCE	Structural Engineering Institute/American Society of Civil Engineers (See ASCE)	
SJI	Steel Joist Institute www.steeljoist.org	(843) 626-1995
SSPC	SSPC: The Society for Protective Coatings www.sspc.org	(877) 281-7772 (412) 281-2331
STI	Steel Tank Institute www.steeltank.com	(847) 438-8265
SWI	Steel Window Institute www.steelwindows.com	(216) 241-7333
SWRI	Sealant, Waterproofing, & Restoration Institute www.swrionline.org	(816) 472-7974
TIA/EIA	Telecommunications Industry Association/Electronic Industries Alliance www.tiaonline.org	(703) 907-7700
TMS	The Masonry Society www.masonrysociety.org	(303) 939-9700
UL	Underwriters Laboratories Inc. www.ul.com	(877) 854-3577 (847) 272-8800
UNI	Uni-Bell PVC Pipe Association www.uni-bell.org	(972) 243-3902
WASTEC	Waste Equipment Technology Association www.wastec.org	(800) 424-2869 (202) 244-4700
WDMA	Window & Door Manufacturers Association www.wdma.com	(800) 223-2301 (847) 299-5200
WWPA	Western Wood Products Association www.wwpa.org	(503) 224-3930

- B. Code Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ICC	International Code Council www.iccsafe.org	(888) 422-7233

UBC	Uniform Building Code (See ICC)	

- C. Federal Government Agencies: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the entities in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

CE	Army Corps of Engineers www.usace.army.mil	(202) 761-0011

DOE	Department of Energy www.energy.gov	(202) 586-9220

EPA	Environmental Protection Agency www.epa.gov	(202) 272-0167

FCC	Federal Communications Commission www.fcc.gov	(888) 225-5322

HUD	Department of Housing and Urban Development www.hud.gov	(202) 708-1112

NIST	National Institute of Standards and Technology www.nist.gov	(301) 975-6478

OSHA	Occupational Safety & Health Administration www.osha.gov	(800) 321-6742 (202) 693-1999

RUS	Rural Utilities Service (See USDA)	(202) 720-9540

USDA	Department of Agriculture www.usda.gov	(202) 720-2791

- D. Standards and Regulations: Where abbreviations and acronyms are used in Specifications or other Contract Documents, they shall mean the recognized name of the standards and regulations in the following list. Names, telephone numbers, and Web sites are subject to change and are believed to be accurate and up-to-date as of the date of the Contract Documents.

ADAAG	Americans with Disabilities Act (ADA) Accessibility Guidelines for Buildings and Facilities Available from U.S. Access Board www.access-board.gov	(800) 872-2253
CFR	Code of Federal Regulations Available from Government Printing Office www.gpoaccess.gov/cfr/index.html	(866) 512-1800 (202) 512-1800
DOD	Department of Defense Military Specifications and Standards Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil	(215) 697-2664
FS	Federal Specification Available from Department of Defense Single Stock Point http://dodssp.daps.dla.mil Available from Defense Standardization Program www.dps.dla.mil Available from General Services Administration www.gsa.gov Available from National Institute of Building Sciences www.wbdg.org/ccb	(215) 697-2664 (202) 619-8925 (202) 289-7800
UFAS	Uniform Federal Accessibility Standards Available from Access Board www.access-board.gov	(800) 872-2253 (202) 272-0080

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 014200

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for selection of products for use in Project; product delivery, storage, and handling; manufacturers' standard warranties on products; special warranties; and comparable products.
- B. Related Sections:
 - 1. Division 01 Section "Allowances" for products selected under an allowance.
 - 2. Division 01 Section "Alternates" for products selected under an alternate.
 - 3. Division 01 Section "Substitution Procedures" for requests for substitutions.
 - 4. Division 01 Section "References" for applicable industry standards for products specified.

1.3 DEFINITIONS

- A. Products: Items obtained for incorporating into the Work. The term "product" includes the terms "material," "equipment," "system," and terms of similar intent.
 - 1. Named Products: Items identified by manufacturer's product name, including make or model number or other designation shown or listed in manufacturer's published product literature that is current as of date of the Contract Documents.
 - 2. New Products: Items that have not previously been incorporated into another project or facility. Products salvaged or recycled from other projects are not considered new products.
 - 3. Comparable Product: Product that is demonstrated and approved through submittal process, or where approved as a product substitution, to have the indicated qualities related to type, function, dimension, in-service

performance, physical properties, appearance, and other characteristics that equal or exceed those of specified product.

- B. Substitutions: Changes in products, materials, equipment, and methods of construction from those required by the Contract Documents and proposed by Contractor.
- C. Basis-of-Design Product Specification: A specification in which a specific manufacturer's product is named, including make or model number or other designation, to establish the significant qualities related to type, function, dimension, in-service performance, physical properties, appearance, and other characteristics for purposes of evaluating comparable products of additional manufacturers named in the specification.

1.4 SUBMITTALS

- A. Product List: Submit a list, in tabular form, showing specified products. Include generic names of products required. Include manufacturer's name and proprietary product names for each product.
 - 1. Coordinate product list with Contractor's Construction Schedule and the Submittals Schedule.
 - 2. Form: Tabulate information for each product under the following column headings:
 - a. Specification Section number and title.
 - b. Generic name used in the Contract Documents.
 - c. Proprietary name, model number, and similar designations.
 - d. Manufacturer's name and address.
 - e. Supplier's name and address.
 - f. Installer's name and address.
 - g. Projected delivery date or time span of delivery period.
 - h. Identification of items that require early submittal approval for scheduled delivery date.
 - 3. Completed List: Within 30 days after date of commencement of the Work, submit copies of completed product list in accordance with Section 013300. Include a written explanation for omissions of data and for variations from Contract requirements.
 - 4. Engineer's Action: Engineer will respond in writing to Contractor as indicated in Section 013300. Engineer's response will include a list of unacceptable product selections and a brief explanation of reasons for this

action. Engineer's response, or lack of response, does not constitute a waiver of requirement to comply with the Contract Documents.

B. Substitution Requests: Submit copies of each request for consideration in accordance with Section 013300. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.

1. Documentation: Show compliance with requirements for substitutions and the following, as applicable:

- a. Statement indicating why specified material or product cannot be provided.
- b. Coordination information, including a list of changes or modifications needed to other parts of the Work and to construction performed by Owner and separate contractors that will be necessary to accommodate proposed substitution.
- c. Detailed comparison of significant qualities of proposed substitution with those of the Work specified. Significant qualities may include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
- d. Product Data, including drawings and descriptions of products and fabrication and installation procedures.
- e. Samples, where applicable or requested.
- f. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners.
- g. Material test reports from a qualified testing agency indicating and interpreting test results for compliance with requirements indicated.
- h. Research/evaluation reports evidencing compliance with building code in effect for Project, from a model code organization acceptable to authorities having jurisdiction.
- i. Detailed comparison of Contractor's Construction Schedule using proposed substitution with products specified for the Work, including effect on the overall Contract Time. If specified product or method of construction cannot be provided within the Contract Time, include letter from manufacturer, on manufacturer's letterhead, stating lack of availability or delays in delivery.
- j. Cost information, including a proposal of change, if any, in the Contract Sum.
- k. Contractor's certification that proposed substitution complies with requirements in the Contract Documents and is appropriate for applications indicated.
- l. Contractor's waiver of rights to additional payment or time that may subsequently become necessary because of failure of proposed substitution to produce indicated results.

2. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation and notify Contractor of acceptance or rejection of proposed substitution in accordance with Section 013300.
- C. Comparable Product Requests: Submit copies of each request for consideration in accordance with Section 013300. Identify product or fabrication or installation method to be replaced. Include Specification Section number and title and Drawing numbers and titles.
 1. Engineer's Action: If necessary, Engineer will request additional information or documentation for evaluation and notify Contractor of acceptance or rejection of proposed comparable product in accordance with Section 013300.
- D. Basis-of-Design Product Specification Submittal: Comply with requirements in Division 01 Section "Submittal Procedures." Show compliance with requirements.

1.5 QUALITY ASSURANCE

- A. Compatibility of Options: If Contractor is given option of selecting between two or more products for use on Project, select product compatible with products previously selected, even if previously selected products were also options.

1.6 PRODUCT DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, and handle products using means and methods that will prevent damage, deterioration, and loss, including theft and vandalism. Comply with manufacturer's written instructions.
- B. Delivery and Handling:
 1. Schedule delivery to minimize long-term storage at Project site and to prevent overcrowding of construction spaces.
 2. Coordinate delivery with installation time to ensure minimum holding time for items that are flammable, hazardous, easily damaged, or sensitive to deterioration, theft, and other losses.
 3. Deliver products to Project site in an undamaged condition in manufacturer's original sealed container or other packaging system, complete with labels and instructions for handling, storing, unpacking, protecting, and installing.
 4. Inspect products upon delivery to determine compliance with the Contract Documents and to determine that products are undamaged and properly protected.

C. Storage:

1. Store products to allow for inspection and measurement of quantity or counting of units.
2. Store materials in a manner that will not endanger Project structure.
3. Store products that are subject to damage by the elements, under cover in a weathertight enclosure above ground, with ventilation adequate to prevent condensation.
4. Comply with product manufacturer's written instructions for temperature, humidity, ventilation, exposure to sunlight, and weather-protection requirements for storage.
5. Protect stored products from damage and liquids from freezing.
6. Provide a secure location and enclosure at Project site for storage of materials and equipment. Coordinate location with Owner.
7. Provide periodic rotation or movement of equipment as required by manufacturer.

1.7 PRODUCT WARRANTIES

- A. Warranties specified in other Sections shall be in addition to, and run concurrent with other warranties required by the Contract Documents. Manufacturer's disclaimers and limitations on product warranties do not relieve Contractor of obligations under requirements of the Contract Documents.
1. Manufacturer's Warranty: Written warranty furnished by individual manufacturer for a particular product and specifically endorsed by manufacturer to Owner.
 2. Special Warranty: Written warranty required by, or incorporated into, the Contract Documents, either to extend time limit provided by manufacturer's warranty or to provide more rights for Owner.
- B. Special Warranties: Prepare a written document that contains appropriate terms and identification, ready for execution. Submit a draft for approval before final execution.
1. Manufacturer's Standard Form: Modified to include Project-specific information and properly executed.
 2. Specified Form: When specified forms are included with the Specifications, prepare a written document using indicated form properly executed.
 3. Refer to Divisions 02 through 46 Sections for specific content requirements and particular requirements for submitting special warranties.
- C. Submittal Time: Comply with requirements in Division 01 Section "Closeout Procedures."

PART 2 - PRODUCTS

2.1 PRODUCT SELECTION PROCEDURES

- A. General Product Requirements: Provide products that comply with the Contract Documents, that are undamaged and, unless otherwise indicated, that are new at time of installation.
1. Provide products complete with accessories, trim, finish, fasteners, and other items needed for a complete installation and indicated use and effect.
 2. Standard Products: If available, and unless custom products or nonstandard options are specified, provide standard products of types that have been produced and used successfully in similar situations on other projects.
 3. Owner reserves the right to limit selection to products with warranties not in conflict with requirements of the Contract Documents.
 4. Descriptive, performance, and reference standard requirements in the Specifications establish salient characteristics of products.
 5. Or Equal: For products specified by name and accompanied by the term "or equal," or "or approved equal," or "or approved," comply with requirements in "Comparable Products" Article below to obtain approval for use of an unnamed product.
- B. Product Selection Procedures:
1. Product: Where Specifications name a single product and manufacturer, provide the named product that complies with requirements.
 2. Manufacturer/Source: Where Specifications name a single manufacturer or source, provide a product by the named manufacturer or source that complies with requirements.
 3. Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed that complies with requirements.
 4. Manufacturers: Where Specifications include a list of manufacturers' names, provide a product by one of the manufacturers listed that complies with requirements.
 5. Available Products: Where Specifications include a list of names of both products and manufacturers, provide one of the products listed, or an unnamed product, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.

6. Available Manufacturers: Where Specifications include a list of manufacturers, provide a product by one of the manufacturers listed, or an unnamed manufacturer, that complies with requirements. Comply with provisions in Part 2 "Comparable Products" Article for consideration of an unnamed product.
7. Product Options: Where Specifications indicate that sizes, profiles, and dimensional requirements on Drawings are based on a specific product or system, provide the specified product or system. Comply with provisions in Part 2 "Product Substitutions" Article for consideration of an unnamed product or system.
8. Basis-of-Design Product: Where Specifications name a product and include a list of manufacturers, provide the specified product or a comparable product by one of the other named manufacturers. Drawings and Specifications indicate sizes, profiles, dimensions, and other characteristics that are based on the product named. Comply with provisions in Part 2 "Comparable Products" Article below for consideration of an unnamed product by the other named manufacturers.

2.2 PRODUCT SUBSTITUTIONS

- A. All product substitutions shall be made in accordance with Division 01 Section "Substitution Procedures".

2.3 COMPARABLE PRODUCTS

- A. Conditions for Consideration: Engineer will consider Contractor's request for comparable product when the following conditions are satisfied. If the following conditions are not satisfied, Engineer may return requests without action, except to record noncompliance with these requirements:
 1. Evidence that the proposed product does not require revisions to the Contract Documents that it is consistent with the Contract Documents, and will produce the indicated results, and that it is compatible with other portions of the Work.
 2. Detailed comparison of significant qualities of proposed product with those named in the Specifications. Significant qualities include attributes such as performance, weight, size, durability, visual effect, and specific features and requirements indicated.
 3. Evidence that proposed product provides specified warranty.
 4. List of similar installations for completed projects with project names and addresses and names and addresses of Engineers and owners, if requested.
 5. Samples, if requested.

PART 3 - EXECUTION (Not Used)

END OF SECTION 016000

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general administrative and procedural requirements governing execution of the Work including, but not limited to, the following:
 - 1. Construction layout.
 - 2. Field engineering and surveying.
 - 3. Installation of the Work.
 - 4. Cutting and patching.
 - 5. Progress cleaning.
 - 6. Starting and adjusting.
 - 7. Protection of installed construction.
 - 8. Correction of the Work.
- B. Related Sections:
 - 1. Division 01 Section "Submittal Procedures".
 - 2. Division 01 Section "Project Management and Coordination" for procedures for coordinating field engineering with other construction activities.
 - 3. Division 01 Section "Closeout Procedures" for submitting final property survey with Project Record Documents, recording of Owner-accepted deviations from indicated lines and levels, and final cleaning.

1.3 DEFINITIONS

- A. Cutting: Removal of in-place construction necessary to permit installation or performance of other work.
- B. Patching: Fitting and repair work required to restore construction to original conditions after installation of other work.

1.4 QUALITY ASSURANCE

- A. Land Surveyor Qualifications: A professional land surveyor who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing land-surveying services of the kind indicated.
- B. Manufacturer's Installation Instructions: Obtain and maintain on-site manufacturer's written recommendations and instructions for installation of products and equipment.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. In-Place Materials: Use materials for patching identical to in-place materials. For exposed surfaces, use materials that visually match in-place adjacent surfaces to the fullest extent possible.
 - 1. If identical materials are unavailable or cannot be used, use materials that, when installed, will provide a match acceptable to the Engineer for the visual and functional performance of in-place materials.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Existing Conditions: The existence and location of site improvements, utilities, and other construction indicated as existing are not guaranteed. Before beginning work, investigate and verify the existence and location of all structures, underground utilities, mechanical and electrical systems, and other construction affecting the Work.

3.2 PREPARATION

- A. Existing Utility Information: Furnish information to local utility and/or Owner that is necessary to adjust, move, or relocate existing utility structures, utility poles, lines, services, or other utility appurtenances located in or affected by construction. Coordinate with authorities having jurisdiction.
- B. Field Measurements: Take field measurements as required to fit the Work properly. Recheck measurements before installing each product. Where portions of the Work are indicated to fit to other construction, verify dimensions of other construction by field measurements before fabrication. Coordinate fabrication schedule with construction progress to avoid delaying the Work.
- C. Space Requirements: Verify space requirements and dimensions of items shown diagrammatically on Drawings.
- D. Review of Contract Documents and Field Conditions: Immediately upon discovery of the need for clarification of the Contract Documents caused by differing field conditions outside the control of the Contractor, submit a request for information to Engineer according to requirements in Division 01 Section "Project Management and Coordination." Include a detailed description of problem encountered, together with recommendations for changing the Contract Documents.

3.3 FIELD ENGINEERING

- A. Identification: Contractor shall identify existing or establish benchmarks, control points, and property corners as necessary.
- B. Reference Points: Locate existing permanent benchmarks, control points, and similar reference points before beginning the Work. Preserve and protect permanent benchmarks and control points during construction operations.
 - 1. Do not change or relocate existing benchmarks or control points without prior written approval of Engineer. Report lost or destroyed permanent benchmarks or control points promptly. Report the need to relocate permanent benchmarks or control points to Engineer before proceeding.
 - 2. Replace lost or destroyed permanent benchmarks and control points promptly. Base replacements on the original survey control points.
- C. Certified Survey: Upon completion of foundation walls, major site improvements, and other work requiring field-engineering services, prepare a certified survey showing dimensions, locations, angles, and elevations of construction and sitework.

3.4 INSTALLATION

- A. General: Locate the Work and components of the Work accurately, in correct alignment and elevation, as indicated.
 - 1. Make vertical work plumb and make horizontal work level.
 - 2. Where space is limited, install components to maximize space available for maintenance and ease of removal for replacement.
 - 3. Conceal pipes, ducts, and wiring in finished areas, unless otherwise indicated.
- B. Comply with manufacturer's written instructions and recommendations for installing products in applications indicated.
- C. Install products at the time and under conditions that will ensure the best possible results. Maintain conditions required for product performance until Substantial Completion.
- D. Conduct construction operations so no part of the Work is subjected to damaging operations or loading in excess of that expected during normal conditions of occupancy.
- E. Tools and Equipment: Do not use tools or equipment that produce harmful noise levels.
- F. Templates: Obtain and distribute to the parties involved templates for work specified to be factory prepared and field installed. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing products to comply with indicated requirements.
- G. Attachment: Provide blocking, attachment plates, anchors and fasteners of adequate size and number to securely anchor each component in place, accurately located and aligned with other portions of the Work. Where size and type of attachments are not indicated, verify size and type required for load conditions.
 - 1. Mounting Heights: Where mounting heights are not indicated, mount components at heights directed by Engineer.
 - 2. Allow for structure movement, including thermal expansion and contraction.
 - 3. Coordinate installation of anchorages. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

- H. Joints: Make joints of uniform width. Where joint locations in exposed work are not indicated, arrange joints for the best visual effect. Fit exposed connections together to form hairline joints.
- I. Hazardous Materials: Use products, cleaners, and installation materials that are not considered hazardous.

3.5 PROGRESS CLEANING

- A. General: Clean Project site and work areas daily. Enforce requirements strictly. Dispose of materials lawfully.
 - 1. Comply with requirements in NFPA 241 for removal of combustible waste materials and debris.
 - 2. Do not hold waste materials more than seven days during normal weather or three days if the temperature is expected to rise above 80 degrees F.
 - 3. Containerize hazardous and unsanitary waste materials separately from other waste. Mark containers appropriately and dispose of legally, according to regulations.
 - a. Utilize containers intended for holding waste materials of type to be stored.
- B. Site: Maintain Project site free of waste materials and debris.
- C. Work Areas: Clean areas where work is in progress to the level of cleanliness necessary for proper execution of the Work.
 - 1. Remove liquid spills promptly.
 - 2. Where dust would impair proper execution of the Work, broom-clean or vacuum the entire work area, as appropriate.
- D. Installed Work: Keep installed work clean. Clean installed surfaces according to written instructions of manufacturer or fabricator of product installed, using only cleaning materials specifically recommended. If specific cleaning materials are not recommended, use cleaning materials that are not hazardous to health or property and that will not damage exposed surfaces.
- E. Concealed Spaces: Remove debris from concealed spaces before enclosing the space.
- F. Exposed Surfaces in Finished Areas: Clean exposed surfaces and protect as necessary to ensure freedom from damage and deterioration at time of Substantial Completion.

- G. Waste Disposal: Do not bury or burn waste materials on-site. Do not wash waste materials down sewers or into waterways. Comply with waste disposal requirements in Division 01 Section "Construction Waste Management".
- H. During handling and installation, clean and protect construction in progress and adjoining materials already in place. Apply protective covering where required to ensure protection from damage or deterioration at Substantial Completion.
- I. Clean and provide maintenance on completed construction as frequently as necessary through the remainder of the construction period. Adjust and lubricate operable components to ensure operability without damaging effects.
- J. Limiting Exposures: Supervise construction operations to assure that no part of the construction, completed or in progress, is subject to harmful, dangerous, damaging, or otherwise deleterious exposure during the construction period.

3.6 PROTECTION OF INSTALLED CONSTRUCTION

- A. Provide final protection and maintain conditions that ensure installed Work is without damage or deterioration at time of Substantial Completion.
- B. Comply with manufacturer's written instructions for temperature and relative humidity.

3.7 CORRECTION OF THE WORK

- A. Repair or remove and replace defective construction. Restore damaged substrates and finishes.
 - 1. Repairing includes replacing defective parts, refinishing damaged surfaces, touching up with matching materials, and properly adjusting operating equipment.
- B. Restore permanent facilities used during construction to their specified condition.
- C. Remove and replace damaged surfaces that are exposed to view if surfaces cannot be repaired without visible evidence of repair.
- D. Repair components that do not operate properly. Remove and replace operating components that cannot be repaired.

END OF SECTION 017000

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for the following:
 - 1. Salvaging nonhazardous demolition and construction waste.
 - 2. Recycling nonhazardous demolition and construction waste.
 - 3. Disposing of nonhazardous demolition and construction waste.
- B. Related Sections:
 - 1. Division 02 Section "Demolition" for disposition of waste resulting from demolition of buildings, structures, and site improvements, and for disposition of hazardous waste.

1.3 DEFINITIONS

- A. Construction Waste: Building and site improvement materials and other solid waste resulting from construction, remodeling, renovation, or repair operations. Construction waste includes packaging.
- B. Demolition Waste: Building and site improvement materials resulting from demolition or selective demolition operations.
- C. Disposal: Removal off-site of demolition and construction waste and subsequent sale, recycling, reuse, or deposit in landfill or incinerator acceptable to authorities having jurisdiction.
- D. Recycle: Recovery of demolition or construction waste for subsequent processing in preparation for reuse.
- E. Salvage: Recovery of demolition or construction waste and subsequent sale or reuse in another facility.
- F. Salvage and Reuse: Recovery of demolition or construction waste and subsequent incorporation into the Work.

1.4 PERFORMANCE REQUIREMENTS (Not Used)

1.5 SUBMITTALS (Not Used)

1.6 QUALITY ASSURANCE

- A. Regulatory Requirements: Comply with hauling and disposal regulations of authorities having jurisdiction.
- B. Waste Management Conference: Conduct conference at Project site. Review methods and procedures related to waste management including, but not limited to, the following:
 - 1. Review and discuss waste management plan including responsibilities of Contractor's waste management coordinator.
 - 2. Review requirements for documenting each type of waste and its disposition.
 - 3. Review and finalize procedures for materials separation and verify availability of containers and bins needed to avoid delays.
 - 4. Review procedures for periodic waste collection and transportation to recycling and disposal facilities.
 - 5. Review waste management requirements for each trade.

1.7 WASTE MANAGEMENT PLAN

- A. General: Develop a waste management plan consisting of waste identification, waste reduction work plan, and cost/revenue analysis. Indicate quantities by weight or volume, but use same units of measure throughout waste management plan.
- B. Waste Identification: Indicate anticipated types and quantities of demolition, site-clearing, and construction waste generated by the Work. Include estimated quantities and assumptions for estimates.
- C. Waste Reduction Work Plan: List each type of waste and whether it will be salvaged, recycled, or disposed of in landfill or incinerator. Include points of waste generation, total quantity of each type of waste, quantity for each means of recovery, and handling and transportation procedures.
 - 1. Salvaged Materials for Reuse: For materials that will be salvaged and reused in this Project, describe methods for preparing salvaged materials before incorporation into the Work.
 - 2. Salvaged Materials for Sale: For materials that will be sold to individuals and organizations, include list of their names, addresses, and telephone numbers.

3. Salvaged Materials for Donation: For materials that will be donated to individuals and organizations, include list of their names, addresses, and telephone numbers.
 4. Recycled Materials: Include list of local receivers and processors and type of recycled materials each will accept. Include names, addresses, and telephone numbers.
 5. Disposed Materials: Indicate how and where materials will be disposed of. Include name, address, and telephone number of each landfill and incinerator facility.
 6. Handling and Transportation Procedures: Include method that will be used for separating recyclable waste including sizes of containers, container labeling, and designated location on Project site where materials separation will be located.
- D. Cost/Revenue Analysis: Indicate total cost of waste disposal as if there was no waste management plan and net additional cost or net savings resulting from implementing waste management plan. Include the following:
1. Total quantity of waste.
 2. Estimated cost of disposal (cost per unit). Include hauling and tipping fees and cost of collection containers for each type of waste.
 3. Total cost of disposal (with no waste management).
 4. Revenue from salvaged materials.
 5. Revenue from recycled materials.
 6. Savings in hauling and tipping fees by donating materials.
 7. Savings in hauling and tipping fees that are avoided.
 8. Handling and transportation costs. Include cost of collection containers for each type of waste.
 9. Net additional cost or net savings from waste management plan.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION

3.1 PLAN IMPLEMENTATION

- A. General: Implement approved waste management plan. Provide handling, containers, storage, signage, transportation, and other items as required to implement waste management plan during the entire duration of the Contract.
1. Comply with Division 01 Section "Temporary Facilities and Controls" for operation, termination, and removal requirements.
- B. Training: Train workers, subcontractors, and suppliers on proper waste management procedures, as appropriate for the Work occurring at Project site.

1. Distribute waste management plan to everyone concerned within three days of submittal return.
 2. Distribute waste management plan to entities when they first begin work on-site. Review plan procedures and locations established for salvage, recycling, and disposal.
- C. Site Access and Temporary Controls: Conduct waste management operations to ensure minimum interference with roads, streets, walks, walkways, and other adjacent occupied and used facilities.
1. Designate and label specific areas on Project site necessary for separating materials that are to be salvaged, recycled, reused, donated, and sold.
 2. Comply with Division 01 Section "Temporary Facilities and Controls" for controlling dust and dirt, environmental protection, and noise control.

3.2 SALVAGING DEMOLITION WASTE

- A. Salvaged Items for Reuse in the Work: Salvage items for reuse and handle as follows:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until installation.
 4. Protect items from damage during transport and storage.
 5. Install salvaged items to comply with installation requirements for new materials and equipment. Provide connections, supports, and miscellaneous materials necessary to make items functional for use indicated.
- B. Salvaged Items for Sale and Donation: Not permitted on Project site.
- C. Salvaged Items for Owner's Use: Salvage items for Owner's use and handle as follows:
1. Clean salvaged items.
 2. Pack or crate items after cleaning. Identify contents of containers.
 3. Store items in a secure area until delivery to Owner.
 4. Transport items to Owner's storage area as designated by Owner.
 5. Protect items from damage during transport and storage.
- D. Doors and Hardware: Brace open end of door frames. Except for removing door closers, leave door hardware attached to doors.
- E. Equipment: Drain tanks, piping, and fixtures. Seal openings with caps or plugs. Protect equipment from exposure to weather.

- F. Plumbing Fixtures: Separate by type and size.
- G. Lighting Fixtures: Separate lamps by type and protect from breakage.
- H. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.

3.3 RECYCLING DEMOLITION AND CONSTRUCTION WASTE, GENERAL

- A. General: Recycle paper and beverage containers used by on-site workers.
- B. Recycling Incentives: Revenues, savings, rebates, tax credits, and other incentives received for recycling waste materials shall accrue to Contractor.
- C. Preparation of Waste: Prepare and maintain recyclable waste materials according to recycling or reuse facility requirements. Maintain materials free of dirt, adhesives, solvents, petroleum contamination, and other substances deleterious to the recycling process.
- D. Procedures: Separate recyclable waste from other waste materials, trash, and debris. Separate recyclable waste by type at Project site to the maximum extent practical.
 - 1. Provide appropriately marked containers or bins for controlling recyclable waste until they are removed from Project site. Include list of acceptable and unacceptable materials at each container and bin.
 - a. Inspect containers and bins for contamination and remove contaminated materials if found.
 - 2. Stockpile processed materials on-site without intermixing with other materials. Place, grade, and shape stockpiles to drain surface water. Cover to prevent windblown dust.
 - 3. Stockpile materials away from construction area. Do not store within drip line of remaining trees.
 - 4. Store components off the ground and protect from the weather.
 - 5. Remove recyclable waste off Owner's property and transport to recycling receiver or processor.

3.4 RECYCLING DEMOLITION WASTE

- A. Asphaltic Concrete Paving: Grind asphalt to maximum 1-1/2-inch size.
 - 1. Crush asphaltic concrete paving and screen to comply with requirements in Division 31 Section "Earth Moving" for use as general fill.

- B. Asphaltic Concrete Paving: Break up and transport paving to asphalt-recycling facility.
- C. Concrete: Remove reinforcement and other metals from concrete and sort with other metals.
 - 1. Pulverize concrete to maximum 1-1/2-inch size.
 - 2. Crush concrete and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.
- D. Masonry: Remove metal reinforcement, anchors, and ties from masonry and sort with other metals.
 - 1. Pulverize masonry to maximum 1-1/2-inch size.
 - a. Crush masonry and screen to comply with requirements in Division 31 Section "Earth Moving" for use as satisfactory soil for fill or subbase.
 - 2. Clean and stack undamaged, whole masonry units on wood pallets.
- E. Wood Materials: Sort and stack members according to size, type, and length. Separate lumber, engineered wood products, panel products, and treated wood materials.
- F. Metals: Separate metals by type.
 - 1. Structural Steel: Stack members according to size, type of member, and length.
 - 2. Remove and dispose of bolts, nuts, washers, and other rough hardware.
- G. Asphalt Shingle Roofing: Separate organic and glass-fiber asphalt shingles and felts. Remove and dispose of nails, staples, and accessories.
- H. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location. Remove edge trim and sort with other metals. Remove and dispose of fasteners.
- I. Acoustical Ceiling Panels and Tile: Stack large clean pieces on wood pallets and store in a dry location.
- J. Metal Suspension System: Separate metal members including trim, and other metals from acoustical panels and tile and sort with other metals.
- K. Piping: Reduce piping to straight lengths and store by type and size. Separate supports, hangers, valves, sprinklers, and other components by type and size.

- L. Electrical Devices: Separate switches, receptacles, switchgear, transformers, meters, panelboards, circuit breakers, and other devices by type.
- M. Conduit: Reduce conduit to straight lengths and store by type and size.

3.5 RECYCLING CONSTRUCTION WASTE

- A. Packaging:
 - 1. Cardboard and Boxes: Break down packaging into flat sheets. Bundle and store in a dry location.
 - 2. Polystyrene Packaging: Separate and bag materials.
 - 3. Pallets: As much as possible, require deliveries using pallets to remove pallets from Project site. For pallets that remain on-site, break down pallets into component wood pieces and comply with requirements for recycling wood.
 - 4. Crates: Break down crates into component wood pieces and comply with requirements for recycling wood.
- B. Site-Clearing Wastes: Chip brush, branches, and trees on-site, if permitted by Owner, or at landfill facility.
 - 1. Comply with requirements in other specification sections for use of chipped organic waste as organic mulch.
- C. Wood Materials:
 - 1. Clean Cut-Offs of Lumber: Grind or chip into small pieces.
 - 2. Clean Sawdust: Bag sawdust that does not contain painted or treated wood.
 - a. Comply with requirements in other specification sections for use of clean sawdust as organic mulch.
- D. Gypsum Board: Stack large clean pieces on wood pallets or in container and store in a dry location.
 - 1. Clean Gypsum Board: Grind scraps of clean gypsum board using small mobile chipper or hammer mill. Screen out paper after grinding.
 - a. Comply with requirements in other specification sections for use of clean ground gypsum board as inorganic soil amendment.

3.6 DISPOSAL OF WASTE

- A. General: Except for items or materials to be salvaged, recycled, or otherwise reused, remove waste materials from Project site and legally dispose of them in a landfill or incinerator acceptable to authorities having jurisdiction.
 - 1. Except as otherwise specified, do not allow waste materials that are to be disposed of accumulate on-site.
 - 2. Remove and transport debris in a manner that will prevent spillage on adjacent surfaces and areas.
- B. Burning: Do not burn waste materials.
- C. Disposal: Transport waste materials off Owner's property and legally dispose of them.

END OF SECTION 017419

SECTION 017700

CLOSEOUT PROCEDURES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for contract closeout, including, but not limited to, the following:
 - 1. Substantial Completion procedures.
 - 2. Final completion procedures.
 - 3. Warranties.
 - 4. Final cleaning.
- B. Related Sections:
 - 1. Division 01 Section "Execution Requirements" for progress cleaning of Project site.
 - 2. Division 01 Section "Project Record Documents" for submitting Record Drawings, Record Specifications, and Record Product Data.
 - 3. Divisions 02 through 46 Sections for specific closeout and special cleaning requirements for the Work in those Sections.

1.3 SUBSTANTIAL COMPLETION

- A. Preliminary Procedures: Before requesting inspection for determining date of Substantial Completion, complete the following. List items below that are incomplete with request.
 - 1. Prepare a list of items to be completed and corrected (punch list), the value of items on the list, and reasons why the Work is not complete.
 - 2. Advise Owner of pending insurance changeover requirements.
 - 3. Submit specific warranties, workmanship bonds, maintenance service agreements, final certifications, and similar documents.

4. Obtain and submit releases permitting Owner unrestricted use of the Work and access to services and utilities. Include occupancy permits, operating certificates, and similar releases.
 5. Prepare and submit Project Record Documents, operation and maintenance manuals, property surveys, and similar final record information.
 6. Deliver tools, spare parts, extra materials, and similar items to location designated by Owner. Label with manufacturer's name and model number where applicable.
 7. Make final changeover of permanent locks and deliver keys to Owner. Advise Owner's personnel of changeover in security provisions.
 8. Complete startup testing of systems.
 9. Submit test/adjust/balance records.
 10. Terminate and remove temporary facilities from Project site, along with construction tools, and similar elements.
 11. Advise Owner of changeover in heat and other utilities.
 12. Submit changeover information related to Owner's occupancy, use, operation, and maintenance.
 13. Complete final cleaning requirements, including touchup painting.
 14. Touch up and otherwise repair and restore marred exposed finishes to eliminate visual defects.
- B. Inspection: Submit a written request for inspection for Substantial Completion. Upon receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare the Certificate of Substantial Completion after inspection or will notify Contractor of items, either on Contractor's list or additional items identified by Engineer, that must be completed or corrected before certificate will be issued.
1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.
 2. Results of completed inspection will form the basis of requirements for final completion.

1.4 FINAL COMPLETION

- A. Preliminary Procedures: Before requesting final inspection for determining final completion, complete the following:
 - 1. Submit a final Application for Payment according to Division 01 Section "Payment Procedures."
 - 2. Submit evidence of final, continuing insurance coverage complying with insurance requirements.
 - 3. Instruct Owner's personnel in operation, adjustment, and maintenance of products, equipment, and systems.
- B. Inspection: Submit a written request for final inspection for acceptance. On receipt of request, Engineer will either proceed with inspection or notify Contractor of unfulfilled requirements. Engineer will prepare a final Certificate for Payment after inspection or will notify Contractor of construction that must be completed or corrected before certificate will be issued.
 - 1. Reinspection: Request reinspection when the Work identified in previous inspections as incomplete is completed or corrected.

1.5 WARRANTIES

- A. Submittal Time: Submit written warranties on request of Engineer for designated portions of the Work where commencement of warranties other than date of Substantial Completion is indicated.
- B. Partial Occupancy: Submit properly executed warranties within 15 days of completion of designated portions of the Work that are completed and occupied or used by Owner during construction period by separate agreement with Contractor.
- C. Organize warranty documents into an orderly sequence based on the table of contents of the Project Manual.
 - 1. Bind warranties and bonds in heavy-duty, three-ring, vinyl-covered, loose-leaf binders, thickness as necessary to accommodate contents, and sized to receive 8-1/2-by-11-inch paper.
 - 2. Provide heavy paper dividers with plastic-covered tabs for each separate warranty. Mark tab to identify the product or installation. Provide a typed description of the product or installation, including the name of the product and the name, address, and telephone number of Installer.
 - 3. Identify each binder on the front and spine with the typed or printed title "WARRANTIES," Project name, and name of Contractor.

4. Scan warranties and bonds and assemble complete warranty and bond submittal package into a single indexed electronic PDF file with links enabling navigation to each item. Provide table of contents at beginning of document.
- D. Provide additional copies of each warranty to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Cleaning Agents: Use cleaning materials and agents recommended by manufacturer or fabricator of the surface to be cleaned. Do not use cleaning agents that are potentially hazardous to health or property or that might damage finished surfaces.

PART 3 - EXECUTION

3.1 FINAL CLEANING

- A. General: Perform final cleaning. Conduct cleaning and waste-removal operations to comply with local laws and ordinances and Federal and local environmental and antipollution regulations.
 1. Complete the following cleaning operations before requesting inspection for certification of Substantial Completion for entire Project or for a portion of Project:
 - a. Clean Project site, yard, and grounds, in areas disturbed by construction activities, including landscape development areas, of rubbish, waste material, litter, and other foreign substances.
 - b. Sweep paved areas broom clean. Remove petrochemical spills, stains, and other foreign deposits.
 - c. Rake grounds that are neither planted nor paved to a smooth, even-textured surface.
 - d. Remove tools, construction equipment, machinery, and surplus material from Project site.
 - e. As necessary, remove snow and ice to provide safe access to the work area.
 - f. Clean exposed exterior and interior hard-surfaced finishes to a dirt-free condition, free of stains, films, and similar foreign substances.

Avoid disturbing natural weathering of exterior surfaces. Restore reflective surfaces to their original condition.

- g. Remove debris and surface dust from limited access spaces, including roofs, plenums, shafts, trenches, equipment vaults, manholes, attics, and similar spaces.
- h. Remove labels that are not permanent.
- i. Touch up and otherwise repair and restore marred, exposed finishes and surfaces. Replace finishes and surfaces that cannot be satisfactorily repaired or restored or that already show evidence of repair or restoration.
 - 1) Do not paint over "UL" and other required labels and identification, including mechanical and electrical nameplates.
- j. Wipe surfaces of mechanical and electrical equipment and similar equipment. Remove excess lubrication, paint and mortar droppings, and other foreign substances.
- k. Replace parts subject to operating conditions during construction that may impede operation or reduce longevity.
- l. Clean any and all plumbing fixtures to a sanitary condition, free of stains, including stains resulting from water exposure.
- m. Leave Project clean and ready for operation.

- B. Construction Waste Disposal: Comply with waste disposal requirements in the Modified General Conditions of this contract.

END OF SECTION 017700

(Standard Form Attached)

CONTRACTOR'S FINAL AFFIDAVIT AND WAIVER OF LIEN

PROJECT: Richalands WWTP Upgrades and
Improvements

OWNER:

TOWN OF RICHLANDS

TOWN OF RICHLANDS

CONTRACTOR:

CONTRACT AMOUNT:

STATE OF:

Virginia

CONTRACT DATE:

CITY OF:

Richlands

DATE:

This is to certify that all claims for labor, material, services and any other just claims arising out of the performance of this Contract have been satisfied, except for payment to subcontractors to be made out of retainage presently being held by the Owner, and that no claims or liens exist against this Contractor in connection with this contract; that to the best of our knowledge no claims or liens exist, and if any such claims or liens appear after payment of the retained amount due on the Contract, this Contractor shall save the Owner harmless on account thereof. After payment of the retained amount the undersigned does hereby waive, release and relinquish any and all claims or rights of lien presently held or hereafter accruing upon the above project.

CONTRACTOR:

BY:

TITLE:

Sworn to and subscribed before me this

day of

201

(Notary Public)

My Commission expires:

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for preparing operation and maintenance manuals, including the following:
 - 1. Operation and maintenance documentation directory.
 - 2. Operational components of manuals for systems, subsystems, and equipment.
 - 3. Product maintenance components of manuals.
 - 4. Systems and equipment maintenance manuals.
- B. Related Sections:
 - 1. Division 1 Section "Submittal Procedures" for submitting copies of submittals for operation and maintenance manuals.
 - 2. Division 1 Section "Closeout Procedures" for submitting operation and maintenance manuals.
 - 3. Division 1 Section "Project Record Documents" for preparing Record Drawings for operation and maintenance manuals.
 - 4. Divisions 2 through 46 Sections for specific operation and maintenance manual requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. System: An organized collection of parts, equipment, or subsystems united by regular interaction.
- B. Subsystem: A portion of a system with characteristics similar to a system.

1.4 SUBMITTALS

- A. Manual Content: Operations and maintenance manual content is specified in individual specification sections to be reviewed at the time of Section

submittals. Submit reviewed manual content formatted and organized as required by this Section.

1. Where applicable, clarify and update reviewed manual content to correspond to modifications and field conditions.

B. Format: Submit operations and maintenance manuals in the following format:

1. PDF electronic file of initial submittal and final submittal. Assemble each manual into a composite electronically-indexed file. Submit on digital media acceptable to Engineer.
 - a. Name each indexed document file in composite electronic index with applicable item name. Include a complete electronically-linked operation and maintenance directory.
 - b. Enable inserted reviewer comments on draft submittals.
2. Paper copies (for final submittal only): Include a complete operation and maintenance directory. Enclose title pages and directories in clear plastic sleeves.

C. Manual Submittal: Submit two (2) digital copies and three (3) paper copies of each manual in final form prior to requesting inspection for Substantial Completion and at least 15 days before commencing demonstration and training. Engineer will return copy with comments.

1. Correct or modify each manual to comply with Engineer's comments. Submit copies of each corrected manual within 15 days of receipt of Engineer's comments and prior to commencing demonstration and training.

1.5 COORDINATION

- A. Where operation and maintenance documentation includes information on installations by more than one factory-authorized service representative, assemble and coordinate information furnished by representatives and prepare manuals.

PART 2 - PRODUCTS

2.1 OPERATION AND MAINTENANCE DOCUMENTATION DIRECTORY

- A. Organization: Include a section in the directory for each of the following:
1. List of documents.
 2. List of systems.

3. List of equipment.
 4. Table of contents.
- B. List of Systems and Subsystems: List systems alphabetically. Include references to operation and maintenance manuals that contain information about each system.
- C. List of Equipment: List equipment for each system, organized alphabetically by system. For pieces of equipment not part of system, list alphabetically in separate list.
- D. Tables of Contents: Include a table of contents for each operation and maintenance manual.
- E. Identification: In the documentation directory and in each operation and maintenance manual, identify each system, subsystem, and piece of equipment with same designation used in the Contract Documents.

2.2 REQUIREMENTS FOR OPERATION AND MAINTENANCE MANUALS

- A. Organization: Unless otherwise indicated, organize each manual into a separate section for each system and subsystem, and a separate section for each piece of equipment not part of a system. Each manual shall contain the following materials, in the order listed:
1. Title page.
 2. Table of contents.
 3. Manual contents.
- B. Title Page: Enclose title page in transparent plastic sleeve. Include the following information:
1. Subject matter included in manual.
 2. Name and address of Project.
 3. Name and address of Owner.
 4. Date of submittal.
 5. Name and contact information for Contractor.
 6. Name and contact information for Engineer.
 7. Name and contact information for Equipment Manufacturer's Representative.
 8. Cross-reference to related systems in other operation and maintenance manuals.
- C. Table of Contents: List each product included in manual, identified by product name, indexed to the content of the volume, and cross-referenced to Specification Section number in Project Manual.

1. If operation or maintenance documentation requires more than one volume to accommodate data, include comprehensive table of contents for all volumes in each volume of the set.
- D. Manual Contents: Organize into sets of manageable size. Arrange contents alphabetically by system, subsystem, and equipment. If possible, assemble instructions for subsystems, equipment, and components of one system into a single binder.
- E. Manuals, Electronic Files: Submit manuals in the form of a multiple file composite electronic PDF file for each manual type required.
1. Electronic Files: Use electronic files prepared by manufacturer where available. Where scanning of paper documents is required, configure scanned file for minimum readable file size.
 2. File Names and Bookmarks: Enable bookmarking of individual documents based upon file names. Name document files to correspond to system, subsystem, and equipment names used in manual directory and table of contents. Group documents for each system and subsystem into individual composite bookmarked files, then create composite manual, so that resulting bookmarks reflect the system, subsystem, and equipment names in a readily navigated file tree. Configure electronic manual to display bookmark panel upon opening file.
- F. Manuals, Paper Copy: Submit manuals in the form of hard copy, bound and labeled volumes.
1. Binders: Heavy-duty, vinyl-covered, binders, in thickness necessary to accommodate contents, sized to hold 8-1/2-by-11-inch paper; with clear plastic sleeve on spine to hold label describing contents and with pockets inside covers to hold folded oversize sheets.
 - a. If two or more binders are necessary to accommodate data of a system, organize data in each binder into groupings by subsystem and related components. Cross-reference other binders if necessary to provide essential information for proper operation or maintenance of equipment or system.
 - b. Identify each binder on front and spine, with printed title "OPERATION AND MAINTENANCE MANUAL," Project title or name and subject matter of contents. Indicate volume number for multiple-volume sets.
 2. Dividers: Heavy-paper dividers with plastic-covered tabs for each section of the manual. Mark each tab to indicate contents. Include typed list of products and major components of equipment included in the section on each divider, cross-referenced to Specification Section number and title of Project Manual.

3. Protective Plastic Sleeves: Transparent plastic sleeves designed to enclose software storage media for computerized electronic equipment.
4. Supplementary Text: Prepared on 8-1/2-by-11-inch white bond paper.
5. Drawings: Attach reinforced, punched binder tabs on drawings and bind with text.
 - a. If oversize drawings are necessary, fold drawings to same size as text pages and use as foldouts.
 - b. If drawings are too large to be used as foldouts, fold and place drawings in labeled envelopes and bind envelopes in rear of manual. At appropriate locations in manual, insert typewritten pages indicating drawing titles, descriptions of contents, and drawing locations.

2.3 OPERATIONAL COMPONENTS OF MANUALS

- A. Content: In addition to requirements in this Section, include operation data required in individual Specification Sections and the following information:
 1. System, subsystem, and equipment descriptions. Use designations for systems and equipment indicated on Contract Documents.
 2. Operating standards.
 3. Operating procedures.
 4. Operating logs.
 5. Wiring diagrams.
 6. Control diagrams.
 7. Piped system diagrams.
 8. Precautions against improper use.
- B. Descriptions: Include the following:
 1. Product name and model number. Use designations for products indicated on Contract Documents.
 2. Manufacturer's name.
 3. Equipment identification with serial number of each component.
 4. Equipment function.
 5. Operating characteristics.
 6. Limiting conditions.
 7. Performance curves.
 8. Engineering data and tests.
 9. Complete nomenclature and number of replacement parts.
- C. Operating Procedures: Include the following, as applicable:
 1. Startup procedures.
 2. Equipment or system break-in procedures.
 3. Routine and normal operating instructions.

4. Regulation and control procedures.
 5. Normal shutdown instructions.
 6. Seasonal and weekend operating instructions.
 7. Required sequences for electric or electronic systems.
 8. Special operating instructions and procedures.
- D. Systems and Equipment Controls: Describe the sequence of operation, and diagram controls as installed.
- E. Piped Systems: Diagram piping as installed, and identify color-coding where required for identification.
- F. Emergency Instructions: Describe and explain warnings, trouble indications, error messages, and similar codes and signals. Include responsibilities of Owner's operating personnel for notification of Installer, supplier, and manufacturer to maintain warranties.
- G. Emergency Procedures: Include the following, as applicable:
1. Instructions on stopping.
 2. Shutdown instructions for each type of emergency.
 3. Operating instructions for conditions outside normal operating limits.

2.4 PRODUCT MAINTENANCE COMPONENTS OF MANUALS

- A. Content: Organize manual into a separate section for each product, material, and finish. Include source information, product information, maintenance procedures, repair materials and sources, and warranties and bonds, as described below.
- B. Source Information: List each product included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Product Information: Include the following, as applicable:
1. Product name and model number.
 2. Manufacturer's name.
 3. Material and chemical composition.
 4. Reordering information for specially manufactured products.
- D. Maintenance Procedures: Include manufacturer's written recommendations and the following:
1. Inspection procedures.

2. Schedule for routine maintenance.
 3. Repair instructions.
- E. Repair Materials and Sources: Include lists of materials and local sources of materials and related services.
- F. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
1. Include procedures to follow and required notifications for warranty claims.

2.5 SYSTEMS AND EQUIPMENT MAINTENANCE COMPONENTS OF MANUALS

- A. Content: For each system, subsystem, and piece of equipment not part of a system, include source information, manufacturers' maintenance documentation, maintenance procedures, maintenance and service schedules, spare parts list and source information, maintenance service contracts, and warranty and bond information, as described below.
- B. Source Information: List each system, subsystem, and piece of equipment included in manual, identified by product name and arranged to match manual's table of contents. For each product, list name, address, and telephone number of Installer or supplier and maintenance service agent, and cross-reference Specification Section number and title in Project Manual and drawing or schedule designation or identifier where applicable.
- C. Manufacturers' Maintenance Documentation: Manufacturers' maintenance documentation including the following information for each component part or piece of equipment:
1. Standard maintenance instructions and bulletins.
 2. Drawings, diagrams, and instructions required for maintenance, including disassembly and component removal, replacement, and assembly.
 3. Identification and nomenclature of parts and components.
 4. List of items recommended to be stocked as spare parts.
- D. Maintenance Procedures: Include the following information and items that detail essential maintenance procedures:
1. Test and inspection instructions.
 2. Troubleshooting guide.
 3. Precautions against improper maintenance.
 4. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 5. Aligning, adjusting, and checking instructions.
 6. Demonstration and training video recording, if available.

- E. Maintenance and Service Schedules: Include service and lubrication requirements, list of required lubricants for equipment, and separate schedules for preventive and routine maintenance and service with standard time allotment.
 - 1. Scheduled Maintenance and Service: Tabulate actions for daily, weekly, monthly, quarterly, semiannual, and annual frequencies.
 - 2. Maintenance and Service Record: Include manufacturers' forms for recording maintenance.
- F. Spare Parts List and Source Information: Include lists of replacement and repair parts, with parts identified and cross-referenced to manufacturers' maintenance documentation and local sources of maintenance materials and related services.
- G. Maintenance Service Contracts: Include copies of maintenance agreements with name and telephone number of service agent.
- H. Warranties and Bonds: Include copies of warranties and bonds and lists of circumstances and conditions that would affect validity of warranties or bonds.
 - 1. Include procedures to follow and required notifications for warranty claims.

PART 3 - EXECUTION

3.1 MANUAL PREPARATION

- A. Operation and Maintenance Documentation Directory: Prepare a separate manual that provides an organized reference to operation, and maintenance manuals.
- B. Product Maintenance Components of Manuals: Assemble a complete set of maintenance data indicating care and maintenance of each product, material, and finish incorporated into the Work.
- C. Operational Components of Manuals: Assemble a complete set of operational data indicating operation of each system, subsystem, and piece of equipment not part of a system.
 - 1. Engage a factory-authorized service representative to assemble and prepare information for each system, subsystem, and piece of equipment not part of a system.
 - 2. Prepare a separate manual for each system and subsystem, in the form of an instructional manual for use by Owner's operating personnel.

- D. Manufacturers' Data: Where manuals contain manufacturers' standard printed data, include only sheets pertinent to product or component installed. Mark each sheet to identify each product or component incorporated into the Work. If data include more than one item in a tabular format, identify each item using appropriate references from the Contract Documents. Identify data applicable to the Work and delete references to information not applicable.
1. Prepare supplementary text if manufacturers' standard printed data are not available and where the information is necessary for proper operation and maintenance of equipment or systems.
- E. Drawings: Prepare drawings supplementing manufacturers' printed data to illustrate the relationship of component parts of equipment and systems and to illustrate control sequence and flow diagrams. Coordinate these drawings with information contained in Record Drawings to ensure correct illustration of completed installation.
1. Do not use original Project Record Documents as part of operation and maintenance manuals.
 2. Comply with requirements of newly prepared Record Drawings in Division 01 Section "Project Record Documents."
- F. Comply with Division 01 Section "Closeout Procedures" for schedule for submitting operation and maintenance documentation.

END OF SECTION 017823

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for project record documents, including the following:
 - 1. Record Drawings.
 - 2. Miscellaneous record submittals.
- B. Related Sections:
 - 1. Division 01 Section "Closeout Procedures" for general closeout procedures.
 - 2. Divisions 02 through 46 Sections for specific requirements for project record documents of the Work in those Sections.

1.3 SUBMITTALS

- A. Record Drawings: Comply with the following:
 - 1. Number of Copies: Submit one set of marked-up record prints and one digital copy as described below.
- B. Miscellaneous Record Submittals: Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Submit one paper copy and one digital copy of each submittal as described below.
- C. As-Built Survey & Drawings: Contractor shall provide an as-built survey prepared under the direction of a licensed surveyor of the installed water line before the project is eligible for a final walk-through.

1.4 PRODUCTS

- A. Not used.

1.5 RECORD DRAWINGS

- A. Record Prints: Maintain one set of marked-up paper copies of the Contract Drawings and Shop Drawings.

1. Preparation: Mark record prints to show the actual installation where installation varies from that shown originally. Require individual or entity who obtained record data, whether individual or entity is Installer, subcontractor, or similar entity, to provide information for preparation of corresponding marked-up record prints.
 - a. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later.
 - b. Accurately record information in an understandable drawing technique.
 - c. Record data as soon as possible after obtaining it.
 - d. Record and check the markup before enclosing concealed installations.
2. Content: Types of items requiring marking include, but are not limited to, the following:
 - a. Dimensional changes to Drawings.
 - b. Revisions to details shown on Drawings.
 - c. Depths of foundations below grade.
 - d. Locations and depths of underground utilities.
 - e. Revisions to routing of piping and conduits.
 - f. Revisions to electrical circuitry.
 - g. Actual equipment locations.
 - h. Changes made by Change Order or Work Change Directive.
 - i. Changes made following Engineer's written orders.
 - j. Details not on the original Contract Drawings.

- k. Field records for variable and concealed conditions.
 - l. Record information on the Work that is shown only schematically.
- 3. Mark the Contract Drawings completely and accurately. If Shop Drawings are marked, show cross-reference on the Contract Drawings.
- 4. Mark record sets with erasable, red-colored pencil. Use other colors to distinguish between changes for different categories of the Work at same location.
- 5. Mark important additional information that was either shown schematically or omitted from original Drawings.
- 6. Note Change Order or Work Change Directive numbers, alternate numbers, and similar identification, where applicable.
- B. Record Digital Data Files: Immediately before inspection for Certificate of Substantial Completion, review marked-up record prints with Engineer. When authorized, prepare a digital copy of those Contract Drawings.
- C. Format: Identify and date each record Drawing; include the designation "PROJECT RECORD DRAWING" in a prominent location. Provide information in the following formats:
 - 1. Record Prints: Organize record prints and newly prepared record Drawings into manageable sets. Bind each set with durable paper cover sheets. Include identification on cover sheets.
 - 2. Record Digital Data Files on a disk: Organize digital data information into separate PDF electronic files that correspond to each sheet of the Contract Drawings. Name each file with the sheet identification. Include identification in each digital data file.
 - 3. Identification: As follows:
 - a. Project name.
 - b. Date.
 - c. Designation "PROJECT RECORD DRAWINGS."
 - d. Name of Contractor.

1.6 MISCELLANEOUS RECORD SUBMITTALS

- A. Assemble miscellaneous records required by other Specification Sections for miscellaneous record keeping and submittal in connection with actual

performance of the Work. Bind or file miscellaneous records and identify each, ready for continued use and reference.

- B. Format: Submit three (3) paper copies and two (2) digital copies of all miscellaneous records.
 - 1. Include a miscellaneous record submittals directory organized by specification section number and title, electronically linked to each item of miscellaneous record submittals.

1.7 AS-BUILT SURVEY

- A. Format: Submit two (2) digital copies of the as-built survey.
 - 1. Survey file shall be prepared under the direction of a surveyor licensed in the state where the work has been performed.
 - 2. Survey shall be provided in AutoCAD format and coordinated with the design drawings by tying the survey to the Engineer's original survey control points.

PART 2 - EXECUTION

2.1 RECORDING AND MAINTENANCE

- A. Recording: Maintain one copy of each submittal during the construction period for project record document purposes. Post changes and modifications to project record documents as they occur; do not wait until the end of Project.
- B. Maintenance of Record Documents: Store record documents in the field office apart from the Contract Documents used for construction. Do not use project record documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition, protected from deterioration and loss. Provide access to project record documents for Engineer's reference during normal working hours.

END OF SECTION 017839

PART 1 - GENERAL**1.1 RELATED DOCUMENTS**

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes administrative and procedural requirements for instructing Owner's personnel, including the following:
 - 1. Demonstration of operation of systems, subsystems, and equipment.
 - 2. Training in operation and maintenance of systems, subsystems, and equipment.
- B. Related Sections:
 - 1. Division 1 Section "Project Management and Coordination" for requirements for preinstruction conferences.
 - 2. Divisions 2 through 46 Sections for specific requirements for demonstration and training for products in those Sections.

1.3 SUBMITTALS

- A. Instruction Program: Submit three copies of outline of instructional program for demonstration and training, including a list of training modules and a schedule of proposed dates, times, length of instruction time, and instructors' names for each training module. Include learning objective and outline for each training module.
 - 1. At completion of training, submit one complete training manual(s) for Owner's use.
- B. Qualification Data: For instructor.
- C. Attendance Record: For each training module, submit list of participants and length of instruction time.
- D. Evaluations: For each participant and for each training module, submit results and documentation of performance-based test.

1.4 QUALITY ASSURANCE

- A. Instructor Qualifications: A factory-authorized service representative, complying with requirements in Division 01 Section "Quality Requirements," experienced in operation and maintenance procedures and training for the specific equipment.

1.5 COORDINATION

- A. Coordinate instruction schedule with Owner's operations. Adjust schedule as required to minimize disrupting Owner's operations.
- B. Coordinate instructors, including providing notification of dates, times, length of instruction time, and course content.
- C. Coordinate content of training modules with content of approved operation and maintenance manuals. Do not submit instruction program until operation and maintenance data has been reviewed and approved by Owner and Engineer.

PART 2 - PRODUCTS

2.1 INSTRUCTION PROGRAM

- A. Program Structure: Develop an instruction program that includes individual training modules for each system and for equipment not part of a system, as required by individual Specification Sections.
- B. Training Modules: Develop a learning objective and teaching outline for each module. Include a description of specific skills and knowledge that participant is expected to master. For each module, include instruction for the following as applicable to the system, equipment, or component:
 - 1. Basis of System Design, Operational Requirements, and Criteria:
 - a. System, subsystem, and equipment descriptions.
 - b. Performance and design criteria.
 - c. Operating standards.
 - d. Regulatory requirements.
 - e. Equipment function.
 - f. Operating characteristics.
 - g. Limiting conditions.
 - h. Performance curves.
 - 2. Documentation:
 - a. Operations and maintenance manuals.
 - b. Project Record Documents.

- c. Identification systems.
 - d. Warranties and bonds.
 - e. Maintenance service agreements and similar continuing commitments.
3. Emergencies:
- a. Instructions on meaning of warnings, trouble indications, and error messages.
 - b. Instructions on stopping.
 - c. Shutdown instructions for each type of emergency.
 - d. Operating instructions for conditions outside of normal operating limits.
 - e. Sequences for electric or electronic systems.
 - f. Special operating instructions and procedures.
4. Operations:
- a. Startup procedures.
 - b. Equipment or system break-in procedures.
 - c. Routine and normal operating instructions.
 - d. Regulation and control procedures.
 - e. Control sequences.
 - f. Safety procedures.
 - g. Instructions on stopping.
 - h. Normal shutdown instructions.
 - i. Operating procedures for emergencies.
 - j. Operating procedures for system, subsystem, or equipment failure.
 - k. Seasonal and weekend operating instructions.
 - l. Required sequences for electric or electronic systems.
 - m. Special operating instructions and procedures.
5. Adjustments:
- a. Alignments.
 - b. Checking adjustments.
 - c. Noise and vibration adjustments.
 - d. Economy and efficiency adjustments.
6. Troubleshooting:
- a. Diagnostic instructions.
 - b. Test and inspection procedures.
7. Maintenance:
- a. Inspection procedures.
 - b. Procedures for preventive maintenance.

- c. Procedures for routine maintenance.
 - d. Instruction on use of special tools.
- 8. Repairs:
 - a. Diagnostic instructions.
 - b. Repair instructions.
 - c. Disassembly; component removal, repair, and replacement; and reassembly instructions.
 - d. Instructions for identifying parts and components.
 - e. Review of spare parts needed for operation and maintenance.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Assemble educational materials necessary for instruction, including documentation and training module. Assemble training modules into a training manual organized in coordination with requirements in Division 01 Section "Operations and Maintenance Data."
- B. Set up instructional equipment at instruction location.
- C. Provide training materials in hard copy and electronic formats.

3.2 INSTRUCTION

- A. Facilitator: Engage a qualified facilitator to prepare instruction program and training modules, to coordinate instructors, and to coordinate between Contractor and Owner for number of participants, times, and location.
- B. Engage qualified instructors to instruct Owner's personnel to adjust, operate, and maintain systems, subsystems, and equipment not part of a system.
- C. Scheduling: Provide instruction at mutually agreed on times. For equipment that requires seasonal operation, provide similar instruction at start of each season. **Schedule training with Owner through Engineer with at least seven (7) days' advance notice.**
- D. Cleanup: Collect unused and leftover educational materials and remove from Project site. Remove instructional equipment. Restore systems and equipment to condition existing before initial training use.

END OF SECTION 017900

SECTION 019113 GENERAL COMMISSIONING REQUIREMENTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including Modified General and Supplementary Conditions and other Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes general requirements that apply to implementation of commissioning without regard to specific systems, assemblies, or components.
- B. Related Sections:
 - 1. Divisions 2 through 46 Sections for specific commissioning requirements for the Work in those Sections.

1.3 DEFINITIONS

- A. Commissioning Plan: A document that outlines the organization, schedule, allocation of resources, and documentation requirements of the commissioning process.
- B. Manufacturer: Generally, the equipment manufacturer and/or their authorized representative.
- C. Systems, Subsystems, Equipment, and Components: Where these terms are used together or separately, they shall mean "as-built" systems, subsystems, equipment, and components.

1.4 COMMISSIONING TEAM

- A. Members Appointed by Contractor: Individuals, each having the authority to act on behalf of the entity he or she represents, explicitly organized to implement the commissioning process through coordinated action. The commissioning team shall consist of, but not be limited to, representatives of Contractor, including Project superintendent and subcontractors, installers, suppliers, and specialists deemed appropriate including the manufacturer.

1. Manufacturer: The designated person, company, or entity that plans, schedules, and coordinates the commissioning team to implement the commissioning process. Contractor will engage the manufacturer under this contract.

B. Members Appointed by Owner:

1. Representatives of the Owner that will operate and maintain the facility.
2. Engineer.

1.5 OWNER'S RESPONSIBILITIES

- A. Assign operation and maintenance personnel and schedule them to participate in commissioning team activities.

1.6 CONTRACTOR'S RESPONSIBILITIES

- A. Contractor shall assign representatives with expertise and authority to act on its behalf and shall schedule them to participate in and perform commissioning process activities including, but not limited to, the following:
1. Evaluate performance deficiencies identified in test reports and, in collaboration with entity responsible for system and equipment installation, recommend corrective action.
 2. Cooperate with the manufacturer for resolution of issues recorded in the Issues Log.
 3. Attend commissioning team meetings held during applicable monthly progress meetings and other specially called meetings.
 4. Integrate and coordinate commissioning process activities with construction schedule.
 5. Review and accept construction checklists provided by the manufacturer.
 6. Review and accept commissioning process test procedures provided by the manufacturer.
 7. Complete commissioning process test procedures.

1.7 MANUFACTURER'S RESPONSIBILITIES

- A. Organize and lead the commissioning team.
- B. Provide commissioning plan.
- C. Convene commissioning team meetings.
- D. Provide Project-specific construction checklists and commissioning process test procedures.

- E. Verify the execution of commissioning process activities. Verification will include, but is not limited to, equipment submittals, construction checklists, training, operating and maintenance data, tests, and test reports to verify compliance with requirements. Report any failures in the Issues Log.
- F. Prepare and maintain the Issues Log.
- G. Prepare and maintain completed construction checklist log.
- H. Witness systems, assemblies, equipment, and component startup.
- I. Compile test data, inspection reports, and certificates; include them in the systems manual and commissioning process report.
- J. Complete the "Equipment Start-Up Form" at the end of this section.

PART 2 - PRODUCTS (Not Used)

PART 3 - EXECUTION (Not Used)

END OF SECTION 019113

(Standard Form Attached)



EQUIPMENT START-UP FORM
NO.

Proj. # _____

Date: _____

PROJECT DATA

NAME: _____

NUMBER: _____

LOCATION: _____

DATE: _____

OWNER: _____

DRAWING NO.: _____

OTHER: _____

SPEC. SECTION: _____

NAME OF EQUIPMENT CHECKED: _____

NAME OF MANUFACTURER OF EQUIPMENT _____

1. The equipment furnished by us has been checked on the job by us. We have reviewed (where applicable) the performance verification information submitted to us by the Contractor.
2. The equipment is properly installed, except for the items noted below.*
3. The equipment is operating satisfactorily, except for the items noted below.*
4. The written operating and maintenance (O&M) information (where applicable) has been presented to the Owner, and gone over with the Owner in detail. Three (3) copies of applicable O&M documents and parts lists have been furnished to Owner.

CHECKED BY:

Name of Manufacturer's Representative

Name of General Contractor

Address & Phone No. of Representative

Authorized Signature/Title/Date

Signature and Title of Person Making Check

Name of Subcontractor

Date Checked

Authorized Signature/Title/Date

MANUFACTURER'S REPRESENTATIVE

Notations: Exceptions noted at the time of check were:

Manufacturer's Representative to note adequacy of related equipment that directly affects operation, performance or function of equipment checked. (No comment presented herein will indicate adequacy of related systems or equipment.)

COPIES TO:

☐ OWNER: _____ ☐

CONTRACTOR: _____

☐ ENGINEER: _____ ☐

FIELD: _____

☐ ARCHITECT: _____ ☐

OTHER: _____



PROJECT MANUAL

VOLUME I OF II

Town of Richlands – 4.0 MGD WWTP Upgrades and Improvements Richlands, Virginia

Prepared for
Town of Richlands

T&L Project No. 14249
VCWRLF Project No. C-515667
Issued for Bids January 7, 2022



**THOMPSON
& LITTON** EST.
1956

PROJECT MANUAL

**Town of Richlands - 4.0 MGD
WWTP Upgrades and Improvements
Richlands, Virginia**

**Prepared For
Town of Richlands**

With Financial Assistance From

**Department of Environmental Quality
Virginia Clean Water Revolving Fund (VCWRLF)**

McGill Associates Note:

Project scope has been reduced from original design. Inapplicable specification sections and addenda have been omitted and inapplicable items have been crossed out in red strikethrough text to reflect the reduced scope.



This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of Thompson & Litton and is not to be used in whole or in part for any other project without the written authorization of Thompson & Litton.



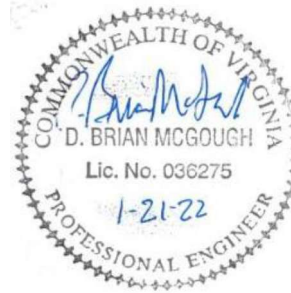
THOMPSON & LITTON

**103 East Main Street
P.O. Box 1307
Wise, Virginia 24293**

**T&L Project No. 14249
VCWRLF Project No. C-515667**

Issued for Bids January 7, 2022

00 0101



ADDENDUM NO. 002

TO: All Plan Holders

RE: Town of Richlands - 4.0 PGD WWTP Upgrades and Improvements
for Town of Richlands
T&L Project No. 14249

DATE: January 21, 2022

~~BIDS RECEIVED DATE:~~ ~~February 23, 2022~~

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated January 7, 2022, as noted below. ~~Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.~~

~~This Addendum consists of 18 pages.~~

CHANGES TO PROJECT MANUAL:

1. The schedule of proposed major equipment suppliers in the ~~Bid Form and~~ Specification Section 43 1133 – Rotary Lobe Blower Packages has been revised to show all pre-approved manufacturers in both locations. ~~The revised Bid Form is enclosed.~~ The revised page from Specification Section 43 1133 is also enclosed.
2. Specification Section 43 1133 incorrectly indicated eight new blowers to be provided in the project. The correct number is four (4) as indicated on the drawings. The revised specification page is enclosed.
3. ~~The project Certificate to Construct permit from the Virginia Department of Environmental Quality has been added to Appendix B. The Certificate is enclosed.~~

Enclosures: ~~Bid Form, 11 pages~~
Specification Section 43 1113 – Rotary Lobe Blower Packages, 2 pages
~~Virginia DEQ Certificate to Construct, 4 pages~~

SECTION 43 1133 - ROTARY LOBE BLOWER PACKAGES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: The Contractor shall provide all labor, materials, equipment and services necessary for furnishing four (4) Positive Displacement Blowers. The blowers shall be furnished completely packaged with all accessories, tested and ready for operation.

1.2 QUALITY ASSURANCE

- A. Manufacturer or Packager Qualifications: Supplier shall have experience in providing similar equipment, and shall show evidence of satisfactorily operating installations in the eastern region of the United States.
- B. Blower Packagers must be an Authorized Distributor or Representative of the blower being supplied and must be authorized to perform warranty service.

1.3 SUBMITTALS

- A. Shop Drawings: Submit as per ~~Section 01 3000 - Administrative Requirements.~~
McGill Section 013300.
- B. Installation, Operation, and Maintenance Manuals: Submit five (5) copies of the manuals within four (4) weeks of receiving approved shop drawings.
- C. Submit Certificate of Proper Use.

1.4 MANUFACTURER'S REPRESENTATIVE

- A. General: Provide the services of a qualified factory certified representative for the required days as specified hereunder. A man-day is defined as eight (8), on-site, working hours.
- B. Initial Operation/Training: Upon notification of completion of aeration system by the Contractor, provide a minimum of one (1) day for blower equipment installation inspection, certification, start-up, training, and corrective adjustments.

1.5 TESTING

- A. A factory slip test report from the actual blower manufacturer shall be supplied for each blower.
- B. Each blower shall be tested in accordance with ASME PTC-9 testing procedures for positive displacement blowers. The results of this test shall be certified and submitted prior to shipment of the blowers.
- C. Submit Certificate of Proper Installation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer List:

1. Pre-approved equipment manufacturers include Aerzen, Excelsior, Gardner Denver, Kaeser, Roots, and United Blower.
2. Substitutions: Section 01 6000 – Product Requirements.
 - a. The naming of a manufacturer and model number is not an indication that the manufacturer's standard equipment offering is acceptable in lieu of the specified features. Naming of a manufacturer is instead an indication that the manufacturer may have the capability of providing the system as specified. Manufacturer shall make any necessary modifications to meet all the requirements of the Contract Documents.
 - b. Dimensions and locations shown on the Drawings for the equipment and accessories in this section are based on the equipment named as the basis of design. Any change to dimensions or locations of equipment and accessories required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner.
 - c. Any costs or modifications incurred by using equipment other than the basis of design, if any, including building construction, structural, piping, electrical, mechanical, plumbing and instrumentation systems, shall be made by the Contractor at no additional expense to the Owner.

2.2 DESIGN CRITERIA

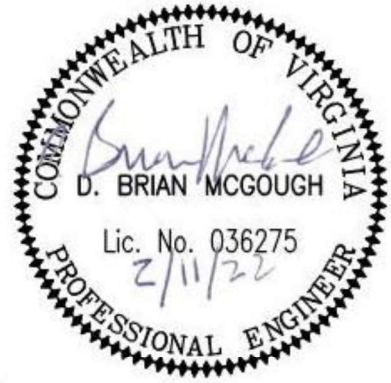
- A. The air blowers shall be fabricated, assembled and located as shown on the drawings.
- B. Operating conditions are as scheduled on the drawings.

2.3 ROTARY POSITIVE DISPLACEMENT BLOWERS

- A. General: Each blower shall be of the horizontal, rotary, positive displacement type. Each assembly shall be rugged in construction and of such design that it may be disassembled and inspected without disturbing the inlet or discharge piping.
- B. Casing: Casing shall be of one piece with separate head plates, and shall be made of close grained gray cast iron suitably ribbed to prevent distortion under service conditions.
- C. Head Plates: Fabricate drive end and gear end head plates of close grained cast iron which are precision machined for exact bearings housing fit.
- D. Impeller and Shaft: Impeller and shaft shall be made from common cast iron. Impeller shall be of the trilobe design. Blower shall be positively timed by a pair of accurately machined heat-treated alloy steel, timing gears.
- E. Bearings: Each impeller/shaft shall be supported by double row ball or spherical roller bearings sized for a minimum of 100,000 hours of B-10 life.



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McGill Associates Note:
All Addendum omissions by
McGill Associates are shown
in red text strikethrough.

ADDENDUM NO. 003

TO: All Plan Holders

RE: Town of Richlands - 4.0 MGD WWTP Upgrades and Improvements
for Town of Richlands
T&L Project No. 14249

DATE: February 11, 2022

~~ORIGINAL BIDS RECEIVED DATE:~~ February 23, 2022

~~REVISED BIDS RECEIVED DATE:~~ March 2, 2022

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated January 7, 2022, Addendum No. 001 dated January 14, 2022, and Addendum No. 002 dated January 21, 2022, as noted below. ~~Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.~~

~~This Addendum consists of 15 pages and 4 drawing sheets, with the revised date of February 11, 2022.~~

CLARIFICATIONS:

- ~~1. A separate building Wage Determination is not required for this project.~~

CHANGES TO BIDDING REQUIREMENTS:

- ~~1. The bids received date and time is being extended to March 2, 2022, at 2:00 pm local prevailing time. The location for delivery of bids received remains as the Town of Richlands, 200 Washington Square, Richlands, Virginia 24641.~~

CHANGES TO CONTRACTING REQUIREMENTS:

- ~~1. The Pre-Approved Major Equipment Manufacturer's Suppliers table cell for air diffusers in the bid form has been revised. The revised bid form is attached.~~

NOTE: ~~As a result of the above changes, the Bid Form has been reissued in its entirety and must be included in the Contractor's bid submittal(s).~~



CHANGES TO THE SPECIFICATIONS:

1. The acceptable manufacturer's list on page 3 of Section 46 4322 – Clarifier and Thickener Restoration has been revised ~~and matches the bid form~~. The revised page is attached.
2. The approved manufacturer's list on page 3 of Section 46 5103 – Air Diffusers been revised. The revised page is attached.

McGill Associates Note:
All T&L Addendum drawing revisions have been incorporated into the plans.

CHANGES TO DRAWINGS:

- ~~1. At the Raven Doran lift station, the existing gate is to remain. What is currently the east/southeast fence line will be demolished to allow access to the new lift station footprint as defined by the remaining existing fence and the new fence. Drawing C303 has been revised and is attached.~~
- ~~2. The top of wetwell elevations for the new and existing structures has been added to drawing C304 for the Raven Doran lift station. Additional inverts have been revised/corrected and pump control elevations have been changed to levels in feet. The revised drawing is attached.~~
- ~~3. Drawing C103 has been revised to reroute existing underground fiber optic and electrical services around the new septic receiving station. The revised drawing is attached.~~
- ~~4. Information about the existing buried fiber-optic lines has been added to drawing C101. The revised drawing is attached.~~

Enclosures: ~~Bid Form, 11 pages~~
Specification Section 46 4322 – Clarifier and Thickener Restoration, 1 page
Specification Section 46 5103 – Air Diffusers, 1 page
~~Drawings C101, C103, C303, and C304~~

1. See Section 11005 - Equipment: Basic Requirements for other requirements.

PART 2 PRODUCTS

2.1 GENERAL

- A. The design and layout shown on the drawings are based on the manufacturer shown in Section 2.2.
- B. Changes in architectural, structural, electrical, mechanical and plumbing requirements for the substitution shall be the responsibility of the Bidder wishing to make the substitution. This shall include the cost of redesign by affected designers. Any additional cost incurred by affected subcontractors shall be the responsibility of the Bidder and not the Owner.
- C. See Section 01640 - *Product Substitutions*.

2.2 ACCEPTABLE MANUFACTURERS

- A. Amwell, Evoqua, Ovivo, Walker Process.

2.3 EQUIPMENT

- A. General:
 1. Furnish and deliver suction type sludge collector components for installation in two (2) existing concrete settling tanks.
 - a. Tank diameter to be 80 feet.
 - b. Tank side water depth to be 11 feet.
 - c. Tank freeboard to be 2 feet.
 - d. Floor slope to be 1/16 inch per foot.
 2. Sludge Collector Mechanism:
 - a. Provide components for a center pier supported, peripheral feed design with peripheral overflow.
 - b. The center drive mechanism supports and rotates a structural steel cage to which is attached a Unitube sludge collection header and manifold.
 - c. The header shall be parallel to the tank floor and have a series of inlet orifices such that the entire tank bottom is swept clean in a single revolution.
 - d. The header shall be designed to uniformly remove sludge in proportion to the area swept with the removal of a larger volume of sludge at greater distances from the tank center.
 - e. Sludge shall be transported through the header to the center manifold, with removal being accomplished by hydrostatic pressure.

a. Products:

- 1) Alfa Laval: <https://www.alfalaval.us/>
- 2) Aqua-Aerobic: www.aqua-aerobic.com/#sle.
- 3) Environmental Dynamics: www.wastewater.com/#sle.
- 4) Sanitaire: <https://www.xylem.com/en-us/brands/sanitaire/>
- 5) SSI: <https://www.ssiaeration.com/>

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the manufacturer's written instructions.
- B. Provide the services of manufacturer's technical representative to supervise installation, adjustment, and testing, and startup.
- C. Adjust diffuser mountings so that all diffusers on a header are within 1/8 inch of common horizontal plane.

3.2 FIELD QUALITY CONTROL - PRIOR TO STARTUP

- A. In-Tank Diffusers: Test by filling tank with water to depth of approximately two feet above top of diffusers, and:
 1. Apply air at design pressure.
 2. Inspect diffusers for proper operation and uniformity of diffusion.
 3. Adjust diffusers as required for uniform diffusion.
- B. Replace diffusers that cannot be sufficiently adjusted.

3.3 OWNER PERSONNEL TRAINING

- A. See Section 46 0500 for additional requirements.
- B. Operating Personnel Training:
 1. Sessions: One.
 2. Trainees: Two.
 3. Training Hours: 2.
- C. Maintenance Personnel Training:
 1. Sessions: One.



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ADDENDUM NO. 004

McGill Associates Note:
All Addendum omissions by
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in red text strikethrough.

TO: All Plan Holders

RE: Town of Richlands - 4.0 MGD WWTP Upgrades and Improvements
for Town of Richlands
T&L Project No. 14249

DATE: February 21, 2022

~~ORIGINAL BIDS RECEIVED DATE:~~ ~~February 23, 2022~~

~~REVISED BIDS RECEIVED DATE:~~ ~~March 2, 2022~~

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated January 7, 2022 as noted below. ~~Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.~~

~~Please note that a final Addendum is anticipated to be issued on Friday, February 25, 2022.~~

~~This Addendum consists of 54 pages and 4 drawing sheets, with the revised date of February 21, 2022.~~

CLARIFICATIONS:

1. Due to the environment of the interior of the new pre-engineered metal building (preliminary treatment building), Galvalume coating systems will not be allowed in lieu of the specified galvanized coating.
2. Liner panels to 7'-4" above finished floor elevation are required at the pre-engineered metal building as per the specification.
3. Loading requirements for the pre-engineered metal building are shown on S001.

CHANGES TO THE SPECIFICATIONS:

1. Section 13 3419 – Metal Building Systems has been modified to add coating requirements in 2.10 for roof panels, wall panels, and liner panels. The revised page is attached.



2. Section 22 2300 – Plumbing Equipment has been added to cover the requirements for submersible sump pumps. The section is attached. ~~No bid form selection is required for these pumps.~~
3. Section 40 9618 – Supervisory Control and Data Acquisition System has been revised to require Windows 10 requirements in lieu of Windows 7. Also, the reference to Iconics HMI software has been removed and replaced with Rockwell Automation Factory Talk, no exceptions. The reference to “VDH” in 2.7 2. Report Software has been revised to “DEQ”. The revised section is not attached.
4. Section 43 2378 – Positive Displacement Sludge Pumps, has been added to the project manual to cover the requirements of P120 and P130. The section is attached. ~~No bid form selection is required for these pumps.~~
5. ~~Section 43 2413 – Vertical Mixed Flow Propeller Pumps, has been added to the project manual to cover the requirements of P100 and P110. The bid schedule has been revised to include a manufacturer choice for these pumps and the Vertical Turbine Solids Handling selection has been removed. The revised bid form and Section 43 2413 are attached.~~
6. Section 46 1010 – Wastewater Pumps has been updated to include requirements for Non-Potable water pumps. Additionally, the list of pre-approved pump manufacturers has been updated ~~and a reference to the bid form pump selection has been added.~~ The revised section is attached.
7. Section 46 2020 – Mechanically Cleaned Bar Screen has been replaced with Section 46 2020 – Mechanically Cleaned Filter Screen. Please note that electrical plan shows gates at screen incorrectly. Refer to civil drawings. The revised section is attached.
8. Section 46 2025 – Screenings Washer/Compactor has been revised to reference the new name of Specification Section 46 2020 – Mechanically Cleaned Filter Screen. The revised page(s) are not attached.

~~CHANGES TO DRAWINGS:~~

1. ~~The pump operating condition at the Raven-Doran lift station on Drawing C005 was incorrect. It has been corrected and the revised drawing is attached.~~
2. ~~Several pump types in the pump schedule on Drawing C005 have been renamed to conform better to the nomenclatures in the project specifications. Additionally, the ferric chloride pump (P290) is not in this project and has been deleted from the schedule. The revised drawing is attached.~~
3. ~~Top of slab and floor elevations for pumps P60 and P70 have been added to Drawing C502. The revised drawing is attached.~~

McGill Associates Note:

All T&L Addendum drawing revisions have been incorporated into the plans.



Addendum No. 004

Town of Richlands - 4.0 MGD WWTP Upgrades and Improvements

February 21, 2022

Page 3

- ~~4. Top of slab and floor elevations for pumps P80, P90, P210 and P220 have been added to Drawing C504. The revised drawing is attached.~~
- ~~5. Top of slab and floor elevations for pumps P100 and P110 have been added to Drawing C702. The revised drawing is attached.~~

Enclosures: ~~Bid Form, 11 pages~~
 Specification Section 13 3419 – Metal Building Systems, 1 page
 Specification Section 22 3000 – Plumbing Equipment, 4 pages
 Specification Section 43 2378 - Positive Displacement Sludge Pumps, 5 pages
 ~~Specification Section 43 2413 – Vertical Mixed flow Propeller Pumps, 8 pages~~
 Specification Section 46 1010 – Wastewater Pumps, 8 pages
 Specification Section 46 2020 – Mechanically Cleaned Filter Screen, 14 pages
 ~~Drawings C005, C502, C504, and C702~~

- H. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.
- I. Thermal spacers: As required for insulation system and panel clip.
- J. Provide continuous mastic as recommended by manufacturer at seams for weathertight seal.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts and scuppers of profile and sized to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

- A. Framing Members: Clean, prepare, and galvanize to ASTM A123/A123M.
- B. Galvanized roof panels, wall panels, and liner panels: Coat using a factory pre-coated enamel on steel of modified silicone finish similar to Signature 200 Coating, color as selected from manufacturer's standard range.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position
- B. Verify existing concrete structure is cleaned, existing anchors are ground smooth and topped with a protective coating and ready to receive new PEMB members.
- C. Verify base plate anchor bolt locations have been coordinated to miss locations of existing anchor bolts.
- D. Verify that all steel framing has been galvanized before erecting and installing steel framing.

3.2 ERECTION - FRAMING

- A. Erect framing in accordance with AISC 360.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- C. Do not field cut or alter structural members without approval.

SECTION 22 3000 - PLUMBING EQUIPMENT

Addendum No. 004
02-21-22

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Sump pumps.

1.2 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittals procedures.
McGill Section 013300.
- B. Product Data:
 - 1. Indicate pump type, capacity, power requirements.
 - 2. Provide electrical characteristics and connection requirements.
- C. Project Record Documents: Record actual locations of components.
- D. Operation and Maintenance Data: Include operation, maintenance, and inspection data, replacement part numbers and availability, and service depot location and telephone number.
- E. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.3 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.
- B. Certifications:
 - 1. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc., as suitable for the purpose specified and indicated.
- C. Identification: Provide pumps with manufacturer's name, model number, and rating/capacity identified by permanently attached label.

1.4 WARRANTY

- A. See ~~Section 01 7800 - Closeout Submittals~~, for additional warranty requirements.

McGill Section 017700.

PART 2 PRODUCTS

2.1 SUBMERSIBLE SUMP PUMPS

- A. Manufacturers:
 - 1. Armstrong Fluid Technology: www.armstrongfluidtechnology.co
 - 2. Goulds Water Technology, a xylem brand: www.goulds.com

- 3. Zoeller Company: www.zoeller.com
- 4. Substitutions: See Section 01 6000 - Product Requirements.
- B. Type: Completely submersible, vertical, centrifugal.
- C. Casing: Cast iron pump body and oil filled motor chamber.
- D. Impeller: Cast iron; open non-clog, stainless steel shaft.
- E. Bearings: Ball bearings.
- F. Accessories: Oil resistant 20 foot cord and plug with three-prong connector for connection to electric wiring system including grounding connector.
- G. Servicing: Slide-away coupling consisting of discharge elbow secure to sump floor, movable bracket, guide pipe system, lifting chain and chain hooks.
- H. Controls: Motor control panel containing across-the-line electric motor starters with ambient compensated quick trip overloads in each phase with manual trip button and reset button, circuit breaker, control transformer, electro mechanical alternator, hand-off-automatic selector switches, pilot lights, high water alarm pilot light, reset button and alarm horn.
Provide mercury switch liquid level controls, steel shell switch encased in polyurethane foam with cast iron weight for pump on (each pump), pump off (common), and alarm.

2.2 ELECTRICAL WORK

- A. Provide electrical motor driven equipment specified complete with motors, motor starters, controls, and wiring.
- B. Electrical characteristics to be as specified or indicated.
- C. Furnish motor starters complete with thermal overload protection and other appurtenances necessary for the motor control specified.
- D. Supply manual or automatic control and protective or signal devices required for the operation specified, and any control wiring required for controls and devices not shown.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install plumbing equipment in accordance with manufacturer's instructions, as required by code, and complying with conditions of certification, if any.
- B. Coordinate with plumbing piping and related fuel piping work to achieve operating system.
- C. Pumps:
 - 1. Ensure shaft length allows sump pumps to be located minimum 24 inches below lowest invert into sump pit and minimum 6 inches clearance from bottom of sump pit.

2. Provide air cock and drain connection on horizontal pump casings.
3. Provide line sized isolating valve and strainer on suction and line sized soft seated check valve and balancing valve on discharge.
4. Decrease from line size with long radius reducing elbows or reducers. Support piping adjacent to pump such that no weight is carried on pump casings. Provide supports under elbows on pump suction and discharge line sizes 4 inches and over.
5. Ensure pumps operate at specified system fluid temperatures without vapor binding and cavitation, are non-overloading in parallel or individual operation, and operate within 25 percent of midpoint of published maximum efficiency curve.
6. Align and verify alignment of base mounted pumps prior to start-up

END OF SECTION

SECTION 43 2378 - POSITIVE DISPLACEMENT SLUDGE PUMPS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Plunger type and progressive cavity type pumps for sludge.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for bases.
- B. Section 46 0106 - Operation and Maintenance Manual: Operating and Maintenance Data.
- C. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Requirements applicable to all equipment.

1.3 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014.
- C. NEMA MG 1 - Motors and Generators 2017.
- D. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 SUBMITTALS

McGill Section 013300.

- A. See ~~Section 01 3000 - Administrative Requirements~~, and Section 46 0500 - Common Work Results For Water and Wastewater Equipment for submittal procedures.
- B. Product Data: Manufacturer's descriptive and technical data on each item of equipment, including performance charts and curves, catalog cuts, and installation instructions.
 - 1. Submit pump characteristic curves showing:
 - a. Capacity in gallons per minute and liters per second.
 - b. Net positive suction head (NPSH).
 - c. Head.
 - d. Efficiency.
 - e. Pumping horsepower from zero to 110 percent (100 percent for positive displacement pumps) of design capacity.
- C. Shop Drawings: Show layout and anchorage of equipment and appurtenances.
 - 1. Show relationship to other parts of work including clearances for maintenance and operation.

2. Include complete wiring and schematic diagrams.
 3. Include any other details necessary to demonstrate that system has been coordinated and will properly function as a unit.
- D. Field Quality Control Reports.
- E. Operating and Maintenance Data: See Section 46 0106.
- F. Maintenance Materials:
1. Spare Parts: Furnish spare parts recommended by manufacturer to keep on hand.
 2. One set of special tools, calibration devices, and instruments required for operation, calibration, and maintenance.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacture, assembly, and field performance of pumps, with minimum three years of documented experience.

1.6 WARRANTY

- A. See ~~Section 01 7800 - Closeout Submittals~~, for additional warranty requirements.

McGill Section 017700.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Plunger Sludge Pumps:
1. Carter Pumps, Inc: www.carterpump.com/#sle.
 2. Komline-Sanderson: www.komline.com/#sle.
 3. Wastecorp: www.wastecorp.com/#sle.
- B. Progressive Cavity Sludge Pumps:
1. Flowrox: www.flowrox.com/#sle.
 2. Moyno: www.moyno.com/#sle.
 3. NOV: www.nov.com/#sle.
 4. Substitutions: See Section 01 6000 - Product Requirements.

2.2 PUMPS - GENERAL REQUIREMENTS

- A. Pumps: Complete pumping systems, including motor and drive, manual operator, automatic actuators where indicated, piping, valves, conduit and wiring, supporting structures, electrical and process controls, overload protection, and alarms; capable of continuous operation

without overheating and without excessive vibration, noise, or power consumption.

1. Cast Iron Pump Casings: Constructed of cast iron of uniform quality and free from blow holes, porosity, hard spots, shrinkage defects, cracks, and other injurious defects.
 2. Impellers (Except for Rotors): Cast iron.
 3. Finishes: Factory finish pumps and motors with manufacturer's standard primer and two coats of paint.
 4. Exterior Surfaces of Casings in Contact with Sewage: Field applied sewage resistant coal tar epoxy coating.
- B. Identification: In addition to the information required by Section 46 0500, for pumps show the pump capacity, pump head, speed of rotation, and direction of rotation, cast into the body of the pump.
- C. Pressure Gauges:
1. Provide compound gauges on suction side of pumps.
 2. Provide standard pressure gauges on discharge side of pumps.
- D. Electric-Motor-Driven Equipment: Provide motors, motor starters, controls and wiring in accordance with Section 46 0500.

2.3 PLUNGER SLUDGE PUMPS

- A. Plunger Sludge Pumps: Positive displacement type, designed to pump sewage sludges with minimum amount of clogging.
- B. Pump Body: Cast iron, heavy construction, of sectional construction so that stuffing box, plunger, valve bodies, air chamber adapters, and connecting rod are independently removable without disturbing other components including piping and shaft.
1. Designed to handle maximum rated capacity and head on continuous duty basis.
 2. Hydrostatically tested at 1.5 times maximum rated head of pump.
 3. Valve Chambers: On both inlet and discharge connections of each cylinder, constructed with contoured interiors to minimize clogging.
 4. Valves: Ball type, neoprene, at least 5-1/8 inches diameter.
 5. Valve Seats: Independent, fully machined plates that can be replaced without disturbing valve bodies or piping.
 6. Plungers: Ductile iron, with plugged drain hole in bottom accessible through top of plunger.
 7. Cylinders: Machined to smooth bore to provide a uniform surface throughout full travel of plunger.

- C. Connecting Rod and Eccentric Strap Assembly: Cast as one piece, comprising connecting rod, shaft, eccentric, and eccentric bearings, with hot-poured Babbitt lining.
 - 1. Designed to handle stresses and deflections imposed upon it by specified service.
 - 2. Pump Eccentric Lubrication: Oil, with sight-feed indicator.
- D. Cylinder and Plunger Stuffing Box: Heavy cast construction with effective packing arrangement to provide lubrication for plunger and maintain most effective vacuum.
 - 1. Circular drain lip and 1 inch threaded drain connection.
 - 2. Minimum of four rings of packing.
- E. Air Chambers: On discharge side of pump.
 - 1. Capacity: 1800 cubic inches, minimum.
 - 2. Opening Diameter: 3 inches, minimum.
- F. Sampling Valve: On discharge side of pump; 2 inches diameter.
- G. Pressure Relief Valve: On bypass line from main suction and discharge manifolds; factory set to prevent motor overload or pump damage.
- H. Pump Base: Single base for pump and motor; welded steel, drip-rim base, fully braced to withstand all shock loads and to resist buckling when properly anchored; threaded drain connection, 1 inch diameter.
- I. Drive: V-belt and integral gear type, with capacity variations provided by stroke adjustment accomplished at each eccentric assembly, through use of eccentric flanges coupled to eccentric body.
 - 1. Overall drive reduction obtained through combination of gears and V-belts.
 - 2. Gears running in oil bath contained in oil-tight cast iron or aluminum enclosure.
 - 3. Gear reduction design, gear materials and face widths, shafting, and bearings selected for specified operating conditions.
 - 4. Entire V-Belt drive assembly covered by rigid safety guard.

2.4 PROGRESSIVE CAVITY SLUDGE PUMPS

- A. Progressive Cavity Sludge Pumps: Single helical rotor rotating in double helical stator.
- B. Pump Casing: Cast iron.
 - 1. Pump body cradle mounted so that suction chamber can be rotated to allow suction port to accommodate any piping configuration.

2. Two inspection ports 180 degrees apart in suction housing to provide access to internal parts.
 3. Drain plug in casing.
- C. Rotor: Helix configuration, constructed of machined and polished high quality tool steel, with finish layer of hard chrome plate.
- D. Stator: Helix configuration, made of elastomeric Buna-N chemically bonded to steel tube.
- E. Connector Rod Type Drive Shaft: Rotor driven by connecting rod between rotor and drive shaft, connected at each end with universal joint.
1. Universal Joint Type: Crowned gear, or pin or cardan type, of adequate design to transmit required thrust and torque.
 2. Connecting rod and universal joint in combination imparting no thrust on seal.
 3. Universal Joints: Grease lubricated, totally sealed to prevent liquid from contaminating joints and shielded to prevent foreign objects from damaging seal.
- F. Flexible Drive Shaft: Rotor driven by one-piece, flexible, high strength spring steel drive shaft with corrosion and abrasion-resistant thermoplastic coating.
- G. Seals: Either stuffing box with split packing gland and lantern ring or mechanical seal; fittings for grease lubrication.
- H. Bearings: Life expectancy of L-10 life of at least 50,000 hours minimum, as specified in ABMA STD 9 or ABMA STD 11, grease lubricated, with lubrication fittings in bearing housing.

END OF SECTION

SECTION 46 1010 - WASTEWATER PUMPS

Addendum No. 004 02-21-22

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown on the Drawings, as specified herein, and as required to furnish and install complete wastewater pumping systems.
 - a. System components generally include pump, motor, piping connections, controls and all appurtenances required for a complete and operational system.

B. Related Sections:

1. Section 40 9200 - Process Control Descriptions.
2. Division 26 - Electrical.

1.2 REFERENCES

- A. American Iron and Steel Institute (AISI).
- B. American National Standards Institute (ANSI).
- C. National Electrical Manufacturers Association (NEMA).
- D. Virginia Department of Environmental Quality (VDEQ).
 1. Sewage Collection and Treatment Regulations.

1.3 SUBMITTALS

- A. ~~Section 01 3000 - Administrative Requirements:~~ Requirements for submittals.
McGill Section 013300.
- B. Product Data: Submit manufacturer's product data for system materials and component equipment, including electrical characteristics and connection requirements.
- C. Shop Drawings:
 1. Indicate system materials and component equipment.
 2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.
 3. Pump performance data including pump characteristic curves, pump efficiency curves, and brake horsepower curves.
- D. Manufacturer's Certificate:
 1. Submit Certificate of Proper Use.

- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- A. ~~Section 01 7800—Closeout Submittals:~~ Requirements for closeout procedures.
McGill Section 017700.
- B. Project Record Documents: Record actual locations and final orientation of equipment.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.
- D. Submit Certificate of Proper Installation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. ~~Section 01 7000—Execution and Closeout Requirements:~~ Requirements for maintenance materials.
McGill Section 017823.
- B. Spare Parts:
 - 1. Furnish the following spare parts, where applicable to pump type, for each pump model/size:
 - a. One set of mechanical seals for each pump model.
 - b. One cover plate O-ring.
 - c. One rotating assembly O-ring.
 - d. One set of impeller clearance adjustment shims.
 - e. One set of double row lower and single row upper ball bearings.
 - 2. Spare parts shall be packed in sturdy containers with identifying text. Protect spare parts from water and wet weather until transferred to the Owner at closeout.
- C. Tools: Furnish special wrenches and other devices required for Owner to maintain equipment components.

1.6 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section, regardless of component manufacture, from one single manufacturer.

2. The single manufacturer supplying the equipment required by this Section shall review and approve, or prepare, all Shop Drawings and other submittals for components required under this Section.
3. No equipment with less than 3 years of proven reliability shall be provided under this section. The manufacturer shall be capable of producing a list of 5 successful installations along with shop drawing, date of installation, contact person and contact number for each installation.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' verifiable experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 6000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept equipment on-Site in original packaging. Inspect for damage.
- D. Store equipment according to manufacturer's instructions.
- E. Protect equipment from water and wet weather.

1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. ~~Section 01 7000 - Execution and Closeout Requirements:~~ Requirements for warranties.

McGill Section 017700.
- B. Furnish one-year manufacturer's warranty for complete pump system.

PART2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer List:
 1. The basis of design for equipment in this Section is Hydromatic for submersible pumps, Flygt for dry pit submersible pumps, and Cornell for non-potable water pumps.
 2. Pre-approved equipment manufacturers also include ABS, Fairbanks, Flowserve, Goulds, Grundfos, KSB, and Smith & Loveless.
 3. Additional manufacturers may be added to the pre-approved manufacturer's list by Addendum.

4. Refer to bid form for acceptable pre-approved manufacturers by pump type.
 5. Substitutions: Section 01 6000 - Product Requirements.
- B. The naming of a manufacturer and model number is not an indication that the manufacturer's standard equipment offering is acceptable in lieu of the specified features. Naming of a manufacturer is instead an indication that the manufacturer may have the capability of providing the system as specified. Manufacturer shall make any necessary modifications to meet all the requirements of the Contract Documents.
 - C. Dimensions and locations shown on the Drawings for the equipment and accessories in this section are based on the equipment named as the basis of design. Any change to dimensions or locations of equipment and accessories required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner.
 - D. Any costs or modifications incurred by using equipment other than the basis of design, if any, including building construction, structural, piping, electrical, mechanical, plumbing and instrumentation systems, shall be made by the Contractor at no additional expense to the Owner.

2.2 COMMON PUMP REQUIREMENTS

- A. Pump manufacturers shall supply pumps as complete units including drivers. Assembly by the contractor of pumps, shafting, motors, and the like supplied by various independent manufacturers will not be allowed.
- B. The pump requirements, where applicable, shall be as scheduled on the Drawings.
- C. Pumps and motors shall be designed to operate continuously at the conditions shown on the pump schedule.
- D. Other motor requirements shall be as shown on the drawings and as specified in Division 26 - Electrical.
- E. Wastewater treatment process pumps shall be equipped with suction (non-submersible installations) and discharge pressure gages graduated in psi and feet of water for the operating range of the pump. Gages shall be protected by diaphragms.
- F. Furnish non-floating displacement type liquid level regulators, each provided with watertight electric cable necessary for proper pump operation as shown on the electric schematics.
- G. Lifting chains, slide rail mounting brackets, discharge pipe mounting brackets and hardware shall be constructed of galvanized steel.

2.3 NON-CLOG SUBMERSIBLE AND DRY PIT SUBMERSIBLE SEWAGE PUMPS

- A. Pump Construction
 1. The pumps shall be designed and constructed to pump sewage, storm water, heavy sludge, and other fibrous materials without injurious damage during operation. Lifting cover, stator housing, volute casing, and impeller shall be constructed of ASTM A48, Class

30 gray cast iron. The volute shall be of the center discharge design and shall be fitted with ANSI 125 lb. flanges and tested to hydraulic institute standards at 150% of shut-off head. The interfaces between the major castings shall be machined and fitted with Buna-N O-rings. All nuts, bolts, washers, and other fastening devices coming into contact with the sewage shall be constructed of 316 stainless steel.

2. The A536 cast iron impeller shall be of Non-Clog design, double shrouded with a smooth, long thoroughfare having no acute angles. The wear ring system shall be constructed of Series 400 stainless steel with a Brinnell hardness of 200-310. The system shall provide efficient sealing between the volute and impeller.
 3. Each pump shall be provided with an enclosed block seal consisting of cartridge containing both the upper and lower sets of mechanical seal faces. Regular tandem mechanical seal running in an oil bath shall also be acceptable provided the designs utilize AL stainless steel springs, mounting hardware, and seal face retention components. The seal face housing and spring system shall be constructed of 316 stainless steel. Both sets of faces (both upper and lower sets) shall be silicon carbide. Conventional double mechanical seals with a spring assembly between the rotating faces, requiring constant differential pressure to effect sealing and subject to penetration and opening by pumping forces shall not be considered equal to the enclosed block seal design or the tandem seal specified. Seal designs that use springs or housing materials other than Type 316 stainless shall not be provided or accepted. Seal face materials other than silicon carbide shall not be accepted.
 4. The pump and motor shaft shall be of series 400 stainless steel with a Brinnell hardness of 200. The shaft shall be designed such that the diameter of the shaft where it passes through the lower seal shall be adequate to limit shaft deflection due to axial and radial thrust loads to 0.16 mm. The shaft shall not extend more than 2-1/2 times its diameter below the nearest support bearing and shall be supported by double row lower and single row upper ball bearings with a B-10 life of 50,000 hours minimum at any point on the flow versus head curve.
- B. The pump motor shall be integral to the pump. The squirrel cage induction type motor shall be utilize Class F insulation, NEMA B inverter duty rated design, Class H slot liners with a service factor of 1.25. The dual voltage copper wound stator, which will allow field changeability of voltage, shall withstand a heat rise to 155°C as defined in NEMA standard MG-1. The NEMA starting code shall be G or less. The rotor shall be constructed of laminated steel plates with poured aluminum shorting bars. The rotor shall be both statically and dynamically balanced. All castings shall be machine fit utilizing metal to metal contact. All machine fits shall be additionally protected with Buna-N O-rings. Motors utilizing jackets to be cooled by passage of the pumped fluid (sewage) shall not be permitted. Motors shall have thermal sensors for overload protection built into motor casing.
1. The motor power cable shall consist of the SJO type insulated cable with a double jacketed protection system, neoprene outside, synthetic rubber inside, exceeding industry standards for oil, gas, and sewage resistance. Individual conductors shall be of the Type RUW.

2. The power cable will enter the pump through a vellums type cable entry constructed of cast iron alloy metal and galvanized for corrosion resistance. The heavy duty cable entry with strain relief shall be provided with an integral rubber grommet to protect against leakage once the cable is secured. The power cable leads shall be connected to terminals on an isolated terminal board. The terminal board shall be connected to terminals on an isolated terminal board. The terminal board shall be constructed of Bake-O-Lite and will include individually O-ringed brass lugs on both upper and lower side of the terminal board. The terminal board shall be totally isolated from the motor using Buna-N O-rings fitted to the terminal board and mating with the machined terminal board housing in the motor. This system will prevent moisture from entering the motor should leakage occur through the cable entry. Motors shall be equipped with moisture sensors to stop pump operation if moisture is detected in the seal cavity.
- C. The following minimum spare parts shall be furnished with each set of pumps:
1. One spare pump mechanical seal cartridge.
 2. One cover plate O-Ring.
 3. One rotating assembly O-ring.
 4. One set of impeller clearance adjustment shims.
 5. One set of double row lower and single row upper ball bearings.
- D. The pump manufacturer shall warrant the pumping equipment to be supplied to the Owner for a period of one year from date of substantial completion. The warranty shall be non-prorated and cover 100% of the cost of parts and labor, including wearing parts and freight.

2.4 GRIT SLURRY PUMPS

- A. The requirements for non-clog dry-pit submersibles shall apply to grit slurry pumps except as superceded in this paragraph.
- B. The shaft shall be solid stianless stell through the mechanicl seal.
- C. Pump shall be of Ni-Hard construction with Ni-Hard impeller.
- D. Impellers shall be vortex type.

2.5 NON-POTABLE WATER PUMPS (CLOSED IMPELLER)

- A. Pumps shall be by Cornell, Goulds, or Grundfos.
- B. Pumps shall be centrifugal, close-coupled type in configuration as shown on the Drawings.
- C. Pump body shall be cast iron bronze fitted. Impellers shall be enclosed cast iron.
- D. Provide mechanical seal, single, of type 1 carbon ceramic with run-dry capability.

PART 3 EXECUTION

3.1 EXAMINATION

McGill Sections 017000 and 017700

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Requirements for installation examination.
- B. Verify that equipment is ready for installation.

3.2 INSTALLATION

- A. Install equipment according to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

McGill Sections 017000 and 017700

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two days on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
 - 1. One representative for each pump manufacturer shall be required as above.

3.4 TESTING

- A. Commercial testing shall be required and include the following:
 - 1. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to hp, voltage, phase and hertz.
 - 2. The motor seal and housing chambers shall be meggered for infinity to test for moisture content or insulation defects.
 - 3. Pump shall be allowed to run dry to check for proper rotation.
 - 4. Discharge piping shall be attached, the pump submerged in water and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced.
 - 5. The pump shall be removed from the water, meggered again, dried and the motor housing filled with oil.
- B. A non-witnessed hydraulic institute performance test shall be performed for pumps with motors rated at 20 or more horsepower. This shall include the following:
 - 1. The pump shall be tested at the design point as well as at least 4 other points to develop a curve. Data shall be collected to plot the head-capacity curve as well as a kW input and amperage curve.
 - 2. In making these tests, no minus tolerance or margin shall be allowed with respect to capacity, total head or efficiency at the specified design condition. Pump shall be held

within a tolerance of 10% of rated capacity or at rated capacity with a tolerance of 5% of rated head. The pump shall be tested at shut-off, but not be plotted, and only used as a reference point when plotting the performance curve.

3. Complete records shall be kept of all information relevant to the test, as well as the manufacturer's serial number, type and size of pump, as well as any impeller modifications made to meet the design conditions.
4. A written test report shall be prepared, signed and dated by the test engineer incorporating 3 curves (head-capacity, kW input, and amperage) along with the pump serial number, test number, date, speed, volts, phase, impeller diameter, and certification number. This report shall then be submitted to the Engineer.

3.5 DEMONSTRATION

- A. Section 01 7900 - Demonstration and Training: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 46 2020 - MECHANICALLY CLEANED FILTER SCREEN

Addendum No. 004
02-21-22

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Contractor shall furnish all labor, equipment, materials, tools, and incidental items required to install and place into proper operation one (1) mechanically cleaned filter screen(s) and one (1) screenings washer/compactor(s) specified in Section 46 2025. All equipment shall be installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, state, and federal codes and regulations.
- B. Each screen shall be furnished complete with filter panels, discharge chute, side frames, covers, drive chains, sprockets and bearings, scraper assembly, drive motor, gear reducer, anchor bolts, controls for operation of the screen and associated screenings washer/compactor and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.
- C. Screen(s), Washer/compactor(s) and Controls shall be supplied by a single manufacturer to ensure compatibility and proper operation of the system.
- D. Contractor shall be responsible for coordination of all related parts of the work. The contractor shall verify all structures, piping, wiring, and components are compatible. Contractor shall be responsible for all structural and other alterations required to accommodate equipment differing in dimensions or other characteristics from these specifications and drawings.
- E. All equipment to be installed shall be rated for Class I, Division 1, Hazardous locations. Equipment main control panel will be located in a non-classified indoor area.

1.2 RELATED SECTIONS

- A. ~~Section 01 3000 – Administrative Requirements: Submittals~~
McGill Section 013300.
- B. Section 03 3000 – Cast-in-Place Concrete
- C. Section 05 5010 – Miscellaneous Metal
- D. Section 09 9110 – Painting
- E. Division 16 – Electrical
- F. Section 46 0103 – Startup and Commissioning Procedures: Equipment Installation Inspection and Start Up
- G. Section 46 0106 – Operation and Maintenance Manuals
- H. Section 462025 – Screenings Washer/Compactor

1.3 SUBMITTALS

- A. Provide shop drawings and product data in accordance with section 01 3000 for the equipment being furnished, to include at minimum the following:
 - 1. Certified shop drawings showing the details of construction, dimensions and anchor bolt requirements.
 - 2. Complete wiring diagrams detailing all required field connections.
 - 3. Descriptive literature, brochures, and/or catalogs of submitted equipment.
 - 4. Headloss calculations showing the ability of the screen to meet the flow and headloss requirements as specified in Table 2.2.B.
 - 5. Complete bill of materials for the equipment.
 - 6. List of Manufacturer's supplied spare parts.
 - 7. Manufacturer's ISO 9001:2015 certificate of registration
 - 8. Equipment weights.
 - 9. A copy of Manufacturer's 3-year factory warranty.
- B. The manufacturer shall furnish operation and maintenance manuals in accordance with the requirements of section 46 0106 – Operation and Maintenance Manuals, to include at minimum the following:
 - 1. Short and long term storage requirements.
 - 2. Manufacturers unloading instructions.
 - 3. Manufacturer's installation instructions
 - 4. Equipment weights and lifting points.
 - 5. Complete wiring diagrams detailing all required field connections.
 - 6. Assembly drawings
 - 7. Maintenance schedule
 - 8. Maintenance instructions

1.4 REFERENCE STANDARDS

- A. American Iron and Steel Institute (AISI).
- B. American National Standards Institute (ANSI).
- C. American Society for Testing Materials (ASTM).
- D. American Bearing Manufacturers Association (ABMA).

- E. American Gear Manufacturers Association (AGMA).
- F. National Electrical Manufacturers Association (NEMA).
- G. Underwriters Laboratory (UL).

1.5 QUALITY ASSURANCE

- A. Qualifications: Qualified Manufacturers shall have a minimum 15 years' experience manufacturing screens, with no fewer than 20 operating installations of the type specified herein located in the USA. Manufacturer shall provide a list of 20 names and dates of installations for verification by the Engineer or Owner's Representative.
- B. A single manufacturer shall provide all components including but not limited to the screen, motors, gear reducers and control panels as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.
- C. Screen shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions. Equipment manufactured outside the United States, or by third parties, shall not be permitted for this project. The equipment manufacturer shall supply a certificate of origin and letter of compliance confirming both requirements.
- D. All welding shall be performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code.
- E. Screen shall undergo a passivation process to ensure maximum resistance to corrosion. All stainless steel surfaces shall be thoroughly cleaned and glass bead-blasted to a minimum SSPC-SP-6 finish. The use of nitric and hydrofluoric acid passivation is not acceptable due to the negative impact these chemicals have on the environment.
- F. Manufacturer shall warranty all equipment against faulty or inadequate design, improper assembly, defective workmanship or materials. Materials shall be suitable for the service conditions.
- G. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. The fabrication shall be performed by the equipment manufacturer at the manufacturer's facility located within the continental USA; all welding and assembly shall be performed by direct employees of the manufacturer; each welder shall be certified in accordance with AWS or ASME. Welder certificates shall be provided to the Engineer upon request.
- H. All structural members of the equipment shall be designed for shock and vibratory loads. Additionally, the screen shall be designed to withstand the forces generated by maximum operating head without damage to the screen or its components.
- I. Each screen shall have the Manufacturer's name, address, and product identification information on a corrosion resistant nameplate securely affixed to the equipment.

- J. Screen manufacturer shall be ISO 9001:2015 certified and provide the Engineer with a copy of a valid certificate of registration. Equipment suppliers not utilizing ISO 9001 manufacturing facilities shall not be considered or approved for this project.
- K. All control panels shall be fabricated and tested in the manufacturer's UL Authorized control panel shop. The equipment manufacturer shall supply a certificate of conformance confirming this requirement.

1.6 WARRANTY

- A. The equipment shall be warranted by the manufacturer for a period of three (3) years from the date of shipment. Additionally, the lower sprocket bearings shall include a (5) year warranty period from the date of shipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Shipping
 - 1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
 - 2. Pack spare parts in containers bearing labels clearly designating contents and equipment for which they are intended.
- B. Receiving and Storage:
 - 1. Store and safeguard equipment, material, and spare parts. All spare parts must be stored in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Screen shall be in compliance with these specifications and plans and shall be supplied by the following manufacturer:
 - 1. Basis of design manufacturer: Kusters Water, ProTechtor® Multirake Screen (Model MRS-C)
 - 2. Pre-approved equal manufacturers: Parkson, Veolia.
 - 3. Any request for pre-approval must be submitted at least 21 calendar days prior to the bid date. Pre-Approved equals must meet these specifications without exception. The pre-approval information shall include a copy of this specification with a line by line check confirming 100% compliance with every item, a letter of compliance signed by a corporate officer for section 1.5, and customer references for no fewer than 10 installations which shall include:
 - a. Jobsite address
 - b. Customer name

- c. Customer phone number
 - d. Customer email address
 - e. Date of installation
 - f. Peak flow capacity for each screen
 - g. Bar spacing
 - h. Headloss calculations at peak flow
4. Suppliers not meeting the experience clause identified in section 1.5.A shall provide a performance and payment bond for 100% of the contract amount. The bond shall be issued by a surety with an FSR rating of no less than "A". A letter of surety shall be provided with the pre-approval to confirm bondability. The owner and/or engineer reserves the right to reject any manufacturer should insufficient or incomplete data be provided to determine an approved equal manufacturer status.

2.2 FILTER SCREEN UNITS

A. GENERAL DESIGN REQUIREMENTS

1. The mechanically cleaned filter screen shall be a self-contained screening system designed to positively clean and remove debris from the influent flow stream and transport the retained debris to the discharge point. The screen system shall be fully automated and controlled by the manufacturer supplied control system.
2. The screen shall be mounted by fastening to the top of the channel. Routine service, repair or replacement of damaged parts, shall either be possible with the screen in the channel or the screen shall be provided with a pivot to allow it to be rotated out of the panel for maintenance. The screen shall be designed so that maintenance of the drive mechanism can be accomplished at operating floor level. Screen elements shall be capable of removal at the operating level without taking the screens out of the channel and affecting the continuous or intermittent rotation of the screen, or the screen shall be provided with a pivot to allow it to be removed from the channel for element replacement.
3. The screen shall be designed to provide maximum solids filtration, and thus maximize capture of debris, while minimizing the rate of head loss increase through the screen. This shall be achieved by means of one piece perforated curved filter elements arranged to form a continuous filter belt. The one piece curved screening elements shall be minimum 1/8" thick and fixed by four fasteners to a heavy duty box link drive chain. The use of roller chain or filter shafts and rollers will not be acceptable.
4. The chains shall run over stainless steel drive sprockets keyed to a main, solid, stainless steel drive shaft which shall be mounted in externally mounted bearings and driven by a shaft mounted motor-driven gear unit.

5. The screen shall be automatically self-cleaning through the interaction of the one piece filter elements with a rotating cleaner brush and the use of spray water for supplementary cleaning. Screens which use a spray water cleaning system only will not be accepted due to the high volume of water required for proper cleaning.
6. A rotating deflector consisting of a tube roller and wiper supported by externally mounted bearings shall be provided at the discharge point of the screen. The roller shall function to direct all solids removed from the screen by the revolving brush cleaner to the screenings discharge chute and shall prevent bypassing of solids into the downstream channel. Screens which do not incorporate a rotating deflector shall not be acceptable.
7. The Contractor shall be required to make any necessary modifications to the existing concrete channel walls and floor, and to the operating floor curb, to accommodate the equipment furnished. The manufacturer shall ensure the manufacturer furnished seals at the channel walls and floor are properly mounted to redirect influent flow into the bar rack and prevent screenings from passing between the concrete walls and screen side frames.

B. DESIGN CRITERIA

Maximum Flow:	10.0 MGD
Channel Width:	3.0 ft.
Channel Depth:	4.0ft.
Filter Panel Perforation:	6mm
Downstream Water Level at Maximum Flow:	1.5 ft.
Headloss at Maximum Flow:	14.15in.
Headloss at Maximum Flow and 30% Blinding:	20.33 in.
Maximum Upstream Water Level:	3.19ft.
Channel Invert to Operating Floor Depth:	4.0ft.
Screen Discharge Height:	4.0 ft.
Screen Incline from Horizontal:	60 degrees
Screen Motor Horsepower:	Minimum 1.5
Brush Motor Horsepower:	Minimum 1.5
Deflector Motor Horsepower	Minimum 0.5
Side Frame Material / Thickness:	304 Stainless Steel/ 3/16 in.
Guide Track Material:	304 Stainless Steel
Sprocket/Guide Material:	304 Stainless Steel
Chain material:	304 Stainless Steel
Fastener Material:	304 Stainless Steel

Washwater Flow Rate:	10 gpm maximum, 40 psi maximum
Operational Environment:	Class I, Div. I
Operational Voltage:	460V/3ph/60Hz
Control Panel NEMA Rating:	NEMA 4X, Stainless Steel
Local Station NEMA Rating:	NEMA 7, Cast Aluminum

C. PERFORMANCE AND DESIGN REQUIREMENTS

1. Each screen shall be capable of processing the specified peak flow of municipal wastewater with the specified amount of freeboard when installed in the channel at a screen inclination as noted in Table 2.2.B. The screen shall lift and discharge screenings at an elevation as specified in Table 2.2.B into the discharge chute without use of brushes or spray washes.
2. The maximum upstream water level shall not exceed that specified in Table 2.2.B. The screen shall be capable of processing the peak flow without exceeding the maximum upstream water level based on a 30% reduction (blinding) of the screens free open area.
3. The travel speed of the cleaning rakes shall be as specified in Table 2.2.B. The bar rack must be continually cleaned by the travelling rakes with an elapsed time between cleaning of 5 -10 seconds.
4. All parts shall be designed and manufactured so the screen structure can withstand the hydraulic force exerted by the maximum water depth. All structural and functional parts shall be adequately sized to prevent deflection and vibration which could impair operation.
5. All components shall be so designed that jamming at any point will not result in structural failure but will cause the drive motor to stall. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor and/or the maximum differential head at any water depth.
6. If provided with a pivoting support arrangement to provide for maintenance as specified in this section, the pivot shall be attached to the screen frame and top of the channel to allow the screen to be pivoted following the removal of the inlet hopper of the downstream screenings receiving device. It shall not be necessary to disassemble or move the downstream screenings receiving device from its fixed position to allow pivoting of the screen.

D. SCREEN COMPONENTS

1. Screen Frame Assembly
 - a. The screen frame shall be provided and designed to support all required static and dynamic loads.
 - b. Each side frame shall include a separate chain guide track to guide and support the drive chains. The tracks must support both the upstream and downstream chain

lengths and be bolted to the side frames so they can be easily replaced.

- c. The side frames shall incorporate adjustable UHMW-PE, or equivalent, side seals to provide a sliding seal between the filter panel side plates and the screen frame. The side seals shall be adjustable to compensate for any wear that may occur over the life of the screen.
- d. A curved stainless steel deflector plate shall be provided at the foot of the screen to prevent ingress of stones and grit that may create wear on the filter panels. A lateral seal element consisting of a full width brush and neoprene flap shall be attached to the curved deflector plate to seal the gap between the screen frame and the channel floor as well as the gap between the deflector plate and the filter panels.

2. Filter Belt

- a. The screen filtration belt shall be comprised of one piece perforated plate filter panels. The panels shall be curved to prevent deflection.
- b. The one piece curved screening elements shall be minimum 1/8" thick and adequately fixed to heavy duty drive links. The panels shall incorporate integral stainless steel side plates which are welded to the panel for durability and to prevent material from bypassing the panel.
- c. On approximately every fifth screen panel a set of static lifters shall be attached to the lower edge of the panel, designed specifically to lift spherical and large size solids from the bottom of the channel.
- d. The screen elements shall be cleaned by a motorized polypropylene bristle brush. The brush shall be adjustable such that as the brush wears during use, it can be manually adjusted to increase cleaning efficiency. The brush shall be driven independently with a single speed motor coupled to a shaft-mounted gear reducer.

3. Wash Water System

- a. To control the buildup of biological slimes behind the screen panels, an internal spray water wash bar shall be provided.
- b. The spray bar shall be attached in the internal space between the moving screen panels, and the spray water shall be directed to wash each screen panel as the panel moves past the spray nozzles.
- c. The spray bar shall supply approximately 3 gpm per ft. of screen panel width.
- d. The spray nozzle shall be of non-plug design and compatible with non-potable water provided from the plant effluent.
- e. Influent to the system shall be provided with a control solenoid valve, manual flow adjustment ball valve, and water strainer.

4. Chains

- a. Drive chains for the screen panels shall be box link type chains. Each chain shall have a minimum breaking load of 20,000 lbf.
 - b. Chain with non-stainless steel components will not be accepted.
 - c. Each guide track shall incorporate a replaceable 2" wide x 1.5" thick UHMW-PE chain support to prevent metal on metal wear.
5. Upper Bearings and Drive Sprockets
- a. The screen shall be provided with upper drive sprockets with 8 teeth and a nominal pitch diameter of 13". The sprockets shall have a minimum plate thickness of 1".
 - b. The drive shaft shall be solid and supported on each side by an externally mounted, grease lubricated bearings.
 - c. Upper bearings shall be ball bearings, greased, and protected by double seals. The bearing diameter shall be a minimum of 2-3/8" and mounted in oil-resistant, enamel coated casings supported by a stainless steel take-up frame.
6. Lower Chain Guides
- a. The screen shall be provided with lower revolving sprockets/guides with 8 teeth and a nominal pitch diameter of 13". The sprockets shall have a minimum plate thickness of 1".
 - b. The lower guides will be mounted on two stub shafts bolted to the screen side frames and shall incorporate high performance metallic bushings that can be lubricated from the operating floor.
 - c. UHMW or plastic guides are not acceptable materials of construction.
7. Discharge Chute
- a. A discharge chute shall be provided that fully encloses the discharge section of the screen. The discharge chute shall be made of minimum 3/16" thick stainless steel plate.
 - b. The height of the discharge chute shall allow proper discharge into the screenings receptacle.
 - c. The discharge chute shall contain inspection ports on each side and shall pivot away from the screen frame for access to the cleaning brush.
8. Guards and Covers
- a. The portion of the screen above the operating floor level shall be provided with easily removable, properly stiffened stainless steel covers.
 - b. The covers shall fully enclose the screen to provide safety and to contain odors. The covers will allow ready access for maintenance to the equipment.

- c. The covers shall be removable to facilitate visual observation by maintenance personnel when required.
- 9. Screen Drive Assembly
 - a. The screen shall be driven by a heavy-duty, shaft-mounted helical worm gear reducer. The gear reducer shall be sized to provide the proper input power and torque to operate the screen and be rated for greater than the nominal horsepower of the drive motor.
 - b. The gear reducer shall be driven by an inverter duty electric motor. The motor shall be UL rated for the operational environment, rated as specified, with a minimum service factor of 1.0.
- 10. Brush Drive Assembly
 - a. The screen cleaner brush shall be driven by a heavy-duty, shaft-mounted helical worm gear reducer. The gear reducer shall be sized to provide the proper input power and torque to operate the screen and be rated for greater than the nominal horsepower of the drive motor.
 - b. The gear reducer shall be driven by an inverter duty electric motor. The motor shall be UL rated for the operational environment, rated as specified, with a minimum service factor of 1.0.
- 11. Rotating Deflector Drive Assembly
 - a. The rotating deflector shall be driven by a heavy-duty, shaft-mounted helical worm gear reducer. The gear reducer shall be sized to provide the proper input power and torque to operate the screen and be rated for greater than the nominal horsepower of the drive motor.
 - b. The gear reducer shall be driven by an inverter duty electric motor. The motor shall be UL rated for the operational environment, rated as specified, with a minimum service factor of 1.0.

2.3 CONTROLS AND INSTRUMENTATION

A. GENERAL

- 1. Each control panel shall be the supplier's standard UL listed enclosure and wired for the voltage as specified in Table 2.2.B. The enclosure shall be furnished completely pre-wired and tested, requiring only mounting and connection to field mounted electrical devices. The control panel shall include all equipment required to control the equipment specified herein and the washer/compactor specified in Section 46 2025.
- 2. The control panel enclosure shall be suitable for wall or floor mounting. The enclosure shall house all control devices required for a complete and operable system. All hinges and latches shall be corrosion resistant.

3. A separate local control station in an enclosure as specified in Table 2.2.B shall be provided. The local control station shall include an emergency stop, red, mushroom head pushbutton, Hand/Off/Auto switches and all other operators as required for proper operation of the equipment specified.

B. CONTROL DEVICES

1. Main power fusible disconnect switch with through door lockable handle.
2. Pilot devices shall be mounted on the front of the enclosure door.
3. Indicator lights shall be LED type.
4. Selector switches shall be heavy duty NEMA type.
5. Control transformer shall be protected by two (2) primary fuses and one (1) secondary circuit breaker. The 120-volt secondary shall have one leg grounded.
6. Auxiliary relay contacts shall be included for signal outputs. The contacts shall be rated 10 amp, 240 VAC, resistive load.

C. SAFETY FEATURES

1. If a power failure occurs while the equipment is running, operation shall resume when power is restored.
2. If a power failure occurs while the equipment is in a fault condition, the fault indicator shall reactivate when power is restored.
3. Short-circuit protection requires that a properly sized circuit breaker be provided by the Electrical Contractor.
4. Control reset shall be from the main control panel only.

D. COMPONENTS

1. Controller
 - a. Allen Bradley MicroLogix 1400 PLC.
 - b. Allen-Bradley PanelView 800, 7" color flat panel touch screen.
2. Operation Controls
 - a. Control Power: OFF/ON switch
 - b. Alarm reset: Pushbutton
 - c. Emergency Stop: Push to stop, pull to run pushbutton
3. Indicator Lights

- a. Control power on: White pilot light
- 4. Dry Contacts
 - a. Screen In-Auto
 - b. Screen Running
 - c. Screen Fault
 - d. Brush Running
 - e. Brush Fault
 - f. Deflector Running
 - g. Deflector Fault
 - h. High Level
 - i. E-Stop
- E. LOCAL STATION
 - 1. Screen
 - a. Screen: HAND/OFF/AUTO selector switch
 - b. Screen: REVERSE/OFF/FORWARD selector switch
 - c. Screen: FAST/SLOW selector switch
 - d. Emergency Stop: Push to stop, pull to run pushbutton
- F. FIELD MOUNTED DEVICES
 - 1. Level Control
 - a. Two (2) Siemens Sitrans LU Ultrasonic level controllers and Mounts
 - b. One (1) High level alarm float switch
- G. OPERATION
 - 1. When in Automatic mode, the screen shall be started by the level sensors, a high water level float switch, or a screen idle timer.
 - 2. Screen operation shall begin in slow speed when the level sensors detect a start differential water level. The screen will continue to run until the differential drops below the start differential. Once below this level the screen will continue to run for the duration set in its off-delay timer and then stop.

- a. If the water differential continues to increase while the screen is running the screen will increase to high speed operation. The screen will continue to run in high speed until the water differential decreases to the slow speed (start) differential level. The screen will then decelerate to slow speed until the differential is below the start differential. Once below this level the screen will continue to run for the duration set in its off-delay timer and then stop.
3. If the high level float switch starts the screen, the screen will start in high speed and an alarm signal will be sent by the control system. The screen will continue to run in high speed until the float switch no longer detects a level. Once below this level the screen will continue to run for the duration set in its off-delay timer and then stop.
4. If the screen has not been started by a differential or float signal and the screen idle timer elapses, the screen will start in slow speed and run for the duration set in its off-delay timer and then stop.
5. If the over-torque sensor for the screen is activated during screen operation, indicating a jam, the screen will reverse in an attempt to clear the jam. The screen will reverse for a set period of time, then run forward again. If the jam has been cleared, the screen will return to normal operation. If the jam still exists, the screen will make additional attempts to clear the jam, (3 attempts, maximum). If the jam is not cleared after the final attempt, the screen will stop, and an alarm signal will be sent by the control system.
 - a. A jam (over-torque) condition in HAND mode immediately stops the screen and the control system will send an alarm signal.

2.4 SOURCE QUALITY CONTROL

- A. Screen system and control panel shall be factory assembled and tested to ensure proper design and satisfactory operation. Equipment shall be shipped in the minimal practical number of pieces for minimal field assembly by the Contractor.

2.5 SHOP PAINTING

- A. Stainless steel and other corrosion-resistant surfaces shall not be painted. Gearboxes, Motors, and other manufactured components will receive the manufacturer's standard weather and corrosion-resistant coating.

2.6 SPARE PARTS

- A. The following spare parts shall be provided:
 1. One (1) Replacement screen panel without lifter
 2. One (1) Replacement screen panel with lifter
 3. One (1) Lower seal assembly
 4. Three (3) Fuses of each size and type used in the control panel

PART 3 EXECUTION

3.1 INSTALLATION AND TESTING

- A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of any significant deviations.
- B. Installation of the equipment shall be in strict accordance with the contract documents and the Manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the Manufacturer's recommendations.
- C. Supplier shall furnish the services of a factory-trained Service Engineer for two (2) trips. One (1) trip of one (1) day for installation inspection services. One (1) trip of two (2) days for start-up, commissioning, and to provide operator training.
 - 1. Equipment shall not be energized, or "bumped", to check the electrical connection for motor rotation without installation inspection and the Service Engineer present.
 - 2. The Service Engineer shall make all necessary adjustments and settings to the controls.
 - 3. The Service Engineer shall demonstrate proper and sequential operation of the screen. The screen shall be operated in both Automatic and Hand mode by the Service Engineer during the start-up and commissioning to demonstrate proper operation of the screen system.
 - 4. The screen must undergo a full scale site test during which the screen will be subjected to the maximum differential head condition.
 - a. This test will consist of fully blinding the front of the screen using plywood and plastic sheeting to allow for the maximum differential head level to be built on the front face of the screen.
 - b. Should the screen fail this test, for example there is bending, bowing, buckling or other significant signs of mechanical damage, then the screen shall be repaired or replaced at the manufacturer's cost.

END OF SECTION

ADDENDUM NO. 005

McGill Associates Note:
All Addendum omissions by
McGill Associates are shown
in red text strikethrough.



TO: All Plan Holders

RE: Town of Richlands - 4.0 MGD WWTP Upgrades and Improvements
for Town of Richlands
T&L Project No. 14249

DATE: February 25, 2022

~~ORIGINAL BIDS RECEIVED DATE:~~ ~~February 23, 2022~~

~~REVISED BIDS RECEIVED DATE:~~ ~~March 2, 2022~~

This Addendum forms a part of the Contract Documents and modifies the original Bidding Documents dated January 7, 2022 as noted below. ~~Acknowledge receipt of this Addendum in the space provided on the Bid Form. Failure to do so may subject Bidder to disqualification.~~

~~This Addendum consists of 37 pages and 13 drawing sheets, with the revised date of February 25, 2022.~~

CLARIFICATIONS:

1. Unless specifically stated otherwise, all underground electric (UGE) shall be installed per trench detail on sheet E501 and as described in specification section 26 0533.13.
2. Provide NEMA-3R Variable Frequency Motor Controllers for primary sludge pumps P-60 and P-70. Mount them to support structure adjacent to valve vault as shown in "TYPICAL NON-SHELTER EQUIPMENT MOUNTING DETAIL" on Sheet E501. Safety switches on the load side of the VFD as shown on sheet E203 for pumps P-60 and P-70 are not required.
3. Not all meter locations are indicated on E series drawings, refer to C series drawings.
4. Valve operators for valves listed in schedules on Drawing C006 are all manual.



CHANGES TO THE SPECIFICATIONS:

1. In Section 26 2923 – Variable-Frequency Motor Controllers, the requirement for "Manual Bypass" in specification in paragraph 2.4 I has been removed. No manual bypasses are required. The revised page is not attached.
2. Section 40 0552 – Process Valves has been revised to provide the requirements for check valves. Note that the valve (and gate) schedule as shown in the drawings requires only manual actuators. Actuator type requirements in the section have been clarified that they only apply if actuator type is not indicated in the valve schedule. Electrical and pneumatic actuator requirements in this section are provided only if an equipment manufacturer uses such on their packaged equipment and the actuator requirements are not shown elsewhere. The revised Section is attached in its entirety.
3. In Section 40 0559 – Hydraulic Gates, paragraph 2.2.B for stainless steel gates has been deleted. The revised page is not attached.
4. The reference to an incorrect section has been corrected on page 8 of Section 46 4322 – Clarifier and Thickener Restoration. The revised page is attached.
5. Section 46 7621 – Belt Filter Presses has been revised to remove references to a skid mounted system and to revise the minimum sludge feed rate, the minimum belt width and contact area for the dewatering belt, and the washwater feed rate. The equipment for this project will be mounted on a concrete base as shown in the Drawings. The revised Section is attached in its entirety.

McGill Associates Note:
All T&L Addendum drawing revisions
have been incorporated into the plans.

CHANGES TO DRAWINGS:

1. ~~Several valves in the valve schedule on Drawing C006 have been revised. The revised drawing is attached.~~
2. ~~An additional section of pipe is to be demolished on Drawing C208. The revised drawing is attached.~~
3. ~~A portion of the lower level piping and valve layout has been edited on Drawing C301. The revised drawing is attached.~~
4. ~~Two lower floor slide gates have been deleted on Drawing C401. The revised drawing is attached.~~
5. ~~A slide gate label has been edited on Drawing C402. The revised drawing is attached.~~
6. ~~A septage storage tank valve has been edited on Drawing C403. The revised drawing is attached.~~



- ~~7. Several valves have been edited on Drawing C505. The revised drawing is attached.~~
- ~~8. An additional section label and valves have been added to Drawing C801. The revised drawing is attached.~~
- ~~9. Section 3 has been added to Drawing C802. The revised drawing is attached.~~
- ~~10. Section labels have been added to Drawing C804. The revised drawing is attached.~~
- ~~11. Section labels and valves have been added to Drawing C805. The revised drawing is attached.~~
- ~~12. Additional valves and dimensions have been added and a section of piping has been revised on Drawing C806. The revised drawing is attached.~~
- ~~13. Drawing C807 has been added and is attached. The sheet index has been revised accordingly and is not attached.~~

Enclosures: Specification Section 40 0552 – Process Valves, 13 pages
 Section 46 4322 – Clarifier and Thickener Restoration, 1 page
 Specification Section 46 7621 – Belt Filter Presses, 20 pages
 ~~Drawings C006, C208, C301, C401, C402, C403, C505, C801, C802, C804, C805, C806 and C807~~

SECTION 40 0552 - PROCESS VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ball valves - metal body.
- B. Butterfly valves - metal body.
- C. Gate valves - metal body.
- D. Pinch valves - metal body.
- E. Plug valves - metal body.
- F. Swing check valves - metal body.
- G. Valve operators.
- H. Electric valve operators (unless superseded in equipment specifications).
- I. Pneumatic valve operators (unless superseded in equipment specifications).

1.2 RELATED REQUIREMENTS

- A. Section 40 2340 - Sanitary Wastewater Process Piping.
- B. Section 46 0106 - Operation and Maintenance Manual: Operating and maintenance data.
- C. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Valve finish colors.

1.3 REFERENCE STANDARDS

- A. AWWA C508 - Swing-Check Valves for Waterworks Service, 2-In. Through 24-In.
- B. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
- C. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
- D. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service 2021.
- E. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings 2012.
- F. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings 2017.
- G. AWWA C504 - Rubber-Seated Butterfly Valves 2015.
- H. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service 2015.

- I. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates 2016.
- J. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates 2016.
- K. AWWA C550 - Protective Interior Coatings for Valves and Hydrants 2017.
- L. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions 2018.
- M. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.
- N. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

1.4 SUBMITTALS

- A. ~~See Section 01 3000 - Administrative Requirements~~ for submittal procedures.

McGill Section 013300.
- B. Product Data: Manufacturer's data sheets for each valve and accessory, showing compliance with requirements; include materials, pressure ratings, valve operators, seats and seals, clearances for operation and maintenance, and other characteristics.
 - 1. Identify data sheets using the valve identification scheme used on drawings.
 - 2. For electric actuators, show electrical characteristics.
 - 3. For pneumatic actuators, show air supply pressure.
 - 4. AWWA C504 Butterfly Valves: Submit certified statement by manufacturer that proof-of-design performance, leakage, and hydrostatic tests as described in AWWA C504 were successfully met.
- C. Shop Drawings: Custom-prepared piping diagrams showing location of each valve and drain, whether or not indicated in Contract Documents; this shop drawing may be combined with other piping shop drawings.
- D. Valve Schedule: Custom-prepared schedule of valves, showing:
 - 1. Valve identifying number; cross-reference to product data sheets and to process and instrumentation diagrams (P&ID).
 - 2. Manufacturer and model name/number.
 - 3. Valve type using specification terminology (e.g. gate, metal body, over 2 inch).
 - 4. Application (direct-buried or exposed).
 - 5. Piping Service (e.g. return activated sludge).
 - 6. Installation orientation (horizontal or vertical pipe, stem vertical or horizontal).
 - 7. Size and dimensions.
 - 8. Flow coefficient Kv.

9. Pressure rating and pressure drop at specified flow rate.
 10. Spring range.
 11. Valve end type (e.g. flanged, threaded, socket-welded).
 12. Manual operator type.
 13. Automatic operator type, where applicable, and identifying number.
 14. Accessories (e.g. extension stem, floor stand, extension bonnet).
 15. Access and clearance requirements.
- E. Automatic Operator Schedule: Custom-prepared schedule of automatic valve operators, showing:
1. Valve and operator identifying numbers.
 2. Operator manufacturer and model number.
 3. Positive positioner range.
 4. Close-off pressure to torque.
 5. Actuator type (electric or pneumatic).
 6. Electric Actuators: Input and output contacts.
 7. Pneumatic Actuators: Input air pressure.
 8. Access and clearance requirements.
- F. Automatic Valve Operator Calculations: For each remote-controlled valve, submit calculations supporting selection of actuator, including calculations of the force required to move and seal the valve.
- G. Operating and Maintenance Data: See Section 46 0106.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than 10 years documented experience.

PART 2 PRODUCTS

2.1 VALVE APPLICATIONS

- A. Do not direct-bury flanged valves; provide valve pit or manhole.
- B. In-Line Electrical Devices: Provide a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

2.2 REQUIREMENTS APPLICABLE TO ALL VALVES

- A. See drawings for valve sizes, valve ratings, operator types, and piping types and sizes.
- B. Provide valves suitable for the service indicated and coordinated to piping system.
 - 1. Provide valves that will withstand working pressure indicated or working pressure of pipe to which valve is connected, whichever is greater.
 - 2. Provide valves of sizes indicated or of port diameter/area equal to that of pipe to which valve is connected, whichever is larger.
 - 3. Provide valves that open by turning counterclockwise, with direction of opening integrally marked on operating nut or operator.
 - 4. Valve End Connections: As indicated; if not indicated, provide end connections of the same type as indicated for joints in pipe to which valve is connected.
 - 5. Factory install operators and accessories.
- C. Identification and Tagging: In addition to the information required by Section 46 0500, mark valves in accordance with MSS SP-25 using identification tags securely attached; on tags show the service, valve identification number from drawings, manufacturer's name and model number.
 - 1. Identification Tags: 1.375 inches diameter, minimum; engraved laminated plastic with black lettering.
 - 2. Attachment: No. 12 AWG copper wire.

2.3 REQUIREMENTS APPLICABLE TO METAL-BODY VALVES

- A. Valve End Connections:
 - 1. Flanged Ends: In accordance with ASME B16.5; Class 125 pound unless otherwise indicated.
 - 2. Mechanical Joint Ends: Styrene butadiene rubber (SBR) or vulcanized SBR gasketed type, in accordance with AWWA C111/A21.11 and AWWA C110/A21.10.
- B. Valve Exterior Finish: Factory-applied epoxy coating complying with AWWA C550; either two-part liquid material or heat-activated material.
 - 1. Where valve is indicated to have fusion bonded epoxy finish, provide only heat-activated material.
 - 2. Coating Thickness: 7 mils, minimum, dry film thickness.
 - 3. Colors: As specified in Section 46 0500; use "safety yellow" for isolation valves and lockout valves with handles, hand wheels, or chain wheels.

- C. Valve Lining: Factory-applied factory-applied lining; use epoxy lining unless other material is indicated.
 - 1. Epoxy Lining: AWWA C550; either two-part liquid material or heat-activated material except provide only heat-activated material when lining is indicated as fusion bonded.
 - 2. Epoxy Lining Thickness: 7 mils, minimum, dry film thickness, except where thickness is limited by valve operating tolerances.

2.4 BALL VALVES - METAL-BODY

- A. Ball Valves - Sizes 2 inch and Smaller: End entry one-piece body type.
 - 1. Rating: 400 psig at 150 degrees F.
 - 2. Body: Bronze, with full bore ports.
 - 3. Seat: Polytetrafluoroethylene (PTFE) seats and packing.
 - 4. Ball: Chrome plated steel.
- B. Ball Valves - Sizes 2.5 inch and larger: End entry one-piece body type.
 - 1. Rating: 400 psig at 150 degrees F.
 - 2. Body: Bronze, with full bore ports.
 - 3. Seat: Polytetrafluoroethylene (PTFE) seats and packing.
 - 4. Ball: Chrome plated steel.
- C. Ball Valves - Sizes 1.5 inches to 6 inch: Multi-piece body type with stainless steel ball.
 - 1. Rating: 1000 psig.
 - 2. ASME Class: [_____] in accordance with ASME B16.34.
 - 3. Body: Three piece; ASTM A216/A216M stainless steel, with full bore ports.
 - 4. Trim: TP316 stainless steel ball, reinforced polytetrafluoroethylene (PTFE) seats and stem packing.

2.5 BUTTERFLY VALVES - METAL BODY

- A. Butterfly Valves: Lugged style.
 - 1. AWWA Class: 125 in accordance with AWWA C504.
 - 2. Body: ASTM A126 cast iron.
 - 3. Disc: Contoured ASTM A436 Type 1 Ni-resist cast iron with maximum lead content of 0.003 percent.

4. Valve Shafts: Carbon steel with self-lubricating, corrosion-resistant sleeve type bearings.
5. Seats for Valves 24 inch and Smaller: Attached to either valve body or disc; chloroprene.
6. Seats for Valves Larger Than 30 inch: Field replaceable.

2.6 GATE VALVES - METAL BODY

- A. Gate Valves - Sizes 2 inch and Smaller: Solid wedge type with clear waterway equal to full diameter of valve.
 1. Rating: 175 psig.
 2. Body: , Type 1, Class 150; bronze body and stem.
 3. Bonnet: Bronze; screwed.
 4. Disc: Bronze; with rising stem.
- B. Gate Valves - Sizes 2-1/2 inches and Larger: Solid wedge type with clear waterway equal to full diameter of valve.
 1. Rating: 200 psig.
 2. Body: AWWA C509, resilient-seated; Ni-resistant.
 3. Trim: Iron.
 4. Bonnet: OS&Y, bolted type.
 5. Disc: Iron; with non rising stems with backseats.

2.7 PINCH VALVES - METAL BODY

- A. Manufacturers:
 1. Flowrox: www.flowrox.com/#sle.
 2. Onyx Valve Company: www.onyxvalve.com/#sle.
 3. RF Valves, Inc: www.rfvalve.com/#sle.
- B. Pinch Valves:
 1. Rating: 200 psig.
 2. Body: Aluminum; full port sleeves and upper and lower pinch bars.
 3. Seats: Natural rubber.

2.8 PLUG VALVES - METAL BODY

- A. Manufacturers:

1. Milliken Valve: www.millikenvalve.com/#sle.
 2. Henry Pratt Company: www.henrypratt.com/#sle.
 3. Val-Matic Valve & Manufacturing Corporation: www.valmatic.com/#sle.
 4. Weir Power Industrial; The Weir Group PLC: www.weirpowerindustrial.com/#sle.
- B. Plug Valves - Sizes 3 inch and Smaller: Eccentric type.
1. Rating: 175 psig at 140 degrees F.
 2. Body: Nonlubricated type; cast iron; drip-tight shutoff with pressure from either direction.
 3. Plugs: Same material as body, with round ports.
 4. Ports: Regular, with open area minimum 80 percent of connecting pipe area.
 5. Seats: Stainless steel.
 6. Stem Bearings: Self-lubricating stainless steel.
 7. Seals: Butadiene acrylonitrile U-cup type.
- C. Plug Valves - Sizes 3 inches through 54 inch: Eccentric type.
1. Rating: 175 psig at 140 degrees F.
 2. Body: Nonlubricated type; cast iron; drip-tight shutoff with pressure from either direction.
 3. Plugs: Cast iron, with round ports.
 4. Ports: Regular, with open area minimum 80 percent of connecting pipe area.
 5. Seats: Stainless steel.
 6. Stem Bearings: Self-lubricating stainless steel.
 7. Manual Operator for Valves 6 inches and Smaller: Wrench lever.
 8. Manual Operator for Valves 8 inches and Larger: Totally enclosed, geared; with hand wheel, 2-inch nut, or chain wheel.

2.9 SWING CHECK VALVES - METAL BODY

- A. Shall conform to the most current version of AWWA C508 "Swing-Check Valves for Waterworks Service, 2-In. Through 24-In."
- B. The valve shall be mountable in either a horizontal or vertical configuration.
- C. Valve must be repairable in line.

D. Valve must utilize an adjustable lever and weight for assisted closure.

E. Joint/Connection:

1. Flanged connection ANSI B16.1, Class 125

F. Materials:

1. Body: Cast Iron (Fusion Epoxy Coated)
2. Valve Seat: Bronze or Stainless Steel
3. Shaft (Hinge Pin): Stainless Steel
4. Fasteners: Stainless Steel

G. Maximum Pressures:

1. 2" – 30": 200 psi
2. 14" – 30": 150 psi

H. Maximum Temperature: 180°F

I. Manufacturers:

1. Flomatic
2. Cla-Val
3. Engineer Approved Equal

2.10 VALVE OPERATORS

A. Operator Types:

1. For each valve controlled by process control system, provide remote-controlled automatic operator, electric type.
2. For each valve not controlled by process control system, provide a manual operator, except for self-actuated valves.

B. Operators: Sized to operate valve for full range of pressures and velocities and of the type specified for application:

1. Maximum Force to Operate: Not more than 39.3 pounds-force under any operating condition including initial breakaway; provide gear reduction where necessary to reduce force to operate.
2. Locking: Self-locking or equipped with self-locking device; padlock eyes on valve handles; wheels lockable with chain and padlock.
3. Quarter Turn Valves: Provide position indicator.

4. Direct-Buried Quarter-Turn Valves: Operator designed to withstand input torque of 450 foot-pounds at fully open or fully closed positions; grease packed and gasketed to withstand submersion in water to 10.2 psig.
- C. Automatic Operators: Actuator, valve stem coupling, gearing if required, size and configuration to suit full range of valve operation, and additional requirements as indicated.
1. Totally enclosed valve actuating mechanism with adjustable travel stops and valve position indicator.
 2. For Quarter Turn Valves: Reversing, bi-directional operation.
 3. Provide manual override mechanism unless specifically indicated as "no manual override"; with lockable motor de-clutch mechanism.
 4. On loss of control signal, maintain valve in last position, unless otherwise indicated.
 5. Housing: NEMA 250 Type 4X enclosure.
- D. Manual Operators:
1. Provide operator as indicated on the Drawings for each valve. If no operator is shown, provide operator(s) as designated in this section.
 2. Direct-Buried Valves Larger Than 2-1/2 inches: 2 inch operating nut.
 3. Direct-Buried Valves 2 inches and Smaller: Cross handle for operation by forked key.
 4. Exposed Valves: Hand wheel type operator except where other type is permitted or required.
 5. Hand Wheels: Galvanized and painted.
 6. Lever handles are allowed on quarter-turn valves 8 inches and smaller.

2.11 ELECTRIC VALVE OPERATORS

- A. Manufacturers:
1. Rotork: www.rotork.com/#sle.
- B. Electric Operators: Motor-operated.
1. Gearing: Two-stage, planetary, permanently lubricated self-locking gear train with self-lubricating bearings; connections via male output shaft.
 2. Start-up Torque: 120 foot-pound.
 3. Stall Torque: 150 foot-pound.
 4. Duty Cycle: 75 percent.

5. Equipped with AC thermal overload protector with automatic reset or non-overloading under normal operating conditions.
- C. Positioners: For modulating actuators provide positioner controlling the valve position as function of input signals; direct acting; with corrosion-resistant, splash- and moisture-proof enclosure with gasketed cover.

2.12 PNEUMATIC VALVE OPERATORS

- A. Pneumatic Operators: Cylinder and diaphragm actuators as indicated; pressure regulator, gearing, exhaust muffler, safety vented lockout isolation valve, and accessories.
1. Provide pressure gauges in piping as indicated, easily readable and accessible.
 2. Air Supply Pressure: 80 psig.
- B. Cylinder Actuators: Comply with AWWA C541 and AWWA C542.
1. Non Swivel Type: Totally enclosed; position indicator; factory lubricated and sealed, requiring no additional lubrication.
 2. Double Acting Type: Nonmetallic, for operation on non lubricated air; manual override independent of cylinder.
- C. Diaphragm Actuators: Spring return with steel or aluminum diaphragm case and spring barrel, steel spring and actuator stem, and fabric-reinforced chloroprene diaphragm; factory lubricated and sealed.
- D. Pressure Regulator: Adjustable reduced pressure range as required by valve actuator; gauge range 1.33 to 2 times maximum operating pressure; with internal relief, filter, outlet pressure gauge, aluminum body and hand wheel.
- E. Positioners: Pneumatic force balance instruments to control valve position as function of input signal, suitable for either double acting or spring return actuator, with zero and span adjustment and field reversible for direct or reverse action.
1. Accomplish positive positioning of valve by mechanical feedback connection from valve actuating mechanism, consisting of a characterized linear cam allowing adjustment of valve positioning and input signal.
 2. Provide gauges for supply and output pressure and for input signal pressure.
 3. Input: Pneumatic or DC electric, unless otherwise indicated.
 4. Pneumatic Input: 3 to 15 psig.
 5. DC Electric Input: 4 to 20 mA; provide transducer to convert electrical signal to appropriate pneumatic signal; transducer to be integral with positioner or separate component.
 - a. Separate transducers factory mounted on actuator.

- b. Transducer must operate without line electric power.
- 6. Enclosures: Corrosion-resistant, splash- and moisture-proof with gasketed cover.

2.13 VALVE ACCESSORIES

- A. Extension Bonnets: Provide as necessary, with stem and accessories applicable to specific valve and operator.
- B. Direct-Buried Valves: Provide extension stem enclosed in cast iron, concrete, or polyethylene valve box housing to prevent contact with soil.
 - 1. Length: Sufficient to bring operating nut to a point 6 inches or less below grade.
 - 2. Diameter: Sufficient to completely cover valve.
 - 3. Cast Iron Valve Boxes: Extension type with slide or screw vertical adjustment and flared base; minimum metal thickness of 3/16 inch.
 - 4. Concrete Valve Boxes: Standard product of a manufacturer of precast concrete equipment; cast iron cover and cover ring.
- C. Manual Valves Below Operating Personnel Floor Level: Where depth of valve centerline is more than 36 inches below floor level, provide extension stem and floor stand.
 - 1. Floor Stands: Non rising, indicating type; with extension stem, coupling, hand wheel, and yoke attachment.
 - 2. Stem Guide Brackets: Spaced such that stem L/R ratio does not exceed 200; provide anchors as required.
 - 3. Quarter Turn Valves: Provide torque tube, properly sized for maximum torque capacity of valve.
- D. Access Doors: Where valves are to be installed inside walls or above ceilings in finished spaces, provide access doors for valve access.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install valves as nearly as possible in position indicated on drawings, located and oriented to provide easy access to valve operator and to avoid interference with other equipment.
- C. Install valves without exerting distortion or strain on appurtenances.
- D. Flanged Connections:
 - 1. Install flanged valve bolt holes so as to straddle vertical centerline of pipe.

2. Clean flanged faces prior to inserting gasket and bolts.
 3. Tighten nuts progressively and uniformly.
- E. Threaded Connections: Clean threads by wire brushing or swabbing prior to installation.
- F. Manual Valve Orientation in Horizontal Runs of Pipe:
1. Where pipe centerline elevation is 54 inches or less above finished floor, install valve with operating stem of in vertical position, unless otherwise indicated.
 2. Where pipe centerline elevation is between 54 inches and 81 inches above finish floor, install valve with stem in horizontal position, unless otherwise indicated.
- G. Automatic Valves: Install in accordance with manufacturer's instructions.
- H. Butterfly Valves: Orient valve shafts so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of disc.
- I. Plug Valves: If seat position is not indicated, locate seat position as follows:
1. For horizontal flow, orient seat so that flow produces an "unseating" pressure, with plug opening into top half of valve.
 2. For vertical flow, locate seat in highest portion of valve.
- J. Insulation: Where piping is indicated to be insulated, insulate valves in same manner using same materials.

3.2 FIELD QUALITY CONTROL - PRIOR TO STARTUP

- A. Demonstrate proper valve operation while testing pipelines or as a separate step.
1. Show that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications.
 2. Count and record the number of turns required to open and close each valve, and account for any discrepancies from manufacturer's data.
- B. Isolation Valve Leak Check:
1. With full pressure in the system, command valve closed.
 2. Use an ultra-sonic flow meter to detect flow or leakage.
- C. Actuator Range Check: Verify proper operation of actuators and positioners.
1. Verify that actuator extreme positions are correct.
 2. Apply a signal to actuator through its controller.
 3. Record the signal levels for the extreme positions.

4. Vary the signal over its full range and verify that actuators travel in the correct direction and from one extreme position to the other.
- D. Valve Stroke Setup and Check:
1. Verify the actual positions against the control system readout.
 2. Set pump to normal operating mode.
 3. Command valve closed; visually verify that valve is closed and adjust output zero signal as required.
 4. Command valve to open; verify position is full open and adjust output signal as required.
 5. Command valve to a few intermediate positions.
 6. If actual valve position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3.3 OWNER PERSONNEL TRAINING

- A. Content: For each valve include actuator and transmitter, cover control sequences, actuating sensors, manual operation, maintenance, and testing.
- B. Operating Personnel Training:
1. Sessions: One.
 2. Trainees: Two.
 3. Training Hours: 2, minimum, for each valve.

END OF SECTION

3. Finish coats shall be applied in the field by installing Contractor.
 4. Reference Section 46 0500 - Common Work Results for Water and Wastewater Equipment.
- N. New Effluent Weirs and Scum Baffles (supplied by Installing Contractor):
- ~~1. Fabricate weirs from 3/16" thick x 9" FRP.~~
 - ~~2. Weir shall have 90 degree, 2.5 inch deep "V" notches spaced 6" on centers.~~
 3. Fabricate scum baffle from 1/4" thick x 12" FRP.
- O. Anchor Bolts:
1. All equipment anchor bolts shall be stainless steel.
 2. Equipment Manufacturer shall furnish steel template and grout shield to accurately locate center pier anchors and allow for grouting beneath the pier and manifold seal plate after final plumbing.

Refer to Weir
Detail on Sheet
C-502

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install the clarifier components as shown on the drawings.
- B. Equipment shall be installed in accordance with the Manufacturer's recommendations to provide a complete installation.
- C. The Contractor shall plumb, adjust for true plane of rotation, grout beneath center pier, manifold seal plate and drive unit and grout the floor in accordance with the Manufacturer's recommendations.

3.2 ELECTRICAL CONNECTIONS AND WIRING

- A. Wiring and conduits for electrical power, control, and instrumentation will be provided by the Electrical Contractor under Division 16 - Electrical.
- B. Reconnect new torque overload switches to properly de-energize equipment when high torque conditions are encountered.

END OF SECTION

SECTION 46 7621 - BELT FILTER PRESSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown on the Drawings, as specified herein, and as required to furnish and install a complete belt press system on a concrete foundation as shown on the Drawings for blended primary and secondary sludge dewatering.
2. System components generally include the concrete base , positive displacement sludge feed pump with VFD drive, electromagnetic sludge flow meter, polymer system, sludge mixing system, belt press, hydraulic power unit, belt washwater booster pump, NEMA 4X control panel with touch screen HMI, PLC based process control system, and all other components required for a complete installation.

B. Related Sections :

1. Section 05 5010 - Miscellaneous Metal: Miscellaneous metalwork and fasteners as required by this Section.
2. Section 40 9200 - Process Control Descriptions: Additional control descriptions for equipment specified in this Section.
3. Division 26 - Electrical.

1.2 REFERENCES

- A. American Gear Manufacturers Association (AGMA)
- B. ASTM International (ASTM)
- C. National Electrical Manufacturers Association (NEMA)
- D. Virginia Department of Environmental Quality (VDEQ)
 1. Sewage Collection and Treatment Regulations.

1.3 SUBMITTALS

- A. Section 01 3300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's product data for system materials and component equipment, including electrical characteristics and connection requirements.
- C. Shop Drawings:
 1. Indicate system materials and component equipment.

2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.
- D. Manufacturer's Certificate:
 1. Submit Certificate of Proper Use.
 2. Submit Certificate of Proper Installation.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- McGill Section 017700.**
- A. ~~Section 01 70 00 – Execution and Closeout Requirements~~: Requirements for closeout procedures.
 - B. Project Record Documents: Record actual locations and final orientation of equipment.
 - C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.
 - D. Submit Certificate of Proper Installation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- McGill Section 017823.**
- A. ~~Section 01 70 00 – Execution and Closeout Requirements~~: Requirements for maintenance materials.
 - B. Furnish the following Spare Parts:
 1. One complete set of dewatering belts.
 2. One complete set of discharge blades.
 3. One complete set of sludge containment seals.
 4. One press roller bearing of each different size used.
 5. One oil filter for the hydraulic power unit.
 - C. Tools: Furnish special wrenches and other devices required for Owner to maintain equipment components.

1.6 QUALITY ASSURANCE

- A. Component Supply and Compatibility:

1. Obtain all equipment included in this Section, regardless of component manufacture, from one single manufacturer.
2. The single manufacturer supplying the equipment required by this Section shall review and approve, or prepare, all Shop Drawings and other submittals for components required under this Section.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' verifiable experience.
- B. The manufacturer shall have a belt filter press of the type specified herein successfully operating for a minimum of five years in each of at least ten wastewater treatment plants in the USA, along with shop drawing, date of installation, contact person and contact number for each installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. McGill Section 011200
~~Section 01 6000 – Product Requirements:~~ Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept equipment on-Site in original packaging. Inspect for damage.
- D. Store equipment according to manufacturer's instructions.
- E. Protect equipment from water and wet weather.

1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Requirements for warranties.
McGill Section 017700.
- B. The equipment shall be guaranteed against defects in material and workmanship under normal use and service for a period of one year after start up during which time replacement parts shall be provided without charge. Further, an additional four year warranty (total of five years) shall be provided for the belt press frame and its coating, the belt press rollers and their coatings and the belt press roll bearings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer List:

1. The basis of design for equipment in this Section is Komline Sanderson's Model RSL-2.0 Series III Kompress two-belt extended length press with galvanized steel frame and appurtenances.
 2. Other Pre-approved equipment manufacturers include Alfa Laval. Additional manufacturers may be added to the Pre-approved manufacturer's list by Addendum.
 3. Substitutions: Section 01 2500 - Substitution Procedures.
- B. The naming of a manufacturer and model number is not an indication that the manufacturer's standard equipment offering is acceptable in lieu of the specified features. Naming of a manufacturer is instead an indication that the manufacturer may have the capability of providing the system as specified. Manufacturer shall make any necessary modifications to meet all the requirements of the Contract Documents.
 - C. Dimensions and locations shown on the Drawings for the equipment and accessories in this section are based on the equipment named as the basis of design. Any change to dimensions or locations of equipment and accessories required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner.
 - D. Any costs or modifications incurred by using equipment other than the basis of design, if any, including building construction, structural, piping, electrical, mechanical, plumbing and instrumentation systems, shall be made by the Contractor at no additional expense to the Owner.

2.2 GENERAL:

- A. Each belt filter press shall be of the continuous belt design with three distinct dewatering zones including a gravity dewatering zone, an adjustable wedge or low pressure zone and a shear/pressure zone and shall consist of a galvanized steel frame, dewatering belts, an inlet flocculation/distributor, belt support/wiper bars, drainage elements, drums, rollers, bearings, discharge blades, a belt drive unit, belt tracking and tensioning systems, a belt wash system and a filtrate/belt washwater drainage system. Each belt filter press shall be factory assembled including all internal piping, valving, wiring and control devices and shall be shipped as a complete assembly except that the dewatering belts shall be shipped separately in suitable containers to prevent accidental damage.
- B. Compliance with the performance requirements of the specifications will not relieve the contractor of his responsibilities of supplying equipment having the specified structural, mechanical, corrosion resistant and operational features. Deviations from the requirements specified shall not be permitted.

2.3 EQUIPMENT DESIGN:

- A. Feed Sludge Characteristics.
 1. Feed Sludge Type: Primary sludge blended with aerobically digested secondary sludge.
 2. Design Daily Sludge Production: 852 lbs. dry solids per day, average daily flow basis.

3. Total Solids Concentration: 1 to 3%.
 4. Sludge age: 30 days (design SRT of aerobic digester).
 5. Volatile Solids/Total Solids: 50 - 60%.
- B. Required Performance Criteria:
1. Hours of Operation: maximum of 6 hours per day, 5 days per week at design daily sludge production.
 2. Minimum sludge feed rate at average dry solids concentration: 80 gallons per minute.
 3. Minimum solids capture rate: 88%.
 4. Discharge Cake solids, minimum: 15%.
 5. Maximum Polymer Usage: 20 dry lbs per ton dry solids in feed sludge.
- C. Equipment Characteristics:
1. Effective belt width: 2.0 meters with overall belt width approximately 2.2 meters
 2. Number of Press Units: As shown on the Drawings.
 3. Power Supply: 480V, 3 Phase, 60 Hz, 20.55 FLA (15.38 KW)
- D. Water Requirements:
1. Wash water: 80 gpm @ 85 psi pressure
 2. Polymer Blending System: 25 gpm @ 45 psi.

2.4 EQUIPMENT SCOPE

- A. After proper flocculation of the sludge with polymer, initial dewatering shall occur by gravity drainage through the gravity section filter belt, traveling horizontally along the press. Further dewatering shall occur by squeezing the sludge between two tensioned pressure belts, first through a wedge zone then over and under a minimum of eight drums forcing entrained water from the sludge through both pressure and shear action. Dry cake discharge shall be assisted by doctor blades at each belt. Each belt shall be subsequently washed with high pressure, low volume water from spray headers before it returns to the head of its section of the press. Washwater and filtrate shall be collected in drain pans for direction to a curbed concrete drainage basin surrounding the press.
1. The overall dimensions of each fully assembled belt filter press shall not exceed 23'-0" long by 11'-0" wide by 8'-0" high.
- B. The equipment furnished shall be designed and constructed in accordance with the best practices and methods and for continuous service at maximum conditions. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be fully suitable for the intended conditions of service. Provisions shall be made for easy lubrication,

adjustment or replacement of all parts. Corresponding parts of multiple units shall be interchangeable. Except as otherwise specified, steel plates and shapes shall have a minimum thickness of 3/8 inch, sheet metal shall be 14 gauge minimum and bolts shall be 1/2 inch diameter minimum. All welding shall be in accordance with the latest applicable codes of the American Welding Society. All materials used shall be of the best quality and fully suitable in every respect for the service intended. Unless otherwise specified, all materials in direct contact with sludge, polymer or filtrate shall be type 316 stainless steel or plastic. All fasteners shall be type 316 stainless steel.

- C. All materials used in the construction of the sludge dewatering equipment shall be of the best quality and entirely suitable in every respect for the service required. All structural steel shall conform to the ASTM Standard Specification for Structural Steel. All iron castings shall conform to the ASTM Standard Specifications of Gray Iron Castings and shall be of a class suitable for the purpose intended. Other materials shall conform to the ASTM Specifications where such specifications exist and the use of such materials shall be based on continuous and successful use under similar conditions of service.

2.5 SLUDGE CONDITIONING SYSTEM

- A. Each sludge conditioning system shall consist of an in-line polymer injection ring, a variable orifice venturi type mixing valve and a press mounted flocculation tank/ feed distributor to provide even distribution of sludge across the full width of the press.
- B. The polymer injection ring shall be of the multiport type to assure optimum polymer usage, shall be of polyethylene construction and shall be supplied with a polyethylene injection manifold complete with tubing and fittings for distributing polymer to the injection points on the ring. The mixing valve shall be of cast type 316 stainless steel construction and shall include provisions to vary the throat area through an external adjustably weighted lever arm for most effective instantaneous polymer/sludge mixing. The mixing valve shall also include a removable inspection cover.
- C. Each injection ring and mixing valve shall form a sludge/polymer mixing assembly which shall be located directly in the sludge feed line. The contractor shall provide spool pieces to simulate the mixing assembly at two additional locations in each sludge feed line to allow for repositioning the mixing assembly for most effective floc formation. The contractor shall also provide the necessary polymer piping and valving to accommodate the alternate mixing assembly locations.
- D. The flocculation tank/feed distributor shall be mounted on the feed end of the press and shall be sized to provide an adequate residence time for effective floc formation. The system shall consist of a lower inlet section or feed hopper and an upper distribution and exit section. All parts of the system shall be constructed of type 316 stainless steel. Sludge shall directly overflow the hopper onto the full width of the distribution section. The sludge inlet line to the tank shall incorporate a means of draining the feed hopper. The hopper shall also be provided with a drain connection. The contractor shall provide a quick opening valve and PVC piping to the drain basin below. No mechanical or static mixing devices shall be included in the hopper or distributor as such devices become fouled and require frequent cleaning.

2.6 PRESS FRAME

- A. Each side frame shall be constructed of welded members formed from 3/8 inch thick ASTM A36 structural steel plate. A minimum of five cross members shall be bolted to the side frames to form a rigid structure, properly stiffened for supporting the belt press rollers and other components and to withstand the applied loading without deflection, deformation or vibration during operation. All mainframe members shall be 7 inch channel shapes with minimum moment of inertia of 44 inches. Channel flanges shall be turned out to allow for convenient and thorough washdown. Frame construction shall allow easy access to and visual contact with all internal press components.
- B. The frame shall have minimum safety factors of nine times the allowable yield strength in bending and ten times the allowable shear stress at an applied belt tension of 50 pounds per linear inch. Frame deflection shall not exceed 0.002 inch under the same belt tension load. Design calculations shall be submitted to substantiate the required frame safety factors and deflection limit.
- C. After fabrication all frame members shall be hot dipped galvanized per ASTM A123 to a thickness of 5 to 7 mils to assure complete and thorough corrosion protection. Painted or flame sprayed coatings are not acceptable since adequate surface protection at boltholes, slots and inaccessible areas is not assured. Stainless steel local side panels shall be provided where necessary to contain spray mist and provide operator protection from moving parts.

2.7 GRAVITY DRAINAGE SECTION

- A. Each belt filter press shall contain a gravity drainage section consisting of an inlet flocculation/distributor, a filter belt, belt supports, sludge containment seals, drainage elements, a discharge chute and a filtrate collection pan.
- B. Conditioned sludge shall be fed to the press by gravity overflow from the flocculation tank onto a sludge distributor constructed of type 316 stainless steel. Even distribution of the sludge across the entire belt width shall be achieved without the use of a driven spreader mechanism.
- C. Gravity dewatering shall occur on a horizontal traveling belt section with a minimum active dewatering length of 10 feet and a minimum active dewatering area of 53 square feet through which free water drainage shall occur. Inclined gravity drainage areas shall not be allowed due to the cloth blinding effect caused by pooling of fragile sludges. The belt shall be supported in this section by full width ultra high density molecular weight polyethylene support/ wiper bars 1-3/4 inches in diameter with minimum 3-1/2 inch spacing. The bars shall assure maximum free water drainage by repeatedly breaking the surface tension of the water on the underside of the belt. The bars shall be mounted in type 316 stainless steel support brackets. The bars shall be fabricated with square type 316 stainless steel plugs on each end which shall allow each bar to be rotated in 90 degree increments for extended life and reduced maintenance cost. The gravity drainage zone shall be so designed that the filter belt does not have to be removed to rotate or replace support bars. Replaceable rubber side seals with type 316 stainless steel holders shall be provided to contain the sludge on the belt. These seals shall not require bolted connections so that they may be easily and quickly replaced. A type 316 stainless steel discharge chute shall be provided at the discharge end of the gravity section to provide a gentle transition to the wedge zone to prevent floc shear of the thickened sludge at

this point.

- D. In order to minimize polymer use, maximize hydraulic and solids loading rates and promote more rapid drainage of free water from the sludge, a combination of plows shall be located in the gravity drainage zone. A minimum of six rows of plows shall be furnished at least three rows of which shall be high rate drainage elements with the balance being plows for thorough sludge dispersion along the entire length of the gravity zone. To facilitate convenient operator cleaning and to provide flexibility of operation, the plows shall be mounted on crossbars with lifting handles to raise and lock each row in an upright, out of service position. The crossbars shall be type 304 stainless steel; associated mounting and lifting hardware shall be hot dipped galvanized malleable iron. Each plow shall be of ultra high density molecular weight polyethylene and shall be mounted on a type 316 stainless steel holder which in turn shall be mounted on the crossbar and spaced on 6 inch centers. The plows shall be individually adjustable on the crossbars to allow for more flexibility. A total of 53 plows shall be provided in the gravity drainage zone. Plows shall be cylindrical and flare shaped at the bottom and elements shall be 6 inch diameter. Low profile cones which shall allow the sludge to keep both types of plows in constant and uniform contact with the belt. They shall also be designed to be self-cleaning by being mounted to allow them to freely and independently rotate and/or raise to prevent solids build-up.
- E. 14 gauge type 316 stainless steel drain pan shall be provided beneath the gravity drainage section to collect the filtrate and to direct it to the collection sump beneath the press through rigid PVC pipes of sufficient size to handle the drainage from the combined sludge and polymer feed streams. Other drain pan materials of construction are not acceptable due to possible cracking or breaking or failure of any applied corrosion resistant coating.

2.8 WEDGE SECTION

- A. Each press shall contain a wedge or low pressure section consisting of a pair of converging pressure belts, belt supports, troughing seals, a filtrate collection pan and provisions to adjust the angle of convergence of the belts.
- B. The wedge section shall receive thickened sludge discharged from the gravity zone, shall be horizontal and shall provide a zone wherein the two pressure belts gradually converge and begin to apply pressure to the sludge contained between the two tensioned belts. The wedge section shall have a minimum dewatering length of 6 feet and a minimum dewatering area of 31 square feet figured on the basis of one belt. The carrying belt shall be supported in this section by full width ultra high density molecular weight polyethylene support/wiper bars 1-3/4 inches in diameter spaced on 3-1/2 inch centers. The bars shall be mounted in type 316 stainless steel support brackets, shall have square type 316 stainless steel end plugs, shall be rotatable in 90° increments for extended life and shall be rotated or replaced without removing the belts.
- C. For process flexibility a manually adjustable roller shall be provided above the upper belt at the entrance to the wedge section to adjust the angle of convergence of the two belts to provide a means for adjusting the amount of pressure exerted on the sludge before entering the shear/pressure section of the press. Adjustable troughing seals shall be provided under both sides of the lower belt to prevent sludge migration beyond the belt edges and allow the application of mild pressure without process upset.

- D. A 14 gauge type 316 stainless steel drain pan shall be provided beneath the wedge section to collect the filtrate and to direct it to the collection sump beneath the press through rigid PVC pipes. Other drain pan materials of construction are not acceptable.

2.9 SHEAR/PRESSURE SECTION

- A. Each press shall include a shear/pressure section containing a minimum of eight dewatering drums in a horizontal plane which shall apply compression and shear reversals to the sludge by passing the sludge cake sandwiched between the two tensioned belts alternately over one drum and under the next. Designs that include the pressure roll profile in a vertical plane are not acceptable. The shear/pressure section shall begin with a 30 inch diameter perforated drum which shall be self-bailing to provide unimpeded filtrate drainage without rewetting of downstream cake and provide a gradual transition into the shear/pressure section. The remainder of the dewatering drums shall be solid surface drums and shall vary from 20 to 10 inches in diameter to provide the proper combination of dewatering area, applied pressure profile and time under pressure. The shear/pressure section configuration shall provide a minimum belt length in actual contact with the drums of 17 feet and a minimum dewatering area in actual contact with the drums of 129 square feet figured on the basis of one belt. Inactive belt runs between dewatering drums shall be kept to a minimum.

2.10 BELTS

- A. Each press shall be provided with two dewatering belts which shall be seamed and shall be fabricated of wear-resistant monofilament polyester. The mesh design, porosity and tensile properties shall be selected for optimum dewatering of the specific sludge to be processed and for a minimum life of 2000 hours of continuous failure-free operation. Each belt shall be a minimum of 87 inches wide, providing an effective 1.5 meter operating belt width in contact with the sludge.
- B. Belt edges shall be heat sealed and bonded for stability. A low profile type 316L stainless steel clipper seam shall be used to join the belt ends. Multiple coats of polyurethane adhesive shall be applied to the belt/clipper seam joint to provide a full and uniform bond at the joint, to reinforce the joint and to provide a smooth transition from belt to seam for proper doctor blade and drainage system element interface.
- C. Belts shall be designed for ease of replacement with a minimum of press downtime. Belt replacement shall be such that disassembly of the equipment is not required.

2.11 BELT WASH SYSTEM

- A. Each press shall be furnished with a belt wash system consisting of a spray header, a spray containment housing and a washwater collection box for each belt to thoroughly clean both belts after cake discharge. The belt wash system shall be suitable for use with plant effluent water furnished at a line pressure of 40 psig at the belt press locale. A washwater booster pump shall be furnished with each press to provide the required operating pressure to the belt wash system when adequate line pressure is not available. The system demand for each press shall be 80 gpm at 85 psig.

- B. A Self-cleaning spray header shall be furnished for each belt consisting of a schedule 10 type 316 stainless steel header, a series of replaceable type 317LM stainless steel spray nozzles providing an overlapping spray pattern on each belt, a replaceable stainless steel nozzle cleaning brush inside the header and an external handwheel operator which shall make the header self-cleaning. A full turn of the handwheel shall cause the brush to clean the nozzle orifices and shall allow the flushing water to pass through the header for discharge directly to the collection basin beneath the press through a rigid PVC pipe. Presses without this or similar direct individual nozzle cleaning provisions shall not be acceptable.
- C. A 14 gauge type 316 stainless steel enclosure shall surround each wash header both to contain spray mist and to collect and discharge the spent washwater. The wash header enclosures shall include a housing above and below the filter belt to contain all mist and spray water and shall include easily replaceable brush type seals above and below the belt at both the entry and exit of the enclosures to prevent the escape of spray mist. Seal replacement shall be convenient and quick and shall not involve the use of bolted connections. Spent washwater shall be directed to the collection sump under the press through rigid PVC piping. Other enclosure materials of construction shall not be acceptable due to possible cracking or breaking or failure of any applied corrosion resistant coating.
- D. The spray headers shall be piped to a common washwater inlet connection on the press. A NEMA 4X pressure switch shall be provided in the water inlet manifold to provide an alarm signal in the event of low washwater pressure. Each spray header shall have a 150 psi Victaulic clamp connection to the water inlet manifold to allow for belt spray direction adjustment. A NEMA 4X solenoid valve for on-off control shall be provided and installed by the contractor at the inlet manifold and wired to the control panel.
- E. Washwater booster pump shall be furnished for each press to raise the system water pressure to the required operating level. The pump shall be a horizontal end suction centrifugal pump in type 316L stainless steel construction with mechanical shaft sealing. The pump shall be driven by a direct coupled 5 hp, 3600 rpm, TEFC motor and shall be furnished with a common steel channel base for the motor, pump and a coupling guard.

2.12 BELT TRACKING SYSTEM

- A. Each press shall be furnished with a continuous automatic belt tracking system consisting of a belt edge location sensor, a proportional tracking valve, a steering roller and a hydraulic cylinder for steering roller control for each of the belts along with a common hydraulic control system. Electro-mechanical belt tracking systems and belt tracking systems that are non-continuous shall not be permitted. The system shall constantly monitor belt location and through the proportional sensor, continuously adjust each belt path as necessary to maintain a central location on the rollers thereby preventing over-steering and belt wrinkling and providing longer belt life.
- B. A stainless steel sensing arm shall be in continuous contact with each belt edge and its location shall govern the position of a proportional pilot valve which in turn shall affect the position of a hydraulic cylinder which shall be connected to a pivotable belt steering roller. The cylinder shall cause the roller to skew from its transverse position and cause the belt to track centrally on the press rollers. The alignment system shall operate with smooth and slow

motions resulting in a minimum of belt travel from side to side. Limit switches in NEMA 4X enclosures shall be furnished on both sides of each belt to sense gross belt misalignment and provide a signal to immediately shut the entire system down and sound an alarm in the event of a tracking system failure of either of the belts.

- C. A hydraulic control system shall be provided. For maximum corrosion resistance each hydraulic cylinder shall have heads, a fiberglass body, a chrome plated rod and stainless steel hardware. Belt tracking and tension controls shall be located on the hydraulic power unit. All hydraulic lines shall be stainless steel tubing, neatly arranged and run along and across the press framing.
- D. A hydraulic power unit shall be furnished for each press consisting of a 2 hp, 1800 rpm, TEFC motor, a variable volume pressure compensated pump, a system pressure gauge, a tension control/relieving valve, a tension system pressure gauge, a breather type filler cap, a return filter with bypass, a level sight gauge and a thermometer all mounted on a 5 gallon type 316 stainless steel reservoir. The power unit shall be mounted on the press frame. All system hydraulic piping and tubing shall be factory furnished and installed. A NEMA 4X pressure switch shall be included to sense low system pressure and provide a signal to shut the entire system down and sound an alarm in the event of the loss of system pressure. The hydraulic unit is a completely sealed stainless steel unit designed for direct wash down in a WWTP including the wash down severe duty AC motor.

2.13 BELT TENSIONING SYSTEM

- A. Each press shall be furnished with a belt tensioning system for each of its belts consisting of a tension roller, hydraulic cylinders to apply tension to the belt, a rack and pinion mechanism to synchronize the hydraulic cylinder motions and a hydraulic control system. The tensioning system shall be such that dewatering pressure is directly proportional to belt tension and that adjustments in belt tension shall result in immediate changes in dewatering pressure.
- B. A tension roller shall be provided for each belt and it shall be powered by a hydraulic cylinder on each end of the roller. The motion of each cylinder shall be synchronized with its opposite side cylinder. This cylinder synchronization arrangement shall consist of a frame mounted rack and a tension assembly mounted pinion on each side of the press. The pinions, rigidly connected to a cross-shaft, shall provide parallel movement of the tension roll ends thereby preventing belt tracking and alignment problems. For maximum corrosion resistance the pinions and racks shall be nylon; the hydraulic cylinders shall be furnished with heads and fiberglass bodies, chrome plated rods and stainless steel hardware.
- C. Belt tension shall be controlled at the hydraulic power unit by means of a tension control valve as previously described. A common control shall be furnished such that both belts are tensioned equally preventing operational difficulties due to unequal belt tensions. Once set, the dewatering pressure shall be maintained automatically regardless of process changes. The belt tension system shall be designed to provide belt tensions varying from 0 to 50 pounds per linear inch throughout the shear/pressure section of the press. A directional control valve shall also be provided on the press for retraction of the tension cylinders when required.

2.14 BELT DRIVE SYSTEM

- A. Each press shall be provided with a belt drive system consisting of a rubber covered belt drive roll, a gear reducer with an AC drive motor for variable frequency control of the two belts. Hydraulic belt drive motors shall not be permitted.
- B. The belt drive motor shall be a 3 hp, 1800 rpm, TEFC, severe duty energy-efficient AC motor. The motor shall be C-face mounted to a hollow shaft, torque arm helical-bevel reducer, AGMA Class II rated, which shall be shaft mounted on the drive roll. The belt speed range shall be adjustable over a range of 2 to 20 feet per minute. For positive belt traction the belt drive roll shall be rubber covered. The drive roll body shall be a minimum of 9-1/2 inches in diameter with a 1/4 inch thick minimum rubber covering on top of that.
- C. Each drive motor shall contain a thermal sensor imbedded in the windings which shall provide a signal for alarm and system shutdown if excessive motor temperature develops. Loss of motion detectors shall be provided on the press to sense belt drive failure or a broken belt condition and provide signals for system shutdown and sound an alarm in the event that either of these conditions occur. The drive motor shall be located above the discharge rolls and away from high moisture areas. A variable frequency controller shall be furnished in the belt press electrical control panel to provide power and speed control for the belt drive motor.

2.15 DISCHARGE BLADES

- A. Each press shall contain two discharge blades to assist in removing dewatered sludge cake from the belts at the discharge end of the press. The lower blade shall also direct the sludge cake to the receiving device (conveyor, container, chute, etc.). The discharge blades shall be replaceable and shall be made from high density polyethylene and each shall have two beveled edges for doubling the life of the blade. The blades shall be mounted on 316 stainless steel constructed, stiffened, pivotable support members with arms at each end for mounting adjustable counterweights for maintaining the proper pressure between the blades and the discharge rolls thereby reducing belt and closure wear. Lockable handles shall be provided so that the blades can be easily positioned away from the belts for cleaning.

2.16 DRUMS AND ROLLERS

- A. Each press shall be furnished with the necessary drums and rollers to provide gravity dewatering, shear/pressure dewatering, belt drive, belt tension, belt tracking and general belt support. A minimum of one perforated drum shall be furnished, all others shall be solid surface drums and rollers.
- B. Type 316 stainless steel shall be used for the perforated drum body and its end plates. The body shall be 3/16 inch thick and end plates 1/2 inch thick. Perforated drum shaft journals shall be type 17-4 PH stainless steel. All other drums and rollers shall be constructed of ASTM A-53, A-106 or A-500 Grade B carbon steel with wall thicknesses of 1/2 inch minimum. Larger diameter major load carrying drums shall have forged or one piece shaft and end plate machined from single bar stock using AISI 4140 material. The rubber covered drive roll shall have 17-4 PH stainless steel shafts. Smaller diameter nominal load carrying rollers shall have AISI 1045 steel shafts deep bored shrink fit and welded solid journal construction on each end. Shaft diameters through the support bearings shall be 2-13/16 inches diameter minimum for pressure drums and 2-11/16 inches diameter minimum for rollers.

- C. Belt drive rollers shall have a 1/4 inch thick 80 durometer vulcanized rubber covering for gripping the belts and for corrosion protection and shall have type 316 stainless steel end plates. All other solid surface drums and rollers shall have a 30 mil thick black fusion bonded applied nylon coating for corrosion protection which shall cover the roll body, ends and shafts up to the point of insertion into the bearings.
- D. All drums and rollers shall be designed to withstand the stress reversals inherent in rotating elements and shall be designed with a minimum factor of safety of 2 over fatigue failure of the material for shafts and 5 over fatigue failure for drum and roller bodies. Drum and roller design shall be based on operating at rated belt speed, a belt tension of 50 pounds per linear inch on each belt and rated drive horsepower. Shaft stress concentration shall be minimized by the use of generous, well polished radii. Deflection of all drums and rollers whether major load carrying or not, shall be limited to 0.015 inch over the full width of the drum or roll body when operating at a belt tension of 50 pounds per linear inch per belt at rated drive horsepower. Calculations shall be furnished substantiating shaft sizing, drum and roll construction design, fatigue failure safety factors and drum and roller deflection.

2.17 BEARINGS

- A. The shafts of all drums and rollers on each press shall contain heavy duty self-aligning double row spherical roller bearings in split case four bolt base cast iron pillow block housings. Self-alignment shall occur within the housing. The housings shall permit the changing of bearings without disturbing the factory-set alignment of the rollers.
- B. Bearings shall be arranged for tapered adapter mounting to the drum and roller shafts. Bearings shall contain contact seals and shaft mounted splashguards on the shaft side to provide adequate sealing from moisture and grime. Non-shaft sides of bearing housings shall be solid. Bearing housings shall have a factory applied 12 mil thick black fusion bonded applied nylon coating for added corrosion resistance. All bearing hardware shall be stainless steel. All roller bearings shall be main frame mounted and shall be greaseable while the press is in operation.
- C. All roller bearings shall have an L-10 bearing life in excess of 1,800,000 hours with belts tensioned at 50 pounds per linear inch and with belts traveling at rated speed. Calculations shall be furnished demonstrating compliance with these provisions.

2.18 MISCELLANEOUS

- A. Each press shall be provided with two orange safety trip cords at each side of the press, one at a lower elevation and one at a higher elevation. Each cord shall be connected to a NEMA 4X dual actuated emergency stop switch which shall immediately stop the belt drives and shut down the entire system upon pulling or breaking of the trip cord. These switches shall be independent of the gross belt misalignment switches and shall require resetting at the press before the equipment can be restarted.
- B. Each press shall be complete with all intra-unit power and control wiring terminating in a single press mounted NEMA 4X stainless steel junction box. All wiring shall be run in rigid PVC conduit for added corrosion resistance.

- C. Each press shall be complete with all intra-unit hydraulic system and washwater piping as well as all filtrate and washwater drain lines directed to the collection basin beneath the press, all washwater supply piping terminating at a single washwater inlet connection. All interconnecting stainless steel hydraulic piping and tubing is included.
- D. For maximum corrosion resistance, all miscellaneous steel parts such as brackets, guards, spacers, etc. shall be fabricated from 304 stainless steel or UHMW plastic material.

2.19 ELECTRICAL CONTROL PANEL

- A. An electrical control panel shall be furnished with each belt filter press to control the belt press functions and those of the related auxiliary equipment specified herein. The panel shall be preassembled and prewired and shall include all controls necessary for semi-automatic system operation with provisions also for manual control of individual items when desired. The panel shall be suitably wired for connection to a 480 volt, 3 phase, 60 Hertz power source.
- B. The enclosure shall be fabricated from 14 gauge type 304 stainless steel, shall be floorstand-mounted and constructed to NEMA 4X standards. Instruments and control devices mounted on the enclosure door shall be rated for or installed in such a manner as to maintain the NEMA 4X integrity. Nameplates shall be engraved laminated phenolic with black background and white letters to identify each component mounted on the panel face. Letter height shall not be less than 3/16 inch. Additionally, the complete panel, as an assembly, shall be built in accordance with UL 508A and shall have a UL serialized label.
- C. Wiring shall be accomplished in a neat workmanlike manner and run in PVC wiring duct where practical. Where not practical it shall be supported and tied in position with nylon cable ties. All wiring shall be identified with a number code and all wiring for external connection shall be brought to a numbered terminal strip. Wiring shall comply with the applicable requirements of the latest edition of the National Electrical Code. Interconnecting wiring between this panel and the press and other related equipment shall be the responsibility of the contractor.
- D. The enclosure shall house a flange mounted dead front main disconnect, all motor starters, variable frequency controls, a programmable logic controller, interlocks, alarms, indicating lights and operator controls required for the operation of the belt filter press and auxiliary equipment described in this specification section. Each AC motor, contactor and wiring shall be protected by a properly sized motor starter protector and overload relays. Variable frequency drives shall be protected by properly sized fuses. Indicating lights and operator controls only as required shall be included in this panel for other system auxiliary equipment items described in other sections of the specifications. Starters, variable speed drives, controllers, etc. for such other items shall be furnished by others and shall be located elsewhere. The following control interfaces shall be provided for this auxiliary equipment: dry contacts rated at 10A 125V for start/stop control, PLC inputs to accept dry contact 'on' status and motor overload/fail signals, 4-20 ma DC signals or high/low speed switch contact closures as required for speed command signals. System interlocking and logic shall be provided by an industrial grade programmable logic controller meeting the following minimum requirements:

1. Total input/output: As required, expandable I/O
 2. Memory: EEPROM or FLASH
 3. Allen Bradley Micrologix Series
 4. CPU to have integrated Ethernet Communications
- E. Components shall be selected and the enclosure sized to limit the enclosure internal heat rise to 10°C while operating in a 40°C ambient. Calculations or method of determining compliance shall be submitted to the Engineer with the initial drawing submittal. A minimum of 20% spare terminal blocks shall be provided. The control panel shall be completely tested under simulated field conditions by the press manufacturer prior to shipment. The Operation and Maintenance Manual shall contain complete as-built drawings including schematics, physical layout and terminal connections. It shall also contain tabulated maintenance procedures.
- F. The control panel shall include an Allen-Bradley PanelView Plus 1000 touch screen HMI with Ethernet Communications to provide the following controls and indicators:
1. Main disconnect switch.
 2. System automatic cycle start/stop control with on status light.
 3. Hydraulic power unit start/stop control with on status/motor fail light.
 4. Belt washwater booster pump start/stop control with on status/motor fail light and/or washwater solenoid valve to open/close appropriately.
 5. Belt drive start/stop control with on status/motor overtemperature light, speed control potentiometer and speed indicator.
 6. Sludge feed pump start/stop control with on status/motor fail light, speed control and speed indicator.
 7. Sludge meter flow rate indicator.
 8. Polymer feed pump start/stop control with on status/motor fail light, speed control and speed indicator as required.
 9. Sludge cake conveyor start/stop control with on status/motor fail light if required.
 10. Start/stop controls with on status/motor fail lights for any other auxiliary equipment items if required.
 11. Belt prewet and post wash cycle indicator lights.
 12. Motor run/jog selector switch.
 13. Emergency stop pushbutton with alarm/emergency trip light.
 14. Gross belt misalignment alarm light.

15. Low system hydraulic pressure alarm light.
 16. Low system washwater pressure alarm light.
 17. Belt drive fail/broken belt alarm light.
 18. Alarm lights as required for other specified alarm conditions.
 19. Audible alarm horn.
 20. Alarm acknowledge pushbutton.
 21. Alarm reset/lamp test pushbutton.
- G. Each press shall be provided with a belt drive system consisting of a rubber covered belt drive roll, a gear reducer with an AC drive motor for variable frequency control of the two belts. Hydraulic belt drive motors shall not be permitted.
 - H. Semi-automatic operation of the entire system shall be controlled by a single start/stop cycle control. This control along with status and alarm contacts shall provide inputs to the programmable controller (PLC). The controller shall continuously scan the inputs and according to a logic program stored in its memory shall develop the appropriate run, stop, status or alarm signals for devices connected to its output. The PLC shall cause specific functions to be interlocked, timed, started or stopped as required during the start up, run and shutdown modes of operation. These modes of operation may be operator initiated or caused by one of the inputs. Essentially, the PLC shall initiate and monitor each step of the cycle, check that all interlocks are satisfied and drive start-ups are confirmed before proceeding to the next step, provide for prewetting the belts before sludge is introduced to the press on start-up and provide for the proper timed intervals for complete discharge of sludge cake and thorough belt washdown during the shutdown cycle. The control system shall allow unattended operation in the semi-automatic mode. In the manual mode of operation, the system shall be started and stopped by the actuation of each individual component control.
 - I. During operation in either mode, any of the following alarm conditions shall activate the alarm horn and respective alarm causing the entire system to shut down, either instantaneously or in the normal programmed sequence as appropriate:
 - J. Gross misalignment of any belt, low system hydraulic pressure, low washwater pressure, emergency stop at the press, belt drive failure, any broken belt, belt drive motor overheats, active feed pump or polymer system failure, AC motors overloaded or emergency stop at the control panel.
 - K. Alarm annunciation shall follow ISA sequence AM. If the operator can correct an alarm condition during programmed shutdown, the PLC shall allow continuation of full operation by reactivation of the cycle control.
 - L. Each press shall be provided with a belt drive system consisting of a rubber covered belt drive roll, a gear reducer with an AC drive motor for variable frequency control of the two belts.

Hydraulic belt drive motors shall not be permitted.

M. For either semi-automatic system operation where the programmable logic controller assumes control or manual control where an operator assumes control, the sequence of operation shall be as follows:

1. Start-up Sequence:
 - a. Start the hydraulic power unit.
 - b. Start the belt washwater booster pump and/or open the washwater solenoid valve.
 - c. Start the belt drive.
 - d. Start the conveyor.
 - e. After allowing the belts to become wet, start the polymer feed pump and the sludge feed pump.
 - f. Start any other auxiliary equipment item at the appropriate time during the sequence.
 - g. Adjust belt speed and/or sludge and polymer feed rates if required.
2. Shutdown Sequence:
 - a. Stop the sludge and polymer pumps.
 - b. After allowing sludge to discharge completely from the belts and allowing for complete belt washdown, stop the washwater booster pump and/or close the solenoid valve.
 - c. Stop the belt drive.
 - d. Stop the hydraulic power unit.
 - e. Stop the conveyor.
 - f. Stop any other auxiliary equipment at the appropriate time during the sequence.

2.20 SLUDGE FLOW METER

A. General:

1. Each sludge feed system shall provide an in-line electromagnetic flowmeter manufactured by Foxboro corporation, or approved equal. Meters that use probes or paddle wheels that protrude into the sludge flow are not acceptable.
2. The sludge flowmeter shall be of rugged construction, rated for wet corrosive environments and sized adequately not to restrict sludge flow or sludge conditioning.

B. Performance:

1. The sludge flowmeter function shall not be affected by uneven flow or affected by low-frequency noise (slurry noise).
 - a. The flowmeters detector tube shall be highly resistant to abrasive fluid.
- C. Construction:
 1. The entire unit shall be NEMA 4X (IP67) watertight rated.
- D. Controls:
 1. The unit shall be integrated with the main touch screen control in the main belt press control panel. The controls shall be as follows:
 - a. Master non resettable gallon counter
 - b. Reset able gallon counter
 - c. GPM indicator
- E. Mounting:
 1. The sludge flowmeter shall be wafer type, for mounting between two ANSI class 150 pound flanges.
 2. The sludge flowmeter shall be mounted and pre-wired to Belt Filter Press main skid if provided.
 3. It shall be the responsibility of the contractor for the proper mounting, wiring and plumbing, if the location is different than specified as above.

2.21 SURFACE PROTECTION

- A. Belt filter press materials of construction (stainless steel, fiberglass, plastic, etc.) and protective coatings and coverings (hot dipped galvanizing, fusion bonded nylon, rubber, etc.) shall be completely corrosion resistant such that shop or field applied paint coating is not required.
- B. Miscellaneous parts such as brackets, spacers, guards, etc. shall be fabricated from type 304 stainless steel, galvanized steel or plastic and shall not require shop or field applied paint coating.
- C. Items such as motors, gear reducers, pumps, hydraulic power units and the like shall receive standard manufacturer's finish coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Requirements for installation examination.

- B. Verify that equipment is ready for installation.

3.2 INSTALLATION

- A. Install equipment according to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: The belt press manufacturer shall furnish the services of a competent and experienced person for a period of eight days to be covered in two trips to job site to check the installation, supervise the start up, supervise the performance testing and provide operator instruction for the equipment furnished. Additional service, if requested, shall be available at the manufacturer's portal to portal per diem rate in effect at the time of service delivery, plus all travel and living expenses.

3.4 PERFORMANCE TESTING

- A. The equipment manufacturer shall conduct a performance test to demonstrate that the installed equipment can meet the specified performance requirements. One press shall be selected for testing. The test shall occur as soon as possible after successful equipment start up and process and system stabilization has been accomplished.
- B. The test period shall consist of one five hour steady state test run with sludge feed, sludge cake and effluent (combined filtrate and washwater) samples taken at the start of each run and every hour thereafter resulting in a total of six samples of each type. The sludge feed and effluent samples shall be analyzed for total suspended solids content; the cake samples shall be analyzed for total solids content. The resulting solids contents shall be averaged and the average value of each type shall be used to judge satisfactory performance. Polymer solution strength and flow rate shall be recorded. Sludge feed rate shall be recorded.
- C. The press manufacturer's representative shall operate the equipment during the test. The owner shall furnish personnel to assist in the operation and to take samples. The owner shall also furnish sludge, water, polymer, utilities, sludge cake disposal, routine test equipment and laboratory services for analyzing the samples. The belt press manufacturer shall recommend the most suitable polymer which shall be furnished by the owner. The contractor shall provide any special instrumentation for measuring sludge feed or polymer feed rates.
- D. The equipment shall have passed the performance test if the specified cake solids, solids capture and polymer use requirements are met with the press operating at the specified hydraulic and solids loading rates.
- E. Should the installed equipment fail to meet the specified performance requirements, the manufacturer shall within 30 days make changes in the equipment or method of operation as necessary and the equipment shall be retested. If after a second 30 day period, the equipment still does not meet the performance criteria, the equipment shall have failed the performance test and the owner shall require its removal and replacement with the specified equipment at no additional cost to the owner.

3.5 DEMONSTRATION

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

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APPENDICES

~~Appendix A: Geotechnical Data~~
Appendix B: Permits

SECTION 02 4100 - DEMOLITION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Building demolition excluding removal of hazardous materials and toxic substances.
- B. Selective demolition of built site elements.
- C. Abandonment and removal of existing utilities and utility structures.

1.2 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary: Limitations on Contractor's use of site and premises; description of items to be salvaged or removed for re-use by Contractor
- ~~B. Section 01 5000 - Temporary Facilities and Controls: Site fences, security, protective barriers, and waste removal.~~
- C. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Project conditions; protection of bench marks, survey control points, and existing construction to remain; reinstallation of removed products; temporary bracing and shoring.
- D. Section 31 1000 - Site Clearing: Vegetation and existing debris removal.
- E. Section 31 2200 - Grading: Topsoil removal; fill material for filling holes, pits, and excavations generated as a result of removal operations.
- F. Section 31 2323 - Fill: Fill material for filling holes, pits, and excavations generated as a result of removal operations.

1.3 REFERENCE STANDARDS

- A. 29 CFR 1926 - Safety and Health Regulations for Construction Current Edition.
- B. NFPA 241 - Standard for Safeguarding Construction, Alteration, and Demolition Operations 2019.

1.4 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.

McGill Section 013300.
- B. Project Record Documents: Accurately record actual locations of capped and active utilities and subsurface construction.

1.5 QUALITY ASSURANCE

- A. Demolition Firm Qualifications: Company specializing in the type of work required.
 - 1. Minimum of five years of documented experience.

PART 2 PRODUCTS

~~A. Fill Material: As specified in Section 31 2323 Fill.~~

PART 3 EXECUTION

3.1 SCOPE

- A. Remove the entire building designated within the project limits.
- B. Remove paving and curbs as required to accomplish new work.
- C. Remove all other paving and curbs within site boundaries.
- D. Remove concrete slabs on grade within site boundaries.
- E. Remove other items indicated, for salvage, relocation, recycling, and reuse.
- F. Fill excavations, open pits, and holes in ground areas generated as result of removals, using specified fill; compact fill as specified in Section 31 2200.

3.2 GENERAL PROCEDURES AND PROJECT CONDITIONS

- A. Comply with applicable codes and regulations for demolition operations and safety of adjacent structures and the public.
 - 1. Obtain required permits.
 - 2. Take precautions to prevent catastrophic or uncontrolled collapse of structures to be removed; do not allow worker or public access within range of potential collapse of unstable structures.
 - 3. Provide, erect, and maintain temporary barriers and security devices.
 - 4. Conduct operations to minimize effects on and interference with adjacent structures and occupants.
 - 5. Do not close or obstruct roadways or sidewalks without permit.
 - 6. Conduct operations to minimize obstruction of public and private entrances and exits; do not obstruct required exits at any time; protect persons using entrances and exits from removal operations.
 - 7. Obtain written permission from owners of adjacent properties when demolition equipment will traverse, infringe upon or limit access to their property.
- B. Do not begin removal until receipt of notification to proceed from Owner.
- C. Protect existing structures and other elements that are not to be removed.
 - 1. Provide bracing and shoring.
 - 2. Prevent movement or settlement of adjacent structures.
 - 3. Stop Work immediately if adjacent structures appear to be in danger.

- D. Minimize production of dust due to demolition operations; do not use water if that will result in ice, flooding, sedimentation of public waterways or storm sewers, or other pollution.
- E. If hazardous materials are discovered during removal operations, stop work and notify Architect/Engineer and Owner; hazardous materials include regulated asbestos containing materials, lead, PCB's, and mercury.
- F. Partial Removal of Paving and Curbs: Neatly saw cut at right angle to surface.

3.3 EXISTING UTILITIES

- A. Coordinate Work with utility companies; notify before starting Work and comply with their requirements; obtain required permits.
- B. Protect existing utilities to remain from damage.
- C. Do not disrupt public utilities without permit from authority having jurisdiction.
- D. Do not close, shut off, or disrupt existing life safety systems that are in use without at least 7 days prior written notification to Owner.
- E. Do not close, shut off, or disrupt existing utility branches or take-offs that are in use without at least 3 days prior written notification to Owner.
- F. Locate and mark utilities to remain; mark using highly visible tags or flags, with identification of utility type; protect from damage due to subsequent construction, using substantial barricades if necessary.
- G. Remove all piping, valves, meters, equipment, supports, and foundations of disconnected and abandoned utilities.
- H. When underground utilities are to be abandoned in place, plug, cap, or seal with concrete at the "Construction Limits" or at points shown.
- I. Remove underground utilities as indicated on the drawings and backfill resulting excavation with suitable material, compacted as specified. Plug, cap, or seal utilities with concrete at the "Construction Limits" or at points shown.

3.4 DEBRIS AND WASTE REMOVAL

- A. Remove debris, junk, and trash from site.
- B. Leave site in clean condition, ready for subsequent work.
- C. Clean up spillage and wind-blown debris from public and private lands.

END OF SECTION

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SECTION 03 3000 - CAST-IN-PLACE CONCRETE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Concrete formwork.
- B. Concrete reinforcement.
- C. Joint devices associated with concrete work.
- D. Miscellaneous concrete elements, including equipment pads, light pole bases, and sidewalks.
- E. Concrete curing.

1.2 RELATED REQUIREMENTS

- A. Section 07 9200: Products and installation for sealants for saw cut joints and isolation joints in slabs.

1.3 REFERENCE STANDARDS

- A. ACI 117 - Standard Specifications for Tolerances for Concrete Construction and Materials; American Concrete Institute International; 2010.
- B. ACI 211.1 - Standard Practice for Selecting Proportions for Normal, Heavyweight, and Mass Concrete; American Concrete Institute International; 1991 (Reapproved 2002).
- C. ACI 301 - Specifications for Structural Concrete; American Concrete Institute International; 2010.
- D. ACI 302.1R - Guide for Concrete Floor and Slab Construction; American Concrete Institute International; 2004 (Errata 2007).
- E. ACI 304R - Guide for Measuring, Mixing, Transporting, and Placing Concrete; American Concrete Institute International; 2000.
- F. ACI 305R - Hot Weather Concreting; American Concrete Institute International; 2010.
- G. ACI 306R - Cold Weather Concreting; American Concrete Institute International; 2010.
- H. ACI 308R - Guide to Curing Concrete; American Concrete Institute International; 2001 (Reapproved 2008).
- I. ACI 318 - Building Code Requirements for Structural Concrete and Commentary; American Concrete Institute International; 2011.
- J. ACI 347 - Guide to Formwork for Concrete; American Concrete Institute International; 2004.
- K. ASTM A615/A615M - Standard Specification for Deformed and Plain Carbon Billet-Steel Bars for Concrete Reinforcement; 2014.

- L. ASTM A1064/A1064M - Standard Specification for Carbon-Steel Wire and Welded Wire Reinforcement, Plain and Deformed, for Concrete; 2013.
- M. ASTM C33/C33M - Standard Specification for Concrete Aggregates; 2013.
- N. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens; 2014.
- O. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete; 2014.
- P. ASTM C150/C150M - Standard Specification for Portland Cement; 2012.
- Q. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete; 2007.
- R. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method; 2014.
- S. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete; 2010a.
- T. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete; 2011.
- U. ASTM C494/C494M - Standard Specification for Chemical Admixtures for Concrete; 2013.
- V. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete; 2012.
- W. ASTM C881/C881M - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete; 2013.
- X. ASTM C989/C989M - Standard Specification for Slag Cement for Use in Concrete and Mortars; 2014
- Y. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink); 2014.
- Z. ASTM C1315 - Standard Specification for Liquid Membrane-Forming Compounds Having Special Properties for Curing and Sealing Concrete; 2011.
- AA. ASTM D1751 - Standard Specification for Preformed Expansion Joint Filler for Concrete Paving and Structural Construction (Nonextruding and Resilient Bituminous Types); 2004 (Reapproved 2013).
- BB. NSF 61 - Drinking Water System Components - Health Effects; 2012.
- CC. NSF 372 - Drinking Water System Components - Lead Content; 2011.

1.4 SUBMITTALS

- A. See ~~Section 01-3000~~, for submittal procedures.

McGill Section 013300.

- B. Product Data: Submit manufacturers' data on manufactured products showing compliance with specified requirements and installation instructions.
- C. Mix Design: Submit proposed concrete mix design.
 - 1. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - 2. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
 - 3. Design Mixtures: For each concrete mixture. Submit alternate design mixtures when characteristics of materials, Project conditions, weather, test results, or other circumstances warrant adjustments.
 - a. Indicate amount of mixing water to be withheld for later addition at Project site.
- D. Project Record Documents: Accurately record actual locations of embedded utilities and components that will be concealed from view upon completion of concrete work.
- E. Field quality-control reports.

1.5 QUALITY ASSURANCE

- A. Perform work of this section in accordance with ACI 301 and ACI 318.
- B. Installer Qualifications: A qualified installer who employs on Project personnel qualified as ACI-certified Flatwork Technician and Finisher and a supervisor who is an ACI-certified Concrete Flatwork Technician.
- C. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94/C 94M requirements for production facilities and equipment.
- D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 PRODUCTS

2.1 FORMWORK

- A. Formwork Design and Construction: Comply with guidelines of ACI 347 to provide formwork that will produce concrete complying with tolerances of ACI 117.
- B. Form Materials: Contractor's choice of standard products with sufficient strength to withstand hydrostatic head without distortion in excess of permitted tolerances.
 - 1. Form Facing for Exposed Finish Concrete: Contractor's choice of materials that will provide smooth, stain-free final appearance.
 - 2. Earth Cuts: Do not use earth cuts as forms for vertical surfaces other than footings. Natural rock formations that maintain a stable vertical edge may be used as side forms.

3. Form Coating: Release agent that will not adversely affect concrete or interfere with application of coatings.
4. Form Ties: Cone snap type that will leave no metal within 1-1/2 inches of concrete surface.

2.2 REINFORCEMENT

- A. Reinforcing Steel: ASTM A615/A615M, Grade 60 - 60,000 psi.
 1. Type: Deformed billet-steel bars.
 2. Finish: Unfinished, unless otherwise indicated.
- B. Steel Welded Wire Reinforcement (WWR): Galvanized, plain type, ASTM A1064/A1064M.
 1. Form: Flat Sheets.
 2. WWR Style: As indicated on drawings.
- C. Reinforcement Accessories:
 1. Tie Wire: Annealed, minimum 16 gage, 0.0508 inch.
 2. Chairs, Bolsters, Bar Supports, Spacers: Sized and shaped for adequate support of reinforcement during concrete placement.
 3. Provide stainless steel, galvanized, plastic, or plastic coated steel components for placement within 1-1/2 inches of weathering surfaces.

2.3 CONCRETE MATERIALS

- A. Cement: ASTM C150/C150M, Type I - Normal Portland type or Type II - Moderate Portland type.
 1. Acquire all cement for entire project from same source.
- B. Fine and Coarse Aggregates: ASTM C 33.
 1. Acquire all aggregates for entire project from same source.
- C. Fly Ash: ASTM C618, Class F. Fly ash shall not exceed 25 percent by weight of total cementitious material.
- D. Ground Granulated Blast-Furnace (GGBF) Slag: ASTM C989/C989M, Grade 100. Slag content shall not exceed 50 percent by weight of total cementitious material except if fly ash is used in addition to slag, the combined content of fly ash and slag shall not exceed 50 percent of total cementitious material.
- E. Water: Clean and not detrimental to concrete, complying with ASTM C94/94M.

2.4 ADMIXTURES

- A. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.
- B. Do not use chemicals that will result in soluble chloride ions in excess of 0.1 percent by weight of cement.
- C. Air Entrainment Admixture: ASTM C260/C260M.
- D. High Range Water Reducing and Retarding Admixture: ASTM C494/C494M Type G.
- E. High Range Water Reducing Admixture: ASTM C494/C494M Type F.
- F. Water Reducing and Accelerating Admixture: ASTM C494/C494M Type E.
- G. Water Reducing and Retarding Admixture: ASTM C494/C494M Type D.
- H. Accelerating Admixture: ASTM C494/C494M Type C.

2.5 ACCESSORY MATERIALS

- A. Non-Shrink Cementitious Grout: Premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. ASTM C1107/C1107M; Grade A, B, or C.
 - 2. Minimum Compressive Strength at 48 Hours, ASTM C109/C109M: 2,000 pounds per square inch.
 - 3. Minimum Compressive Strength at 28 Days, ASTM C109/C109M: 7,000 pounds per square inch.

2.6 BONDING AND JOINTING PRODUCTS

- A. Epoxy Bonding System:
 - 1. Complying with ASTM C881/C881M and of Type required for specific application.
- B. Slab Expansion and Isolation Joint Filler: 1/2 inch thick or as indicated, height equal to slab thickness, with removable top section that will form 1/2 inch deep sealant pocket after removal.
 - 1. Material: ASTM D1751, cellulose fiber.
- C. Slab Contraction Joint Device: Preformed linear strip intended for pressing into wet concrete to provide straight route for shrinkage cracking.
- D. Slab Construction Joint Devices: Combination keyed joint form and screed, galvanized steel, with minimum 1 inch diameter holes for conduit or rebars to pass through at 6 inches on center; ribbed steel stakes for setting.

1. Provide removable plastic cap strip that forms wedge-shaped joint for sealant installation.
2. Height: To suit slab thickness.

2.7 CURING MATERIALS

- A. Evaporation Reducer: Liquid thin-film-forming compound that reduces rapid moisture loss caused by high temperature, low humidity, and high winds; intended for application immediately after concrete placement.
- B. Curing and Sealing Compound, Low Gloss: Liquid, membrane-forming, clear, non-yellowing acrylic; complying with ASTM C1315 Type 1 Class A.
 1. Application: Use at all concrete slabs and surfaces not formed..
 2. Vehicle: Solvent-based.
 3. Solids by Mass: 25 percent, minimum.
- C. Moisture-Retaining Sheet: ASTM C171.
 1. Curing paper, regular.
 2. White-burlap-polyethylene sheet, weighing not less than 10 oz/per linear yd, 40 inches wide.
- D. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. (305 g/sq. m) when dry.
- E. Water: Potable, not detrimental to concrete.

2.8 CONCRETE MIX DESIGN

- A. Proportioning Normal Weight Concrete: Comply with ACI 211.1 recommendations.
- B. Limit water-soluble, chloride-ion content in hardened concrete to 0.06 percent by weight of cement.
- C. Concrete Strength: Establish required average strength for each type of concrete on the basis of field experience or trial mixtures, as specified in ACI 301.
 1. For trial mixtures method, employ independent testing agency acceptable to Architect/Engineer for preparing and reporting proposed mix designs.
- D. Admixtures: Add acceptable admixtures as recommended in ACI 211.1 and at rates recommended or required by manufacturer.
- E. Normal Weight Concrete:
 1. Compressive Strength, when tested in accordance with ASTM C39/C39M at 28 days: As indicated or specified..

2. Fly Ash Content: Maximum 25 percent of cementitious materials by weight.
 3. Ground Granulated Blast-Furnace (GGBF) Slab: ASTM C989/C989M, Grade 100. Where used, slag content must be a minimum of 25 percent by weight of cementitious material. Maximum 50 percent of cementitious materials by weight of cementitious material. When used in combination with flyash, the combined flyash and GGBF shall not exceed a maximum 50 percent of cementitious materials by weight.
 4. Maximum Aggregate Size: 1 inch.
- F. Exterior Slabs-on-Grade, Sidewalks and Equipment Bases and Foundations: Proportion normal-weight concrete mixture as follows:
1. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.
 2. Slump Limit: 4 inches (100 mm), plus or minus 1 inch (25 mm).
 3. Air Content: 6 percent, plus or minus 1.5 percent at point of delivery for 1-inch (25-mm) nominal maximum aggregate size.

2.9 MIXING

- A. Transit Mixers: Comply with ASTM C94/C94M and ASTM C1116/C 116M.
1. When air temperature is between 85 and 90 deg F (30 and 32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify lines, levels, and dimensions before proceeding with Work of this Section.

3.2 PREPARATION

- A. Formwork: Comply with requirements of ACI 301. Design and fabricate forms to support all applied loads until concrete is cured, and for easy removal without damage to concrete.
- B. Verify that forms are clean and free of rust before applying release agent.
- C. Coordinate placement of embedded items with erection of concrete formwork and placement of form accessories.
- D. Coat contact surfaces of forms with form-release agent, according to manufacturer's written instructions, before placing reinforcement.
- E. Where new concrete is to be bonded to previously placed concrete, prepare existing surface by cleaning with steel brush and applying bonding agent in accordance with manufacturer's instructions.

1. Use epoxy bonding system for bonding to damp surfaces, for structural load-bearing applications, and where curing under humid conditions is required.

3.3 INSTALLING REINFORCEMENT AND OTHER EMBEDDED ITEMS

- A. Comply with requirements of ACI 301. Clean reinforcement of loose rust and mill scale, and accurately position, support, and secure in place to achieve not less than minimum concrete coverage required for protection.
- B. Verify that anchors, seats, plates, reinforcement and other items to be cast into concrete are accurately placed, positioned securely, and will not interfere with concrete placement.

3.4 PLACING CONCRETE

- A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.
- B. Do not add water to concrete during delivery, at Project site, or during placement unless approved by Architect.
- C. Before test sampling and placing concrete, water may be added at Project site, subject to limitations of ACI 301.
- D. Place concrete in accordance with ACI 304R.
- E. Place concrete for floor slabs in accordance with ACI 302.1R.
- F. Notify special inspector not less than 24 hours prior to commencement of placement operations.
- G. Maintain records of concrete placement. Record date, location, quantity, air temperature, and test samples taken.
- H. Ensure reinforcement, embedded parts, and formed construction joint devices will not be disturbed during concrete placement.
- I. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.
 1. Deposit concrete in horizontal layers of depth to not exceed formwork design pressures and in a manner to avoid inclined construction joints.
 2. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.
 3. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations to rapidly penetrate placed layer and at least 6 inches (150 mm) into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to lose plasticity. At each insertion, limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement

and other embedded items without causing mixture constituents to segregate.

- J. Deposit and consolidate concrete for floors and slabs in a continuous operation, within limits of construction joints, until placement of a panel or section is complete.
 - 1. Consolidate concrete during placement operations so concrete is thoroughly worked around reinforcement and other embedded items and into corners.
 - 2. Maintain reinforcement in position on chairs during concrete placement.
 - 3. Screed slab surfaces with a straightedge and strike off to correct elevations.
 - 4. Slope surfaces uniformly to drains where required.
 - 5. Begin initial floating using bull floats or darbies to form a uniform and open-textured surface plane, before excess bleed water appears on the surface. Do not further disturb slab surfaces before starting finishing operations.
- K. Cold-Weather Placement: Comply with ACI 306.1 and as follows. Protect concrete work from physical damage or reduced strength that could be caused by frost, freezing actions, or low temperatures.
 - 1. When average high and low temperature is expected to fall below 40 deg F (4.4 deg C) for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 2. Do not use frozen materials or materials containing ice or snow. Do not place concrete on frozen subgrade or on subgrade containing frozen materials.
 - 3. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- L. Hot-Weather Placement: Comply with ACI 301 and as follows:
 - 1. Maintain concrete temperature below 90 deg F (32 deg C) at time of placement. Chilled mixing water or chopped ice may be used to control temperature, provided water equivalent of ice is calculated to total amount of mixing water. Using liquid nitrogen to cool concrete is Contractor's option.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.

3.5 SLAB JOINTING

- A. Locate joints as indicated on the Drawings.
- B. Anchor joint fillers and devices to prevent movement during concrete placement.
- C. Isolation Joints: Use preformed joint filler with removable top section for joint sealant, total height equal to thickness of slab, set flush with top of slab.

1. Install wherever necessary to separate slab from other building members, including columns, walls, equipment foundations, footings, stairs, manholes, sumps, and drains.
- D. Load Transfer Construction and Contraction Joints: Install load transfer devices as indicated; saw cut joint at surface as indicated for contraction joints.
- E. Saw Cut Contraction Joints: Saw cut joints before concrete begins to cool, within 4 to 12 hours after placing; use 3/16 inch thick blade and cut at least 1 inch deep but not less than one quarter (1/4) the depth of the slab.
- F. Construction Joints: Install so strength and appearance of concrete are not impaired, at locations indicated or as approved by Architect.
1. Place joints perpendicular to main reinforcement. Continue reinforcement across construction joints unless otherwise indicated. Do not continue reinforcement through sides of strip placements of floors and slabs.
 2. Form keyed joints as indicated. Embed keys at least 1-1/2 inches (38 mm) into concrete.
 3. Locate joints for beams, slabs, joists, and girders in the middle third of spans. Offset joints in girders a minimum distance of twice the beam width from a beam-girder intersection.
 4. Locate horizontal joints in walls and columns at underside of floors, slabs, beams, and girders and at the top of footings or floor slabs.
 5. Space vertical joints in walls as indicated. Locate joints beside piers integral with walls, near corners, and in concealed locations where possible.
 6. Use a bonding agent at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
 7. Use epoxy-bonding adhesive at locations where fresh concrete is placed against hardened or partially hardened concrete surfaces.
- G. Contraction Joints in Slabs-on-Grade: Form weakened-plane contraction joints, sectioning concrete into areas as indicated. Construct contraction joints for a depth equal to at least one-fourth of concrete thickness as follows:
1. Sawed Joints: Form contraction joints with power saws equipped with shatterproof abrasive or diamond-rimmed blades. Cut 1/8-inch- (3.2-mm-) wide joints into concrete when cutting action will not tear, abrade, or otherwise damage surface and before concrete develops random contraction cracks.
- H. Isolation Joints in Slabs-on-Grade: After removing formwork, install joint-filler strips at slab junctions with vertical surfaces, such as column pedestals, foundation walls, grade beams, and other locations, as indicated.
1. Extend joint-filler strips full width and depth of joint, terminating flush with finished concrete surface unless otherwise indicated.

2. Terminate full-width joint-filler strips not less than 1/2 inch (13 mm) or more than 1 inch (25 mm) below finished concrete surface where joint sealants, specified in Section 07 9200 "Joint Sealants," are indicated.
 3. Install joint-filler strips in lengths as long as practicable. Where more than one length is required, lace or clip sections together.
- I. Construction Joints: Where not otherwise indicated, use metal combination screed and key form, with removable top section for joint sealant.
 - J. Doweled Joints: Install dowel bars and support assemblies at joints where indicated. Lubricate or asphalt coat one-half of dowel length to prevent concrete bonding to one side of joint.

3.6 CONCRETE FINISHING

- A. Repair surface defects, including tie holes, honeycombing or bug holes immediately after removing formwork.
- B. Unexposed Form Finish: Rub down or chip off fins or other raised areas 1/4 inch or more in height.
- C. Exposed Form Finish: Rub down or chip off and smooth fins or other raised areas 1/4 inch or more in height. Provide smooth-form finish SF-2.0. Rubbed Finish is not required. Mock-up panel is not required.
- D. Concrete Slabs: Finish to requirements of ACI 302.1R, and as follows:
- E. Broom Finish: Apply a broom finish to exterior concrete slabs, platforms, steps, ramps, sidewalks and elsewhere as indicated.
 1. Immediately after float finishing, slightly roughen trafficked surface by brooming with fiber-bristle broom perpendicular to main traffic route. Coordinate required final finish with Architect before application.

3.7 MISCELLANEOUS CONCRETE ITEMS

- A. Filling In: Fill in holes and openings left in concrete structures after work of other trades is in place unless otherwise indicated. Mix, place, and cure concrete, as specified, to blend with in-place construction. Provide other miscellaneous concrete filling indicated or required to complete the Work.
- B. Equipment Bases and Foundations Including Light Pole Bases:
 1. Coordinate sizes and locations of concrete bases with actual equipment provided.
 2. Construct concrete bases 4 inches (100 mm) high unless otherwise indicated; and extend base not less than 6 inches (150 mm) in each direction beyond the maximum dimensions of supported equipment unless otherwise indicated or unless required for seismic anchor support.
 3. Minimum Compressive Strength: 4000 psi (27.6 MPa) at 28 days.

4. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch (450-mm) centers around the full perimeter of concrete base.
5. Prior to pouring concrete, place and secure anchorage devices. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
6. Cast anchor-bolt insert into bases. Install anchor bolts to elevations required for proper attachment to supported equipment.

3.8 CURING AND PROTECTION

- A. Comply with requirements of ACI 308R. Immediately after placement, protect concrete from premature drying, excessively hot or cold temperatures, and mechanical injury.
 1. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 301 for hot-weather protection during curing.
 2. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h (1 kg/sq. m x h) before and during finishing operations. Apply according to manufacturer's written instructions after placing, screeding, and bull floating or darbying concrete, but before float finishing.
- B. Maintain concrete with minimal moisture loss at relatively constant temperature for period necessary for hydration of cement and hardening of concrete.
 1. Normal concrete: Not less than 7 days.
 2. High early strength concrete: Not less than 4 days.
- C. Formed Surfaces: Cure by moist curing with forms in place for full curing period.
- D. Surfaces Not in Contact with Forms:
 1. Initial Curing: Start as soon as free water has disappeared and before surface is dry. Keep continuously moist for not less than three days by water-fog spray or saturated burlap.
 - a. Spraying: Spray water over floor slab areas and maintain wet.
 - b. Saturated Burlap: Saturate burlap-polyethylene and place burlap-side down over floor slab areas, lapping ends and sides; maintain in place.
 2. Final Curing: Begin after initial curing but before surface is dry.
 - a. Moisture-Retaining Sheet: Lap strips not less than 3 inches and seal with waterproof tape or adhesive; secure at edges.
 - b. Curing Compound: Apply in two coats at right angles, using application rate recommended by manufacturer.

- E. Cure concrete according to ACI 308.1, by one or a combination of the following methods:
1. Moisture Curing: Keep surfaces continuously moist for not less than seven days with the following materials:
 - a. Continuous water-fog spray.
 - b. Absorptive cover, water saturated, and kept continuously wet. Cover concrete surfaces and edges with 12-inch (300-mm) lap over adjacent absorptive covers.
 2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches (300 mm), and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
 - a. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive floor coverings.
 - b. Moisture cure or use moisture-retaining covers to cure concrete surfaces to receive penetrating liquid floor treatments.
 - c. Cure concrete surfaces to receive floor coverings with either a moisture-retaining cover or a curing compound that the manufacturer certifies will not interfere with bonding of floor covering used on Project.
 3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.
 - a. Removal: After curing period has elapsed, remove curing compound without damaging concrete surfaces by method recommended by curing compound manufacturer unless manufacturer certifies curing compound will not interfere with bonding of floor covering used on Project.
 4. Curing and Sealing Compound: Apply uniformly to floors and slabs indicated in a continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Repeat process 24 hours later and apply a second coat. Maintain continuity of coating and repair damage during curing period.

3.9 JOINT FILLING

- A. Prepare, clean, and install joint filler according to manufacturer's written instructions.
 1. Defer joint filling until concrete has aged at least one month(s). Do not fill joints until construction traffic has permanently ceased.
- B. Remove dirt, debris, saw cuttings, curing compounds, and sealers from joints; leave contact faces of joint clean and dry.

- C. Install semirigid joint filler full depth in saw-cut joints and at least 2 inches (50 mm) deep in formed joints. Overfill joint and trim joint filler flush with top of joint after hardening.

3.10 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Engage a qualified testing and inspecting agency to perform tests and inspections and to submit reports.
- B. Inspections:
 - 1. Steel reinforcement placement.
 - 2. Verification of use of required design mixture.
 - 3. Concrete placement, including conveying and depositing.
 - 4. Curing procedures and maintenance of curing temperature.
 - 5. Verification of concrete strength before removal of shores and forms from beams and slabs.
- C. Concrete Tests: Testing of composite samples of fresh concrete obtained according to ASTM C 172 shall be performed according to the following requirements:
 - 1. Testing Frequency: Obtain one composite sample for each day's pour of each concrete mixture exceeding 5 cu. yd., but less than 25 cu. yd., plus one set for each additional 50 cu. yd. or fraction thereof.
 - 2. Slump: ASTM C 143/C 143M; one test at point of placement for each composite sample, but not less than one test for each day's pour of each concrete mixture. Perform additional tests when concrete consistency appears to change.
 - 3. Air Content: ASTM C 231, pressure method, for normal-weight concrete; one test for each composite sample, but not less than one test for each day's pour of each concrete mixture.
 - 4. Concrete Temperature: ASTM C 1064/C 1064M; one test hourly when air temperature is 40 deg F and below and when 80 deg F and above, and one test for each composite sample.
 - 5. Compression Test Specimens: ASTM C 31/C 31M.
 - a. Cast and laboratory cure three sets of three standard cylinder specimens for each composite sample.
 - b. Cast and field cure two sets of two standard cylinder specimens for each composite sample.
 - 6. Compressive-Strength Tests: ASTM C 39/C 39M; test one set of three laboratory-cured specimens at 7 days and one set of three specimens at 28 days. Hold one set of three specimens in reserve to test if 28-day test results are lower than the required

compression strength. If 28-day test results are higher than the required strength, the test at 56-days is not required.

- a. Test one set of two field-cured specimens at 7 days and one set of two specimens at 28 days.
 - b. A compressive-strength test shall be the average compressive strength from a set of two specimens obtained from same composite sample and tested at age indicated.
7. When strength of field-cured cylinders is less than 85 percent of companion laboratory-cured cylinders, Contractor shall evaluate operations and provide corrective procedures for protecting and curing in-place concrete.
 8. Strength of each concrete mixture will be satisfactory if every average of any three-consecutive compressive-strength tests equals or exceeds specified compressive strength and no compressive-strength test value falls below specified compressive strength by more than 500 psi (3.4 MPa).
 9. Test results shall be reported in writing to Architect/Engineer, concrete manufacturer, and Contractor within 48 hours of testing. Reports of compressive-strength tests shall contain Project identification name and number, date of concrete placement, name of concrete testing and inspecting agency, location of concrete batch in Work, design compressive strength at 28 days, concrete mixture proportions and materials, compressive breaking strength, and type of break for both 7- and 28-day tests.
 10. Nondestructive Testing: Impact hammer, sonoscope, or other nondestructive device may be permitted by Architect but will not be used as sole basis for approval or rejection of concrete.
 11. Additional Tests: Testing and inspecting agency shall make additional tests of concrete when test results indicate that slump, air entrainment, compressive strengths, or other requirements have not been met, as directed by Architect. Testing and inspecting agency may conduct tests to determine adequacy of concrete by cored cylinders complying with ASTM C 42/C 42M or by other methods as directed by Architect/Engineer.
 12. Additional testing and inspecting, at Contractor's expense, will be performed to determine compliance of replaced or additional work with specified requirements.
 13. Correct deficiencies in the Work that test reports and inspections indicate do not comply with the Contract Documents.

3.11 DEFECTIVE CONCRETE

- A. Test Results: The testing agency shall report test results in writing to Architect/Engineer and Contractor within 24 hours of test.
- B. Defective Concrete: Concrete not conforming to required lines, details, dimensions, tolerances or specified requirements.
- C. Repair or replacement of defective concrete will be determined by the Architect/Engineer. The cost of additional testing shall be borne by Contractor when defective concrete is

identified.

- D. Do not patch, fill, touch-up, repair, or replace exposed concrete except upon express direction of Architect/Engineer for each individual area.
- E. Repair all concrete with honeycomb surface due to lack of consolidation in accordance with express direction of Architect/Engineer.

3.12 PROTECTION

- A. Do not permit traffic over unprotected concrete floor surface until fully cured.

END OF SECTION

SECTION 05 1200 - STRUCTURAL STEEL FRAMING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Structural steel framing members.
- B. Base plates.
- C. Grouting under base plates.

1.2 REFERENCE STANDARDS

- A. AISC (MAN) - Steel Construction Manual 2017.
- B. AISC 303 - Code of Standard Practice for Steel Buildings and Bridges 2016.
- C. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- D. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- E. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- F. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- G. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- H. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts 2021a.
- I. ASTM A563M - Standard Specification for Carbon and Alloy Steel Nuts (Metric) 2021a.
- J. ASTM A992/A992M - Standard Specification for Structural Steel Shapes 2020.
- K. ASTM A1011/A1011M - Standard Specification for Steel, Sheet and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low-Alloy, High-Strength Low-Alloy with Improved Formability, and Ultra-High Strength 2018a.
- L. ASTM E164 - Standard Practice for Contact Ultrasonic Testing of Weldments 2019.
- M. ASTM E165/E165M - Standard Test Method for Liquid Penetrant Examination for General Industry 2018.
- N. ASTM E709 - Standard Guide for Magnetic Particle Testing 2021.
- O. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).

- P. ASTM F436/F436M - Standard Specification for Hardened Steel Washers Inch and Metric Dimensions 2019.
- Q. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.
- R. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- S. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- T. RCSC (HSBOLT) - Specification for Structural Joints Using High-Strength Bolts; Research Council on Structural Connections 2014, with Errata (2015).
- U. SSPC-Paint 20 - Zinc-Rich Primers (Type I, "Inorganic," and Type II, "Organic") 2002 (Ed. 2004).
- V. SSPC-SP 3 - Power Tool Cleaning 2018.

1.3 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.

McGill Section 013300.
- B. Shop Drawings:
 - 1. Indicate profiles, sizes, spacing, locations of structural members, openings, attachments, and fasteners.
 - 2. Connections not detailed.
 - 3. Indicate welded connections with AWS A2.4 welding symbols. Indicate net weld lengths.
- C. Manufacturer's Mill Certificate: Certify that products meet or exceed specified requirements.
- D. Mill Test Reports: Indicate structural strength, destructive test analysis and non-destructive test analysis.
- E. Fabricator Test Reports: Comply with ASTM A1011/A1011M.
- F. Welders Certificates: Certify welders employed on the Work, verifying AWS qualification within the previous 12 months.

1.4 QUALITY ASSURANCE

- A. Fabricate structural steel members in accordance with AISC (MAN) "Steel Construction Manual."
- B. Design connections not detailed on drawings under direct supervision of a Professional Structural Engineer experienced in design of this work and licensed in the Commonwealth of Virginia.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Steel Angles and Plates: ASTM A36/A36M.
- B. Steel W Shapes and Tees: ASTM A992/A992M.
- C. Cold-Formed Structural Tubing: ASTM A500/A500M, Grade B.
- D. Pipe: ASTM A53/A53M, Grade B, Finish black.
- E. High-Strength Structural Bolts, Nuts, and Washers: ASTM F3125/F3125M, Type 1, with matching compatible ASTM A563 or ASTM A563M nuts and ASTM F436/F436M washers.
- F. Unheaded Anchor Rods: ASTM F1554, Grade 36, plain, with matching ASTM A563 or ASTM A563M nuts and ASTM F436/F436M Type 1 washers.
- G. Welding Materials: AWS D1.1/D1.1M; type required for materials being welded.
- H. Grout: ASTM C1107/C1107M; Non-shrink; premixed compound consisting of non-metallic aggregate, cement, water reducing and plasticizing agents.
 - 1. Minimum Compressive Strength at 48 Hours: 2,000 pounds per square inch.
 - 2. Minimum Compressive Strength at 28 Days: 7,000 pounds per square inch.
- I. Shop and Touch-Up Primer: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.
- J. Touch-Up Primer for Galvanized Surfaces: Fabricator's standard, complying with VOC limitations of authorities having jurisdiction.

2.2 FABRICATION

- A. Shop fabricate to greatest extent possible.
- B. Fabricate connections for bolt, nut, and washer connectors.

2.3 FINISH

- A. Prepare structural component surfaces in accordance with SSPC-SP 3.
- B. Shop prime structural steel members. Do not prime surfaces that will be field welded. All steel members shall be primed and painted unless member is to be hot-dip galvanized.
- C. Galvanize structural steel members to comply with ASTM A123/A123M. Provide minimum 2.0 oz/sq ft galvanized coating. Steel members exposed to weather shall be galvanized.

2.4 SOURCE QUALITY CONTROL

- A. Provide shop testing and analysis of structural steel.
- B. High-Strength Bolts: Provide testing and verification of shop-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 10 percent of bolts at each connection.

- C. Welded Connections: Visually inspect all shop-welded connections and test at least 10 percent of welds using one of the following:
 - 1. Radiographic testing performed in accordance with ASTM E94/E94M.
 - 2. Ultrasonic testing performed in accordance with ASTM E164.
 - 3. Liquid penetrant inspection performed in accordance with ASTM E165/E165M.
 - 4. Magnetic particle inspection performed in accordance with ASTM E709.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that conditions are appropriate for erection of structural steel and that the work may properly proceed.

3.2 ERECTION

- A. Erect structural steel in compliance with AISC 303.
- B. Allow for erection loads and provide sufficient temporary bracing to maintain structure in safe condition, plumb, and in true alignment until completion of erection and installation of permanent bracing.
- C. Field weld components indicated on shop drawings.
- D. Use carbon steel bolts only for temporary bracing during construction, unless otherwise specifically permitted on drawings. Install high-strength bolts in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts".
- E. Do not field cut or alter structural members without approval of Architect/Engineer.
- F. After erection, prime welds, abrasions, and surfaces not shop primed, except surfaces to be in contact with concrete.
- G. Paint all steel not galvanized in accordance with specification section 09 9110 Painting.
- H. Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.
- I. Grout solidly between column plates and bearing surfaces, complying with manufacturer's instructions for nonshrink grout. Trowel grouted surfaces smooth, splaying neatly to 45 degrees.

3.3 TOLERANCES

- A. Maximum Variation from Plumb: 1/4 inch per story, non-cumulative.
- B. Maximum Offset from True Alignment: 1/4 inch.

3.4 FIELD QUALITY CONTROL

- A. An independent testing agency will perform field quality control tests, as specified in Section 01 4000 - Quality Requirements.
- B. High-Strength Bolts: Provide testing and verification of field-bolted connections in accordance with RCSC (HSBOLT) "Specification for Structural Joints Using High-Strength Bolts", testing at least 25 percent of bolts at each connection.
- C. Welded Connections: Visually inspect all field-welded connections and test at least 25 percent of welds using one of the following:
 - 1. Ultrasonic testing performed in accordance with ASTM E164.
 - 2. Magnetic particle inspection performed in accordance with ASTM E709.

END OF SECTION

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SECTION 05 5010 - MISCELLANEOUS METAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Work Included: All miscellaneous iron and steel items not specifically described in other sections of these specifications but required for a complete and operable facility including, but not limited to, anchors, anchor bolts, angle framing, lintels, pipe railings, bearing plates, grating and other miscellaneous iron and steel items shown on drawings.

1.2 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.

McGill Section 013300
- B. Shop Drawings:
 - 1. Within 35 days after award of contract, prior to start of fabrication and before any miscellaneous metal is delivered to the job site, submit shop drawings to the Architect/Engineer for approval in accordance with ~~Section 01 300~~ of these specifications.

McGill Section 013300
 - 2. Show all locations, markings, quantities, materials, sizes, and shapes; and indicate all methods of connection, anchoring, fastening, bracing and attaching to the work of other trades.

1.3 QUALITY ASSURANCE

- A. Qualifications of Welders: Use only certified welders and the shielded arc process for all welding performed in connections with the work of this section.
- B. Codes and Standards: In addition to complying with all pertinent Codes and Regulations, comply with:
 - 1. "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings" of the American Institute of Steel Construction.
 - 2. "Code for Welding in Building Construction" of the American Welding Society.
- C. Conflicting Requirements: In the event of conflict between pertinent Codes and Regulations and the requirements of the referenced standards or these specifications, the provisions of the more stringent shall govern.

1.4 PRODUCT HANDLING

- A. Protection: Use all means necessary to protect miscellaneous metal before, during and after installation and to protect the installed work and materials of all other trades.

PART 2 PRODUCTS

2.1 STEEL BEAM, PLATE, AND ANGLE LINTELS

- A. All steel beam, plate, and angle lintels shall be new, free from rust, and conforming with the requirements of the appropriate ASTM; beams to be A992, angles and plates to be A36. Install as lintel for new door openings as indicated on drawings. All lintels and beams set in, or in contact with exterior surfaces are to be galvanized after fabrication. Galvanize in accordance with ASTM A123. Provide channel door frames where shown on Drawings.

2.2 STEEL PIPE HAND RAILING

- A. Use steel pipe for exterior use.
- B. Form to profiles indicated.
- C. Mount to provide projection from walls not exceeding 3-1/2 inches.
- D. All material ASTM A53.
- E. Make all rails smooth with no projections preventing a hand from sliding along entire length.
- F. Provide pickets, rails as detailed.
- G. All railings, supports and accessories to be powder coated per AAMA 2605, 70% Kynar, 2 mils minimum thickness. Pretreat metal as required for finish. Color as selected by Architect.

2.3 SHELF DEVICES

- A. All Knappe and Vogt shelf brackets 80-180 traditional, adjustable shelf standards #255 and supports #256 to be furnished under this section of the specifications.

2.4 STEEL PLATES

- A. All steel plates shall be new, free from rust, and conforming with the requirements of ASTM A36.

2.5 BOLTS AND NUTS

- A. All embedded bolts and nuts shall be new, free from rust, and conforming with the requirements of ASTM A307.

2.6 ELECTRODES

- A. All arc welding electrodes used shall be only those specifically recommended for the purpose by the American Welding Society.

2.7 PRIMER PAINT

- A. All primer paint shall be compatible with the finish coats specified in Section 09 900 of these specifications except that, where no finish coats are required, all primer paint shall be "Tnemec 99R", a primer meeting the requirements of Federal Specification TT-P-615(d), Type 1, or an equal approved in advance by the Architect/Engineer.

2.8 OTHER MATERIALS

- A. All other materials, not specifically described but required for a complete and proper installation of miscellaneous metals, shall be new, free from rust, best quality of their respective kinds and subject to the approval of the Architect/ Engineer.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection: Prior to all work of this section, carefully inspect the installed work of all other trades and verify that such work is complete to the point where fabrication and installation of the work of this section may properly commence.
- B. Make all required measurements in the field to insure proper and adequate fit of miscellaneous metal items.
- C. Verify that miscellaneous metal may be fabricated and installed in strict accordance with the original design and the approved shop drawings.

3.2 FABRICATION

- A. Compliance: Fabricate all miscellaneous metal in strict accordance with the approved shop drawings and the reference standards.
- B. Prefabrication: Insofar as possible, shop prefabricate all items complete and ready for installation.
- C. Welding:
 - 1. Unless otherwise indicated on the drawings, weld all shop connections.
 - 2. Make all joints and intersections of metal tightly fitting and securely fastened.
 - 3. Make all work square, plumb, straight and true.
- D. Holes:
 - 1. Drill or punch all holes required for the attachment of work of other trades and for bolted connections.
 - 2. Burned holes are not acceptable.

3.3 SHOP PAINTING

- A. Painting: Shop prime all steel except:
 - 1. Steel to be encased in concrete.
 - 2. Surfaces to be welded.
 - 3. Contact surfaces to be high strength bolted.
 - 4. Steel work which will be concealed by interior finish.

3.4 ERECTION

- A. Coordination: Coordinate installation schedule with the schedule of other trades to insure orderly and timely progress of the total work.
- B. Compliance: Erect and install all miscellaneous metal in strict accordance with the drawings, the approved shop drawings, and the referenced standards, aligning straight, plumb, and level within a tolerance of 1 in 200.

END OF SECTION

SECTION 05 5213 - PIPE AND TUBE RAILINGS

PART 1 GENERAL

1.1 SUMMARY

- A. Aluminum railings, balusters, and fittings.
- B. Handrails.

1.2 REFERENCE STANDARDS

- A. American Society of Civil Engineers (ASCE)
 - 1. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures
- B. ASTM International:
 - 1. ASTM B211 - Standard Specification for Aluminum and Aluminum-Alloy Rolled or Cold Finished Bar, Rod, and Wire.
 - 2. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes.
 - 3. ASTM B241 - Standard Specification for Aluminum and Aluminum-Alloy Seamless Pipe and Seamless Extruded Tube.
 - 4. ASTM E985 - Standard Specification for Permanent Metal Railing Systems and Rails for Buildings.
- C. International Building Code (IBC)
- D. National Association of Architectural Metal Manufacturers:
 - 1. NAAMM Metal Finishes Manual.
- E. Occupational Safety and Health Administration (OSHA)
 - 1. OSHA Regulations Standards – 29 CFR – Part 1910

1.3 SUBMITTALS

- A. ~~Section 01 3000 – Administrative Requirements~~: Requirements for submittals.

McGill Section 013300
- B. Shop Drawings: Indicate profiles, sizes, connection attachments, anchorage, size and type of fasteners, and accessories.

1.4 QUALITY ASSURANCE

- A. Perform Work of this Section according to applicable International Building Code.
- B. Perform Work of this Section according to American Society of Civil Engineers, ASCE 7.

- C. Perform Work of this Section according to applicable OSHA guidelines.
- D. Perform Work of this Section according to NAAM-AMP521.
- E. Perform Work of this Section according to ASTM E985.

1.5 QUALIFICATIONS

- A. Fabricator: Company specializing in fabricating products specified in this Section with minimum three years' experience.
- B. Erector: Company specializing in performing Work of this Section with minimum three years' experience.

1.6 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

PART 2 PRODUCTS

2.1 PERFORMANCE AND DESIGN CRITERIA

- A. Design handrail, guardrail, and attachments to resist forces as required by ASTM E985. Apply loads non-simultaneously to produce maximum stresses.
 - 1. Guard Top Rail and Handrail Concentrated Load: 200 lb. applied at any point in any direction.
 - 2. Guard Top Rail Uniform Load: 50 plf applied in any direction.
 - 3. Intermediate Rails, Panels, and Baluster Concentrated Load: 50 lb. applied to 1 sq. ft. area.

2.2 HANDRAILS AND RAILINGS

- A. Manufacturers:
 - 1. Peak to Peak Engineered Railings of Wheat Ridge, CO.
 - 2. Golden Railings, Inc. of Broomfield, CO.
 - 3. Or Engineer Approved Equal

2.3 MATERIALS

- A. Aluminum Railing System:
 - 1. All rail is to be of mechanical construction.
 - 2. All top rails are to be fabricated from 1-1/2" diameter, schedule 40, aluminum pipe (6005A-T61 alloy).

3. All intermediate rails are to be fabricated from 1-1/2" diameter, schedule 40, aluminum pipe (6005A-T61 alloy).
4. All posts are to be fabricated from 1-1/2" diameter, schedule 40, aluminum pipe (6005A-T61 alloy).
5. All components are to be 6005A-T61 alloy.
6. All fasteners (self-tapping screws, machine bolts, adhesive anchors, rivets, etc.) to be 304 stainless steel.
7. All railing surfaces in contact with concrete or dissimilar metals shall receive one 1/16" thick neoprene gasket.
8. All bolts used to mount railings to floors, walls, steel, etc. are to be supplied by the railing manufacturer.
9. All posts are to be furnished cut to length with fittings and mounting plates attached (except for top fitting at level and rake line posts).
10. All rail when properly installed shall meet or exceed OSHA requirements.
11. Max post spacing shall be 6'-0" center to center.
12. All curved rail shall be fabricated using curved top and intermediate rails.
13. All rail is to be finished in accordance with the Aluminum Association's designation M10C22A41.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field conditions are acceptable and are ready to receive Work.
- B. If applicable, verify that concealed blocking and reinforcement are installed and correctly located to receive wall-mounted handrails.

3.2 INSTALLATION

- A. Install components plumb and level, accurately fitted, free from distortion or defects.
- B. Anchor railings to structure as recommended by railing manufacturer.

END OF SECTION

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SECTION 07 9200 - JOINT SEALANTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Nonsag gunnable joint sealants.
- B. Joint backings and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 08 8000 - Glazing: Glazing sealants and accessories.

1.3 REFERENCE STANDARDS

- A. ASTM C794 - Standard Test Method for Adhesion-In-Peel of Elastomeric Joint Sealants 2018.
- B. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- C. ASTM C1087 - Standard Test Method for Determining Compatibility of Liquid-Applied Sealants with Accessories Used in Structural Glazing Systems 2016.
- D. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- E. ASTM C1248 - Standard Test Method for Staining of Porous Substrate by Joint Sealants 2018.

1.4 SUBMITTALS

- A. See ~~Section 01 3000 – Administrative Requirements~~, for submittal procedures.

McGill Section 013300
- B. Product Data for Sealants: Submit manufacturer's technical data sheets for each product to be used, that includes the following.
 - 1. Physical characteristics, including movement capability, VOC content, hardness, cure time, and color availability.
 - 2. List of backing materials approved for use with the specific product.
 - 3. Substrates that product is known to satisfactorily adhere to and with which it is compatible.
 - 4. Substrates the product should not be used on.
- C. Preconstruction Laboratory Test Reports: Submit at least four weeks prior to start of installation.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- B. Preconstruction Laboratory Testing: Arrange for sealant manufacturer(s) to test each combination of sealant, substrate, backing, and accessories.
1. Adhesion Testing: In accordance with ASTM C794.
 2. Compatibility Testing: In accordance with ASTM C1087.
 3. Allow sufficient time for testing to avoid delaying the work.
 4. Deliver to manufacturer sufficient samples for testing.
 5. Report manufacturer's recommended corrective measures, if any, including primers or techniques not indicated in product data submittals.
 6. Testing is not required if sealant manufacturer provides data showing previous testing, not older than 24 months, that shows satisfactory adhesion, lack of staining, and compatibility.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Non-Sag Sealants: Permits application in joints on vertical surfaces without sagging or slumping.
1. ADFAST Corporation: www.adfastcorp.com#sle.
 2. Adhesives Technology Corporation: www.atcepoxy.com/#sle.
 3. Bostik Inc: www.bostik-us.com/#sle.
 4. Dow Chemical Company: consumer.dow.com/en-us/industry/ind-building-construction.html/#sle.
 5. Everkem Diversified Products, Inc: www.everkemproducts.com/#sle.
 6. Fortifiber Building Systems Group: www.fortifiber.com/#sle.
 7. Franklin International, Inc: www.titebond.com/#sle.
 8. Hilti, Inc: www.us.hilti.com/#sle.
 9. Master Builders Solutions by BASF: www.master-builders-solutions.basf.us/en-us/#sle.
 10. Momentive Performance Materials, Inc (formerly GE Silicones): www.momentive.com/#sle.
 11. Pecora Corporation: www.pecora.com/#sle.
 12. QUIKRETE Companies: www.quikrete.com/#sle.
 13. Sherwin-Williams Company: www.sherwin-williams.com/#sle.

14. Sika Corporation: www.usa-sika.com/#sle.
15. Specified Technologies Inc: www.stifirestop.com/#sle.
16. Tremco Commercial Sealants & Waterproofing: www.tremcosealants.com/#sle.
17. W.R. Meadows, Inc: www.wrmeadows.com/#sle.

2.2 JOINT SEALANT APPLICATIONS

A. Scope:

1. Exterior Joints: Seal open joints, whether or not the joint is indicated on drawings, unless specifically indicated not to be sealed. Exterior joints to be sealed include, but are not limited to, the following items.
 - a. Wall expansion and control joints.
 - b. Joints between door, window, and other frames and adjacent construction.
 - c. Joints between different exposed materials.
 - d. Openings below ledge angles in masonry.
 - e. Other joints indicated below.
2. Do not seal the following types of joints.
 - a. Intentional weepholes in masonry.
 - b. Joints indicated to be treated with manufactured expansion joint cover or some other type of sealing device.
 - c. Joints where sealant is specified to be provided by manufacturer of product to be sealed.
 - d. Joints where installation of sealant is specified in another section.
 - e. Joints between suspended panel ceilings/grid and walls.

B. Exterior Joints: Use non-sag non-staining silicone sealant, unless otherwise indicated.

2.3 JOINT SEALANTS - GENERAL

2.4 NONSAG JOINT SEALANTS

- ### **A. Non-Staining Silicone Sealant: ASTM C920, Grade NS, Uses M and A; not expected to withstand continuous water immersion or traffic.**
1. Movement Capability: Plus and minus 50 percent, minimum.
 2. Non-Staining To Porous Stone: Non-staining to light-colored natural stone when tested in accordance with ASTM C1248.

3. Dirt Pick-Up: Reduced dirt pick-up compared to other silicone sealants.
4. Color: Match adjacent finished surfaces.

2.5 ACCESSORIES

- A. Backer Rod: Cylindrical cellular foam rod with surface that sealant will not adhere to, compatible with specific sealant used, and recommended by backing and sealant manufacturers for specific application.
- B. Backing Tape: Self-adhesive polyethylene tape with surface that sealant will not adhere to and recommended by tape and sealant manufacturers for specific application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that joints are ready to receive work.
- B. Verify that backing materials are compatible with sealants.
- C. Verify that backer rods are of the correct size.

3.2 PREPARATION

- A. Remove loose materials and foreign matter that could impair adhesion of sealant.
- B. Clean joints, and prime as necessary, in accordance with manufacturer's instructions.
- C. Perform preparation in accordance with manufacturer's instructions and ASTM C1193.
- D. Mask elements and surfaces adjacent to joints from damage and disfigurement due to sealant work; be aware that sealant drips and smears may not be completely removable.

3.3 INSTALLATION

- A. Perform work in accordance with sealant manufacturer's requirements for preparation of surfaces and material installation instructions.
- B. Perform installation in accordance with ASTM C1193.
- C. Install bond breaker backing tape where backer rod cannot be used.
- D. Install sealant free of air pockets, foreign embedded matter, ridges, and sags, and without getting sealant on adjacent surfaces.
- E. Do not install sealant when ambient temperature is outside manufacturer's recommended temperature range, or will be outside that range during the entire curing period, unless manufacturer's approval is obtained and instructions are followed.
- F. Nonsag Sealants: Tool surface concave, unless otherwise indicated; remove masking tape immediately after tooling sealant surface.

END OF SECTION

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SECTION 08 1100 - HOLLOW METAL DOORS

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Work Included: The work required under this section consists of all hollow metal and related items necessary to complete the work indicated on drawings and described in specifications.
- B. RELATED REQUIREMENTS
 - 1. ~~Section 01 3000—Administrative Requirements~~: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- C. SUBMITTALS
 - 1. ~~See Section 01 3000—Administrative Requirements~~, for submittal procedures.
 - 2. Shop Drawings: Submit drawings through General Contractor. Obtain approval of drawings prior to proceeding with manufacturing. Shop drawings shall indicate elevations of each door type; details of each frame type; location in the building for each item; conditions at openings with various wall thickness and materials; typical and special details of construction; methods of assembling sections; location and installation requirements for hardware; size, shape, and thickness of materials; joints and connections.

PART 2 PRODUCTS

2.1 METAL DOORS

- A. Doors Scheduled to be Metal
 - 1. Steelcraft
 - 2. Ceco
 - 3. Amweld
 - 4. Palmetto Metal Products, Inc.
 - 5. Or equal as meets specifications
- B. Doors to be 1-3/4" full flush construction with vertical mechanical interlocking edge seams; to be made of cold rolled steel. Interior doors to be 18 gauge steel. Exterior doors 16 gauge steel.
- C. Exterior Hollow metal doors shall be reinforced, stiffened, insulated, and sound deadened with 1-1/2 pound density polyurethane core laminated to the inside faces of panels. Exterior doors which are out swinging shall have top caps. Exterior Hollow metal doors shall have a Thermal Resistance Value U-value of U-0.61 or less.
- D. Doors shall have beveled, 1/8" in 2", hinge and lock edges.

- E. Top and Bottom 14 gauge cold rolled steel reinforcing channels shall be spot welded.
- F. Doors shall be reinforced for hardware as specified
- G. Finishes: Doors shall be phosphatized and receive one coat of baked on prime paint in preparation for painting which will be performed at the job site under Section 099110 of these specifications.
- H. Doors shall have flush bead glazing wherever possible and coordinated for a flush mounting of door hardware. Shims may be used in lieu of flush bead glazing in order to accommodate installation of door hardware at glazing beads if necessary.
- I. Furnish, fabricate and reinforce all stiles and rails as required for hollow metal doors.
- J. Doors which require a fire rating label are to have Underwriters Laboratory (U.L.) labels. These labels are to be attached to the butt edge of the door and are to remain unpainted and visible for inspection.

PART 3 EXECUTION

3.1 ERECTION

- A. Doors shall be hung with all clearance shown on the approved shop drawings accurately maintained.
- B. All hardware to be installed after finished painting.

3.2 GLAZING

- A. All glass shall be installed by the Glazing contractor in bed of putty, held in place by glazing mouldings furnished by the door manufacturer.

END OF SECTION

SECTION 08 1213 - HOLLOW METAL FRAMES

PART 1 GENERAL

1.1 GENERAL

A. Scope of work

1. Work Included: The work required under this section consists of all hollow metal frames, and related items necessary to complete the work indicated on drawings and described in specifications.

1.2 RELATED REQUIREMENTS

- A. Section 08 7100 - Door Hardware: Hardware, silencers, and weatherstripping.

1.3 REFERENCE STANDARDS

- A. ANSI/SDI A250.10 - Test Procedure and Acceptance Criteria for Prime Painted Steel Surfaces for Steel Doors and Frames 2020.
- B. NAAMM HMMA 840 - Guide Specifications For Receipt, Storage and Installation of Hollow Metal Doors and Frames 2007.

1.4 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~ for submittal procedures.
McGill Section 013300
- B. Product Data: Materials and details of design and construction, hardware locations, reinforcement type and locations, anchorage and fastening methods, and finishes; and one copy of referenced grade standard.
- C. Shop Drawings: Details of each opening, showing elevations, glazing, frame profiles, and identifying location of different finishes, if any.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing products specified in this section, with not less than three years of documented experience.
- B. Maintain at project site copies of reference standards relating to installation of products specified.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in accordance with applicable requirements and in compliance with standards and/or custom guidelines as indicated.
- B. Protect with resilient packaging; avoid humidity build-up under coverings; prevent corrosion.

PART 2 PRODUCTS

2.1 METAL FRAMES

- A. Location and Type: Except where other frames are scheduled, all metal frames shall be formed of steel, type with integral trim and fabricated with full welded unit type construction at joints.
- B. Type and Gauge of Metal
 - 1. Metal for frames shall be cold rolled, or hot rolled, pickled and oiled, steel sheets indicated or specified; frames shall be fabricated from steel, not lighter than 16 gauge for exterior doors and 16 gauge for interior doors.
 - 2. Provide concealed metal reinforcement for hardware as required. The gauges of metal for reinforcement shall be in accordance with the manufacturer's recommendations for the type of hardware and the thickness and width of doors to be hung in the frame, provided that the gauges used are not lighter than those required by Commercial Standard CS 242-62.
- C. Workmanship and Design: The finished work shall be strong and rigid, neat in appearance, and free from defects. Fabricate molded members straight and true with corner joints well formed, in true alignment, and fastenings concealed where practicable.
- D. Forming Corner Joints: Joints for welded type frames shall be mitered and continuously arc welded for full depth and width of frame and trim. All contact edges shall be closed tight and all welds on exposed surfaces dressed smooth and flush.
- E. Provisions for Hardware: Frames shall be prepared at the factory for the installation of hardware. Welding of hinges to frames will not be permitted. Frames shall be mortised, reinforced, drilled and tapped to templates to receive all mortised hardware; frames to receive surface applied hardware shall be provided with reinforcing plates only. Provide cover boxes in back of all hardware cutouts. Door frames shall be punched to receive rubber or vinyl door silencers; provide three silencers at lock side of single doors and one silencer for each leaf in heads of double door frames; furnish the required number and type of silencers with the frames. Lock strikes shall be set out and adjusted to provide clearance for silencers. Frames shall be coordinated with hardware supplier for the Architect's approval.
- F. Wall Anchors: Provide metal anchors of shapes and sizes required for the adjoining type of wall construction. Fabricate jamb anchors of steel, not lighter than the gauge used for frame.
- G. Locate anchors on jambs near the top and bottom of each frame and at intermediate point. For frames set in masonry, provide 10" long corrugated or other deformed type adjustable anchors at jambs.
- H. Floor Anchors: Provide floor slips of not less than 16 gauge steel and fasten to bottom of each jamb member for anchoring frame to floor construction.
- I. Shop Painting - Primed Finish: Apply a primed finish to all ferrous metal surfaces furnished under this section. Clean and chemically treat metal surfaces to assure maximum paint adherence; follow with a dip or spray coat of rust inhibitive metallic oxide, zinc chromate, or synthetic resin primer on all exposed surfaces. Finished surfaces shall be smooth and free from irregularities and rough spots. Each coat of paint shall be separately baked or oven dried. The time and temperature for drying shall be in accordance with manufacturer's

recommendations for developing maximum hardness and resistance to abrasion.

- J. Where U.L. label doors are required furnish metal frames of equal U.L. label rating. U.L. label shall remain on frame undisturbed and in a location that is easily read.

2.2 FINISHES

- A. Primer: Rust-inhibiting, complying with ANSI/SDI A250.10, door manufacturer's standard.

2.3 ACCESSORIES

- A. Silencers: Resilient rubber, fitted into drilled hole; 3 on strike side of single door, 3 on center mullion of pairs, and 2 on head of pairs without center mullions.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify existing conditions before starting work.
- B. Verify that opening sizes and tolerances are acceptable.
- C. Verify that finished walls are in plane to ensure proper door alignment.

3.2 INSTALLATION

- A. Install frames in accordance with manufacturer's instructions and related requirements of specified frame standards or custom guidelines indicated.
- B. Coordinate frame anchor placement with wall construction.
- C. Doors shall be hung with all clearance shown on the approved shop drawings accurately maintained.
- D. Install door hardware after finish painting.

3.3 GLAZING

- A. All glass shall be installed by the Glazing Subcontractor in bed of putty, held in place by glazing moldings furnished by the door manufacturer.

END OF SECTION

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SECTION 08 3100 - ACCESS DOORS AND PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Floor access door and frame units, interior and exterior.

1.2 SUBMITTALS

McGill Section 013300

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.
- B. Product Data: Provide sizes, types, finishes, hardware, scheduled locations, and details of adjoining work.
- C. Shop Drawings: Indicate exact position of all access door units.

PART 2 PRODUCTS

2.1 FLOOR UNITS

- A. Floor Door and Frame Units: Factory fabricated, fully assembled units with corner joints welded, filled, and ground flush; square and without rack or warp; coordinate requirements with assemblies units are to be installed in.
 - 1. Size: As indicated on the drawings.
 - 2. Hardware: Stainless steel, Type 316.
 - a. Hinges: Non-removable pin with stainless steel compression spring assist.
 - b. Lock: Cylinder lock with latch, two keys for each unit.
 - c. Hold open device: automatic arm locks
- B. Interior and Exterior Units: Aluminum, minimum 1/4 inch thick.
 - 1. Design Load: Design to support live load of H-20 vehicular wheel loading with deflection not to exceed 1/180 of span.
 - 2. Operation: Manual opening, manual closing (spring assisted).
 - 3. Frame Configuration: Drainage channel with drain coupling.
 - 4. Cover Pattern: Diamond tread plate.
 - 5. Lift Handle: Recessed, non-removable.
 - 6. Latch Handle: Provide door with handle which will allow opening from below.
 - 7. Grating: Provide lockable grating panel, factory installed, 1-inch aluminum "I" bar grating, rated for 300lb/sf with safety orange powdered coat finish.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that rough openings are correctly sized and located.

3.2 INSTALLATION

- A. Install units in accordance with manufacturer's instructions.
- B. Install frames plumb and level in openings. Secure rigidly in place.
- C. Position units to provide convenient access to the concealed work requiring access.

END OF SECTION

SECTION 08 5113 - ALUMINUM WINDOWS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Extruded aluminum windows with fixed sash.
- B. Factory glazing.

1.2 RELATED REQUIREMENTS

- A. Section 08 8000 - Glazing.

1.3 REFERENCE STANDARDS

- A. AAMA/WDMA/CSA 101/I.S.2/A440 - North American Fenestration Standard/Specification for Windows, Doors, and Skylights 2017.
- B. AAMA CW-10 - Care and Handling of Architectural Aluminum from Shop to Site 2015.
- C. AAMA 609 & 610 - Cleaning and Maintenance Guide for Architecturally Finished Aluminum (Combined Document) 2015.
- D. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- E. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.
- F. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- G. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.
- H. ASTM E90 - Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions and Elements 2009 (Reapproved 2016).
- I. ASTM E331 - Standard Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference 2000 (Reapproved 2016).
- J. ASTM E1332 - Standard Classification for Rating Outdoor-Indoor Sound Attenuation 2016.
- K. ASTM F588 - Standard Test Methods for Measuring the Forced Entry Resistance of Window Assemblies, Excluding Glazing Impact 2017.

1.4 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.
- B. Product Data: Provide component dimensions and information on glass and glazing.

- C. Shop Drawings: Indicate opening dimensions, elevations of different types, framed opening tolerances, method for achieving air and vapor barrier seal to adjacent construction, anchorage locations, and installation requirements.
- D. Grade Substantiation: Prior to submitting shop drawings or starting fabrication, submit one of the following showing compliance with specified grade:
 - 1. Evidence of AAMA Certification.
 - 2. Evidence of WDMA Certification.
 - 3. Evidence of CSA Certification.
 - 4. Test report(s) by independent testing agency itemizing compliance and acceptable to authorities having jurisdiction.
- E. Warranty: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: Company specializing in performing work of type specified and with at least three years of documented experience.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Comply with requirements of AAMA CW-10.
- B. Protect finished surfaces with wrapping paper or strippable coating during installation. Do not use adhesive papers or sprayed coatings that bond to substrate when exposed to sunlight or weather.

1.7 FIELD CONDITIONS

- A. Do not install sealants when ambient temperature is less than 40 degrees F.
- B. Maintain this minimum temperature during and 24 hours after installation of sealants.

1.8 WARRANTY

- A. See ~~Section 01 7800—Closeout Submittals~~, for additional warranty requirements.

McGill Section 017700
- B. Correct defective Work within a five year period after Date of Substantial Completion.
- C. Provide five year manufacturer warranty against failure of glass seal on insulating glass units, including interpane dusting or misting. Include provision for replacement of failed units.
- D. Provide five year manufacturer warranty against excessive degradation of exterior finish. Include provision for replacement of units with excessive fading, chalking, or flaking.

PART 2 PRODUCTS

2.1 MANUFACTURERS

A. Aluminum Windows:

1. Manko Window Systems, Inc: www.mankowindows.com/#sle.
2. TRACO: www.traco.com/#sle.
3. YKK AP America Inc: www.ykkap.com/#sle.
4. EFCO, a Pella Company: www.efcocorp.com/#sle.

2.2 WINDOWS

A. Fixed, Non-Operable Type:

1. Construction: Thermally broken.
2. Exterior Finish: Class I natural anodized.
3. Interior Finish: Class I natural anodized.

2.3 PERFORMANCE REQUIREMENTS

- A. Grade: AAMA/WDMA/CSA 101/I.S.2/A440 requirements for specific window type:
1. Performance Class (PC): R.
 2. Performance Grade (PG): 15, with minimum design pressure (DP) of 15.04 psf.
- B. Water Leakage: No uncontrolled leakage on interior face when tested in accordance with ASTM E331 at differential pressure of 12.11 psf.
- C. Air Leakage: Maximum of 0.1 cu ft/min sq ft per unit area of outside frame dimension, with 6.27 psf differential pressure when tested in accordance with ASTM E283.
- D. Overall Thermal Transmittance (U-value): 0.35, maximum, including glazing, measured on window sizes required for this project.
- E. Forced Entry Resistance: Tested to comply with ASTM F588 requirements for performance level of Grade 10 for specific window style required.
- F. Acoustic Performance: Minimum outdoor-indoor transmission class (OITC) rating of 34, when tested in accordance with ASTM E90 and ASTM E1332.

2.4 COMPONENTS

- A. Frames: 2.0 inch wide by 6 inch deep profile, of manufacturer's standard thickness section; thermally broken with interior portion of frame insulated from exterior portion; flush glass stops of snap-on type.
- B. Glazing: As specified in Section 08 8000.

- C. Glazing Materials: As specified in Section 08 8000.
- D. Sealant for Setting Sills and Sill Flashing: Non-curing butyl type.

2.5 MATERIALS

- A. Extruded Aluminum: ASTM B221 (ASTM B221M), 6063 alloy, T6 temper.
- B. Sheet Aluminum: ASTM B209 (ASTM B209M), 5005 alloy, H12 or H14 temper.

2.6 FINISHES

- A. Apply one coat of bituminous coating to concealed aluminum and steel surfaces in contact with dissimilar materials.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that wall openings and adjoining air and vapor seal materials are ready to receive aluminum windows.

3.2 INSTALLATION

- A. Install windows in accordance with manufacturer's instructions.
- B. Install window assembly in accordance with AAMA/WDMA/CSA 101/I.S.2/A440.
- C. Attach window frame and shims to perimeter opening to accommodate construction tolerances and other irregularities.
- D. Align window plumb and level, free of warp or twist. Maintain dimensional tolerances and alignment with adjacent work.
- E. Install sill and sill end angles.
- F. Set sill members and sill flashing in continuous bead of sealant.
- G. Provide thermal isolation where components penetrate or disrupt building insulation. Pack fibrous insulation in shim spaces at perimeter of assembly to maintain continuity of thermal barrier.
- H. Install glass and infill panels in accordance with requirements specified in Section 08 8000.

3.3 TOLERANCES

- A. Maximum Variation from Level or Plumb: 1/16 inches every 3 ft non-cumulative or 1/8 inches per 10 ft, whichever is less.

3.4 CLEANING

- A. Remove protective material from factory finished aluminum surfaces.

- B. Wash surfaces by method recommended and acceptable to window manufacturer; rinse and wipe surfaces clean.
- C. Upon completion of installation, thoroughly clean aluminum surfaces in accordance with AAMA 609 & 610.
- D. Remove excess glazing sealant by moderate use of mineral spirits or other solvent acceptable to sealant and window manufacturer.

END OF SECTION

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SECTION 08 7100 - HARDWARE

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.

1.2 SUMMARY

- A. This section includes commercial door hardware for the following:
 - 1. Swinging doors.
 - 2. Other doors to the extent indicated.
- B. Door hardware includes, but is not necessarily limited to, the following:
 - 1. Mechanical door hardware.
 - 2. Electromechanical door hardware, power supplies, back-ups and surge protection.
 - 3. Cylinders specified for doors in other sections.

1.3 RELATED REQUIREMENTS

- A. Division 08 Section "Hollow Metal Doors".
- B. Division 08 Section "Hollow Metal Frames."
- C. McGill Sections 017823 and 017839
~~Section 01 7800 - Closeout Submittals:~~ Project record documents, operation and maintenance (O&M) data, warranties and bonds.

1.4 SUBMITTALS

- A. Product Data: Manufacturer's product data sheets including installation details, material descriptions, dimensions of individual components and profiles, operational descriptions and finishes.
- B. Door Hardware Schedule: Prepared by or under the supervision of supplier, detailing fabrication and assembly of door hardware, as well as procedures and diagrams. Coordinate the final Door Hardware Schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Format: Comply with scheduling sequence and vertical format in DHI's "Sequence and Format for the Hardware Schedule."
 - 2. Organization: Organize the Door Hardware Schedule into door hardware sets indicating complete designations of every item required for each door or opening. Organize door hardware sets in same order as in the Door Hardware Sets at the end of Part 3. Submittals that do not follow the same format and order as the Door Hardware Sets will

be rejected and subject to resubmission.

3. Content: Include the following information:
 - a. Type, style, function, size, label, hand, and finish of each door hardware item.
 - b. Manufacturer of each item.
 - c. Fastenings and other pertinent information.
 - d. Location of door hardware set, cross-referenced to Drawings, both on floor plans and in door and frame schedule.
 - e. Explanation of abbreviations, symbols, and codes contained in schedule.
 - f. Mounting locations for door hardware.
 - g. Door and frame sizes and materials.
 4. Submittal Sequence: Submit the final Door Hardware Schedule at earliest possible date, particularly where approval of the Door Hardware Schedule must precede fabrication of other work that is critical in the Project construction schedule. Include Product Data, Samples, Shop Drawings of other work affected by door hardware, and other information essential to the coordinated review of the Door Hardware Schedule.
- C. Shop Drawings: Details of electrified access control hardware indicating the following:
1. Wiring Diagrams: Upon receipt of approved schedules, submit detailed system wiring diagrams for power, signaling, monitoring, communication, and control of the access control system electrified hardware. Differentiate between manufacturer-installed and field-installed wiring. Include the following:
 - a. Elevation diagram of each unique access-controlled opening showing location and interconnection of major system components with respect to their placement in the respective door openings.
 - b. Complete (risers, point-to-point) access control system block wiring diagrams.
 2. Electrical Coordination: Coordinate with related Division 26 Electrical Sections the voltages and wiring details required at electrically controlled and operated hardware openings.
- D. Keying Schedule: Prepared under the supervision of the Owner, separate schedule detailing final keying instructions for locksets and cylinders in writing. Include keying system explanation, door numbers, key set symbols, hardware set numbers and special instructions. Owner to approve submitted keying schedule prior to the ordering of permanent cylinders.
- E. Operating and Maintenance Manuals: Provide manufacturers operating and maintenance manuals for each item comprising the complete door hardware installation in quantity as required in Division 01, Closeout Submittals. The manual to include the name, address, and contact information of the manufacturers providing the hardware and their nearest service representatives. The final copies delivered after completion of the installation test to include

"as built" modifications made during installation, checkout, and acceptance.

- F. Warranties and Maintenance: Special warranties and maintenance agreements specified in this Section.

1.5 QUALITY ASSURANCE

- A. Manufacturers Qualifications: Engage qualified manufacturers with a minimum 5 years of documented experience in producing hardware and equipment similar to that indicated for this Project and that have a proven record of successful in-service performance.
- B. Installer Qualifications: Installers, trained by the primary product manufacturers, with a minimum 3 years documented experience installing both standard and electrified builders hardware similar in material, design, and extent to that indicated for this Project and whose work has resulted in construction with a record of successful in-service performance.
- C. Door Hardware Supplier Qualifications: Experienced commercial door hardware distributors with a minimum 5 years documented experience supplying both mechanical and electromechanical hardware installations comparable in material, design, and extent to that indicated for this Project. Supplier recognized as a factory direct distributor in good standing by the manufacturers of the primary materials with a warehousing facility in Project's vicinity. Supplier to have on staff a certified Architectural Hardware Consultant (AHC) available during the course of the Work to consult with Contractor, Architect, and Owner concerning both standard and electromechanical door hardware and keying.
 - 1. Scheduling Responsibility: Preparation of door hardware and keying schedules.
- D. Source Limitations: Obtain each type and variety of Door Hardware specified in this Section from a single source, qualified supplier unless otherwise indicated.
 - 1. Electrified modifications or enhancements made to a source manufacturer's product line by a secondary or third party source will not be accepted.
 - 2. Provide electromechanical door hardware from the same manufacturer as mechanical door hardware, unless otherwise indicated.
- E. Regulatory Requirements: Comply with NFPA 70, NFPA 80, NFPA 101 and ANSI A117.1 requirements and guidelines as directed in the model building code including, but not limited to, the following:
 - 1. NFPA 70 "National Electrical Code", including electrical components, devices, and accessories listed and labeled as defined in Article 100 by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - 2. Where indicated to comply with accessibility requirements, comply with Americans with Disabilities Act (ADA), "Accessibility Guidelines for Buildings and Facilities (ADAAG)," ANSI A117.1 as follows:
 - a. Handles, Pulls, Latches, Locks, and other Operating Devices: Shape that is easy to grasp with one hand and does not require tight grasping, tight pinching, or twisting of the wrist.

- b. Door Closers: Comply with the following maximum opening-force requirements indicated:
 - 1) Interior Hinged Doors: 5 lbf applied perpendicular to door.
 - 2) Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - c. Thresholds: Not more than 1/2 inch high. Bevel raised thresholds with a slope of not more than 1:2.
 - 3. NFPA 101: Comply with the following for means of egress doors:
 - a. Latches, Locks, and Exit Devices: Not more than 15 lbf to release the latch. Locks shall not require the use of a key, tool, or special knowledge for operation.
 - b. Thresholds: Not more than 1/2 inch high.
 - 4. Fire-Rated Door Assemblies: Provide door hardware for assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to NFPA 252 (neutral pressure at 40" above sill) or UL-10C.
 - a. Test Pressure: Positive pressure labeling.
- F. Keying Conference: Conduct conference to comply with requirements in Division 01 Section "Project Meetings." Keying conference to incorporate the following criteria into the final keying schedule document:
 - 1. Function of building, purpose of each area and degree of security required.
 - 2. Plans for existing and future key system expansion.
 - 3. Requirements for key control storage and software.
 - 4. Installation of permanent keys, cylinder cores and software.
 - 5. Address and requirements for delivery of keys.
- G. Pre-Submittal Conference: Conduct coordination conference in compliance with requirements in Division 01 Section "Project Meetings" with attendance by representatives of Supplier(s), Installer(s), and Contractor(s) to review proper methods and the procedures for receiving, handling, and installing door hardware.
 - 1. Prior to installation of door hardware, conduct a project specific training meeting to instruct the installing contractors' personnel on the proper installation and adjustment of their respective products. Product training to be attended by installers of door hardware (including electromechanical hardware) for aluminum, hollow metal and wood doors. Training will include the use of installation manuals, hardware schedules, templates and physical product samples as required.

2. Inspect and discuss electrical roughing-in, power supply connections, and other preparatory work performed by other trades.
 3. Review sequence of operation narratives for each unique access-controlled opening.
 4. Review and finalize construction schedule and verify availability of materials.
 5. Review the required inspecting, testing, commissioning, and demonstration procedures
- H. At completion of installation, provide written documentation that components were applied to manufacturer's instructions and recommendations and according to approved schedule.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lock-up and shelving for door hardware delivered to Project site. Do not store electronic access control hardware, software or accessories at Project site without prior authorization.
- B. Tag each item or package separately with identification related to the final Door Hardware Schedule and include basic installation instructions with each item or package.
- C. Deliver, as applicable, permanent keys, cylinders, cores, access control credentials, software and related accessories directly to Owner via registered mail or overnight package service. Instructions for delivery to the Owner shall be established at the "Keying Conference".

1.7 COORDINATION

- A. Templates: Obtain and distribute to the parties involved templates for doors, frames, and other work specified to be factory prepared for installing standard and electrified hardware. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing hardware to comply with indicated requirements.
- B. Door Hardware and Electrical Connections: Coordinate the layout and installation of scheduled electrified door hardware and related access control equipment with required connections to source power junction boxes, low voltage power supplies, detection and monitoring hardware, and fire and detection alarm systems.
- C. Door and Frame Preparation: Related Division 08 Sections (Steel, Aluminum and Wood) doors and corresponding frames are to be prepared, reinforced and pre-wired (if applicable) to receive the installation of the specified electrified, monitoring, signaling and access control system hardware without additional in-field modifications.

1.8 WARRANTY

- A. General Warranty: Reference Division 01, General Requirements. Special warranties specified in this Article shall not deprive Owner of other rights Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by Contractor under requirements of the Contract Documents.
- B. Warranty Period: Written warranty, executed by manufacturer(s), agreeing to repair or replace components of standard and electrified door hardware that fails in materials or

workmanship within specified warranty period after final acceptance by the Owner. Failures include, but are not limited to, the following:

1. Structural failures including excessive deflection, cracking, or breakage.
 2. Faulty operation of the hardware.
 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
 4. Electrical component defects and failures within the systems operation.
- C. Standard Warranty Period: One year from date of Substantial Completion, unless otherwise indicated.
- D. Special Warranty Periods:
1. Ten years for mortise locks and latches.
 2. Five years for exit hardware.
 3. Twenty-five years for manual surface door closers.
 4. Two years for electromechanical door hardware.

1.9 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.
- B. Continuing Service: Beginning at Substantial Completion, and running concurrent with the specified warranty period, provide continuous (6) months full maintenance including repair and replacement of worn or defective components, lubrication, cleaning, and adjusting as required for proper door opening operation. Provide parts and supplies as used in the manufacture and installation of original products.

PART 2 PRODUCTS

2.1 SCHEDULED DOOR HARDWARE

- A. General: Provide door hardware for each door to comply with requirements in Door Hardware Sets and each referenced section that products are to be supplied under.
1. Designations: Requirements for quantity, item, size, finish or color, grade, function, and other distinctive qualities of each type of door hardware are indicated in the Door Hardware Sets at the end of Part 3. Products are identified by using door hardware designations, as follows:
 - a. Named Manufacturer's Products: Product designation and manufacturer are listed for each door hardware type required for the purpose of establishing requirements. Manufacturers' names are abbreviated in the Door Hardware Schedule.

2. Products furnished, but not installed, under this Section include the following. Coordinating, purchasing, delivering, and scheduling remain requirements of this Section.
 - a. Permanent cylinders, cores, and keys to be installed by Owner.

2.2 HANGING DEVICES

- A. Hinges: ANSI/BHMA A156.1 certified butt hinges with number of hinge knuckles as specified in the Door Hardware Sets.
 1. Quantity: Provide the following hinge quantity, unless otherwise indicated:
 - a. Two Hinges: For doors with heights up to 60 inches.
 - b. Three Hinges: For doors with heights 61 to 90 inches.
 - c. Four Hinges: For doors with heights 91 to 120 inches.
 - 1) For doors with heights more than 120 inches, provide 4 hinges, plus 1 hinge for every 30 inches of door height greater than 120 inches.
- B. Mortise Locksets, Grade 1 (Heavy Duty): ANSI/BHMA A156.13, Series 1000, Operational Grade 1 certified mortise locksets furnished in the functions as specified in the Hardware Sets. Locksets to be manufactured with a corrosion resistant, stamped 12 gauge minimum formed steel case and be field-reversible for handing without disassembly of the lock body. Lockset trim (including knobs, levers, escutcheons, roses) to be the product of a single manufacturer. Furnish with standard 2 3/4" backset, 3/4" throw anti-friction stainless steel latchbolt, and a full 1" throw stainless steel bolt for deadbolt functions.
 1. Mortise locks to be certified Security Grade 1 and include vandal resistant heavy gauge escutcheon or sectional type trim.
 2. Provide mortise lock bodies functionally compatible with a rose-less lever trim option.
 3. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) – 8200 Series.
 - b. No Substitution – Facility Standard.

2.3 LOCK AND LATCH STRIKES

- A. Strikes: Provide manufacturer's standard strike with strike box for each latch or lock bolt, with curved lip extended to protect frame, finished to match door hardware set, unless otherwise indicated, and as follows:
 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
 2. Extra-Long-Lip Strikes: For locks used on frames with applied wood casing trim.

3. Aluminum-Frame Strike Box: Provide manufacturer's special strike box fabricated for aluminum framing.
- B. Standards: Comply with the following:
1. Strikes for Mortise Locks and Latches: BHMA A156.13.
 2. Dustproof Strikes: BHMA A156.16.

2.4 CONVENTIONAL EXIT DEVICES

- A. General Requirements: All exit devices specified herein shall meet or exceed the following criteria:
1. At doors not requiring a fire rating, provide devices complying with NFPA 101 and listed and labeled for "Panic Hardware" according to UL305. Provide proper fasteners as required by manufacturer including sex nuts and bolts at openings specified in the Hardware Sets.
 2. Where exit devices are required on fire rated doors, provide devices complying with NFPA 80 and with UL labeling indicating "Fire Exit Hardware". Provide devices with the proper fasteners for installation as tested and listed by UL. Consult manufacturer's catalog and template book for specific requirements.
 - a. Fire Exit Removable Mullions: Provide keyed removable mullions for use with fire exit devices complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire and panic protection, based on testing according to UL 305 and NFPA 252. Mullions to be used only with exit devices for which they have been tested.
 3. Except on fire rated doors, provide exit devices with hex key dogging device to hold the pushbar and latch in a retracted position. Provide optional keyed cylinder dogging on devices where specified in Hardware Sets.
 4. Flush End Caps: Provide heavy weight impact resistant flush end caps made of architectural metal in the same finish as the devices as in the Hardware Sets. Plastic end caps will not be acceptable.
 5. Lever Operating Trim: Where exit devices require lever trim, furnish manufacturer's heavy-duty trim with cold forged escutcheons, beveled edges, and four threaded studs for thru-bolts.
 - a. Lock Trim Design: As indicated in Hardware Sets, provide finishes and designs to match that of the specified locksets. Provided free-wheeling type trim where indicated.
 - b. Where function of exit device requires a cylinder, provide an interchangeable core type keyed cylinder (Rim or Mortise) as specified in Hardware Sets.
 6. Vertical Rod Exit Devices: Provide and install interior surface and concealed vertical rod exit devices as Less Bottom Rod (LBR) unless otherwise indicated.

7. Narrow Stile Applications: At doors constructed with narrow stiles, or as specified in Hardware Sets, provide devices designed for maximum 2" wide stiles.
 8. Dummy Push Bar: Nonfunctioning push bar matching functional push bar.
 9. Rail Sizing: Provide exit device rails factory sized for proper door width application.
 10. Through Bolt Installation: For exit devices and trim as indicated in Door Hardware Sets.
 11. Hurricane and Tornado Resistance Compliance: Conventional exit devices and tube steel removable mullions to be U.L. listed for windstorm components where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
- B. Conventional Push Rail Exit Devices (Heavy Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Mounting rails to be formed from smooth stainless steel, brass or bronze architectural materials no less than 0.072" thick, with push rails a minimum of 0.062" thickness. Painted or aluminum metal rails are not acceptable. Exit device latch to be investment cast stainless steel, pullman type, with deadlock feature.
1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - 80 Series.
 - b. No Substitution – Facility Standard.
- C. Conventional Push Rail Exit Devices (Standard Duty): ANSI/BHMA A156.3, Grade 1 certified panic and fire exit hardware devices furnished in the functions specified in the Hardware Sets. Exit device bar and push rails to be constructed of heavy-duty wrought steel. Exit device covers to be steel or aluminum material; plastic or thermoplastic rails and covers are not acceptable. Provide trim furnished in standard architectural finishes matching the trims and finishes on specified locksets.
1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - 30 Series.
 - b. No Substitution – Facility Standard.
- D. Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, stabilizers, and mounting brackets as specified in the Hardware Sets. At openings designed for severe wind load conditions due to hurricanes or tornadoes, provide manufacturers approved mullion and accessories to meet applicable state and local windstorm codes.
1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - 980S Series.

- E. Electrified Tube Steel Removable Mullions: ANSI/BHMA A156.3 removable steel mullions with malleable-iron top and bottom retainers and a primed paint finish. Provide keyed removable feature, electrical quick connect wiring, stabilizers, and mounting brackets as specified in the Hardware Sets.

- 1. Acceptable Manufacturers:
 - a. Sargent Manufacturing (SA) - EL980S Series.

2.5 DOOR CLOSERS

- A. All door closers specified herein shall meet or exceed the following criteria:
 - 1. General: Door closers to be from one manufacturer, matching in design and style, with the same type door preparations and templates regardless of application or spring size. Closers to be non-handed with full sized covers including installation and adjusting information on inside of cover.
 - 2. Standards: Closers to comply with UL-10C and UBC 7-2 for Positive Pressure Fire Test and be U.L. listed for use of fire rated doors.
 - 3. Cycle Testing: Provide closers which have surpassed 10 million cycles in a test witnessed and verified by UL.
 - 4. Size of Units: Comply with manufacturer's written recommendations for sizing of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Where closers are indicated for doors required to be accessible to the physically handicapped, provide units complying with ANSI ICC/A117.1.
 - 5. Closer Arms: Provide heavy duty, forged steel closer arms unless otherwise indicated in Hardware Sets.
 - a. Where closers are indicated to have mechanical dead-stop, provide heavy duty arms and brackets with an integral positive stop.
 - b. Where closers are indicated to have mechanical hold open, provide heavy duty units with an additional built-in mechanical holder assembly designed to hold open against normal wind and traffic conditions. Holder to be manually selectable to on-off position.
 - c. Where closers are indicated to have a cushion-type stop, provide heavy duty arms and brackets with spring stop mechanism to cushion door when opened to maximum degree.
 - d. Closers shall not be installed on exterior or corridor side of doors; where possible install closers on door for optimum aesthetics. Provide drop plates or other accessories as required for proper mounting.
 - 6. Closer Covers: Provide metal closer covers finished to match other hardware on the project.

7. Closer Covers: Provide PVC free closer covers with a painted finish to match other hardware on the project.
8. Closer Accessories: Provide door closer accessories including custom templates, special mounting brackets, spacers and drop plates, and through-bolt or security type fasteners as specified in the door Hardware Sets.
9. Hurricane and Tornado Resistance Compliance: Door closers to be U.L. listed for windstorm components where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
 - a. Door Closers, Surface Mounted (Heavy Duty): ANSI/BHMA A156.4, Grade 1 surface mounted, heavy duty door closers with complete spring power adjustment, sizes 1 thru 6; and fully operational adjustable according to door size, frequency of use, and opening force. Closers to be rack and pinion type, one piece cast iron or aluminum alloy body construction, with adjustable backcheck and separate non-critical valves for closing sweep and latch speed control. Provide non-handed units standard.
 - 1) Acceptable Manufacturers:
 - (a) Sargent Manufacturing (SA) - 351 Series.
 - (b) No Substitution – Facility Standard.
 - b. Electromagnetic Door Holders: Certified ANSI A156.15 electromagnetic door holder/releases with a minimum 20 to 40 pounds holding power and single coil construction able to accommodate 12VDC, 24VAC, 24VDC and 120VAC. Coils to be independently wound, employing an integral fuse and armatures to include a positive release button.
 - 1) Acceptable Manufacturers:
 - (a) Rixson (RF) – FM998 Series.

2.6 ARCHITECTURAL TRIM

A. Door Protective Trim

1. General: Door protective trim units to be of type and design as specified below or in the Hardware Sets.
2. Size: Fabricate protection plates (kick, armor, or mop) not more than 2" less than door width (LDW) on stop side of single doors and 1" LDW on stop side of pairs of doors, and not more than 1" less than door width on pull side. Coordinate and provide proper width and height as required where conflicting hardware dictates. Height to be as specified in the Hardware Sets.
3. Metal Protection Plates: ANSI/BHMA A156.6 certified metal protection plates (kick, armor, or mop), beveled on four edges (B4E), fabricated from the following.

- a. Stainless Steel: .050-inch thick, with countersunk screw holes (CSK).
- 4. Fasteners: Provide manufacturer's designated fastener type as specified in the Hardware Sets.
- 5. Metal Door Edging: Door protection edging fabricated from a minimum .050-inch thick metal sheet, formed into an angle or "U" cap shapes, surface or mortised mounted onto edge of door. Provide appropriate leg overlap to account for protection plates as required. Height to be as specified in the Hardware Sets.
- 6. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).

2.7 DOOR STOPS AND HOLDERS

- A. General: Door stops and holders to be of type and design as specified below or in the Hardware Sets.
- B. Door Stops and Bumpers: ANSI/BHMA A156.16, Grade 1 certified door stops and wall bumpers. Provide wall bumpers, either convex or concave types with anchorage as indicated, unless floor or other types of door stops are specified in Hardware Sets. Do not mount floor stops where they will impede traffic. Where floor or wall bumpers are not appropriate, provide overhead type stops and holders.
 - 1. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).
- C. Overhead Door Stops and Holders: ANSI/BHMA A156.6, Grade 1 certified overhead stops and holders to be surface or concealed types as indicated in Hardware Sets. Track, slide, arm and jamb bracket to be constructed of extruded bronze and shock absorber spring of heavy tempered steel. Provide non-handed design with mounting brackets as required for proper operation and function.
 - 1. Acceptable Manufacturers:
 - a. Rixson Door Controls (RF).

2.8 ARCHITECTURAL SEALS

- A. General: Thresholds, weatherstripping, and gasket seals to be of type and design as specified below or in the Hardware Sets. Provide continuous weatherstrip gasketing on exterior doors and provide smoke, light, or sound gasketing on interior doors where indicated. At exterior applications provide non-corrosive fasteners and elsewhere where indicated.
- B. Smoke Labeled Gasketing: Assemblies complying with NFPA 105 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for smoke control ratings indicated, based on testing according to UL 1784.
 - 1. Provide smoke labeled perimeter gasketing at all smoke labeled openings.

- C. Fire Labeled Gasketing: Assemblies complying with NFPA 80 that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire ratings indicated, based on testing according to UL-10C.
 - 1. Provide intumescent seals as indicated to meet UL10C Standard for Positive Pressure Fire Tests of Door Assemblies, and UBC 7-2, Fire Tests of Door Assemblies.
- D. Sound-Rated Gasketing: Assemblies that are listed and labeled by a testing and inspecting agency, for sound ratings indicated, based on testing according to ASTM E 1408.
- E. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips are easily replaceable and readily available from stocks maintained by manufacturer.
- F. Hurricane and Tornado Resistance Compliance: Architectural seals to be U.L. listed for windstorm components where applicable. Provide the appropriate hurricane or tornado resistant products that have been independent third party tested, certified, and labeled to meet state and local windstorm building codes applicable to project.
- G. Acceptable Manufacturers:
 - 1. Pemko Manufacturing (PE).
- H. Power Supplies: Provide Nationally Recognized Testing Laboratory Listed 12VDC or 24VDC (field selectable) filtered and regulated power supplies. Include battery backup option with integral battery charging capability in addition to operating the DC load in event of line voltage failure. Provide the least number of units, at the appropriate amperage level, sufficient to exceed the required total draw for the specified electrified hardware and access control equipment.
 - 1. Acceptable Manufacturers:
 - a. Securitron (SU) - BPS Series.

2.9 FABRICATION

- A. Fasteners: Provide door hardware manufactured to comply with published templates generally prepared for machine, wood, and sheet metal screws. Provide screws according to manufacturers recognized installation standards for application intended.

2.10 FINISHES

- A. Standard: Designations used in the Hardware Sets and elsewhere indicate hardware finishes complying with ANSI/BHMA A156.18, including coordination with traditional U.S. finishes indicated by certain manufacturers for their products.
- B. Provide quality of finish, including thickness of plating or coating (if any), composition, hardness, and other qualities complying with manufacturer's standards, but in no case less than specified by referenced standards for the applicable units of hardware.
- C. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.

- D. Antimicrobial Finishes: Where specified, finishes on locksets, latchsets, exit devices and push/pull trim to incorporate an FDA recognized. Silver Ion, antimicrobial coating (MicroShield™) listed for use on equipment as a suppressant to the growth and spread of a broad range of bacteria, algae, fungus, mold and mildew.
- E. Hinge Size: Provide the following, unless otherwise indicated, with hinge widths sized for door thickness and clearances required:
 - 1. Widths up to 3'0": 4-1/2" Heavy weight as specified.
 - 2. Sizes from 3'1" to 4'0": 5" Heavy weight as specified.
- F. Hinge Weight and Base Material: Unless otherwise indicated, provide the following:
 - 1. Exterior Doors: Continuous hinges as specified
 - 2. Interior Doors: Heavyweight, steel, ball bearing or oil impregnated bearing hinges as specified
- G. Hinge Options: Comply with the following where indicated in the Hardware Sets or on Drawings:
 - 1. Non-removable Pins: Provide set screw in hinge barrel that, when tightened into a groove in hinge pin, prevents removal of pin while door is closed; for the following applications:
 - a. Out-swinging exterior doors.
 - b. Out-swinging access-controlled doors.
 - c. Out-swinging lockable doors.
- H. Acceptable Manufacturers:
 - 1. McKinney Products (MK).
 - 2. Continuous Geared Hinges: ANSI/BHMA A156.26 certified continuous geared hinge with minimum 0.120-inch thick extruded 6060 T6 aluminum alloy hinge leaves and a minimum overall width of 4 inches. Hinges are non-handed, reversible and fabricated to template screw locations. Provide concealed flush mount (with or without inset), full surface, or half surface, in standard and heavy-duty models, as specified in the Hardware Sets. Concealed continuous hinges to be U.L. listed for use on up to and including 90-minute rated door installations and U.L. listed for windstorm components where applicable. Factory cut hinges for door size and provide with removable service power transfer panel where indicated at electrified openings.
 - a. Acceptable Manufacturers:
 - 1) Pemko Manufacturing (PE).

2.11 DOOR OPERATING TRIM

- A. Flush Bolts and Surface Bolts: ANSI/BHMA A156.3 and A156.16, Grade 1, certified automatic, self-latching, and manual flush bolts and surface bolts. Manual flush bolts to be furnished with top rod of sufficient length to allow bolt location approximately six feet from the floor. Furnish dust proof strikes for bottom bolts. Surface bolts to be minimum 8" in length and U.L. listed for labeled fire doors and U.L. listed for windstorm components where applicable. Provide related accessories (mounting brackets, strikes, coordinators, etc.) as required for appropriate installation and operation.
 - 1. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).
- B. Coordinators: ANSI/BHMA A156.3 certified door coordinators consisting of active-leaf, hold-open lever and inactive-leaf release trigger. Coordinators fabricated from steel with nylon-coated strike plates and built-in adjustable safety release.
 - 1. Acceptable Manufacturers:
 - a. Rockwood Manufacturing (RO).
- C. Door Push Plates and Pulls: ANSI/BHMA A156.6 certified door pushes and pulls of type and design specified below or in the Hardware Sets. Coordinate and provide proper width and height as required where conflicting hardware dictates.
 - 1. Push/Pull Plates: Minimum .050 inch thick, size as indicated in hardware sets, with square corners and beveled edges, secured with exposed screws unless otherwise indicated.
 - 2. Door Pull and Push Bar Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door unless otherwise indicated.
 - 3. Offset Pull Design: Size, shape, and material as indicated in the hardware sets. Minimum clearance of 2 1/2-inches from face of door and offset of 90 degrees unless otherwise indicated.
 - 4. Fasteners: Provide manufacturer's designated fastener type as indicated in Hardware Sets.
 - a. Acceptable Manufacturers:
 - 1) Rockwood Manufacturing (RO).

2.12 CYLINDERS AND KEYING

- A. General: Cylinder manufacturer to have minimum (10) years' experience designing secured master key systems and have on record a published security keying system policy.
- B. Source Limitations: Obtain each type of keyed cylinder and keys from the same source manufacturer as locksets and exit devices, unless otherwise indicated.
 - 1. Acceptable Manufacturers:

- a. Sargent Manufacturing (SA).
 - b. No Substitution – Facility Standard.
- C. Cylinders: Original manufacturer cylinders complying with the following:
 - 1. Mortise Type: Threaded cylinders with rings and straight cam.
 - 2. Rim Type: Cylinders with back plate, flat-type vertical or horizontal tailpiece, and raised trim ring.
 - 3. Mortise and rim cylinder collars to be solid and recessed to allow the cylinder face to be flush and be free spinning with matching finishes.
 - 4. Keyway: Must key into existing Sargent key system.
- D. Permanent Cores: Manufacturer's standard; finish face to match lockset; complying with the following:
- E. Keying System: Each type of lock and cylinders to be factory keyed. Conduct specified "Keying Conference" to define and document keying system instructions and requirements. Furnish factory cut, nickel-silver large bow permanently inscribed with a visual key control number as directed by Owner. Incorporate decisions made in keying conference, and as follows:
- F. Key Quantity: Provide the following minimum number of keys:
 - 1. Change Keys per Cylinder: Two (2)
 - 2. Master Keys (per Master Key Group): Two (6)
 - 3. Construction Keys (where required): Ten (10)
 - 4. Construction Control Keys (where required): Two (2)
 - 5. Permanent Control Keys (where required): Two (2)
- G. Construction Keying: Provide construction master keyed cylinders or temporary keyed construction cores where specified. Provide construction master keys in quantity as required by project Contractor. Replace construction cores with permanent cores. Furnish permanent cores for installation as directed under specified "Keying Conference".
- H. Key Registration List: Provide keying transcript list to Owner's representative in the proper format for importing into key control software.
- I. Key Control Cabinet: Provide a key control system including envelopes, labels, and tags with self-locking key clips, receipt forms, 3-way visible card index, temporary markers, permanent markers, and standard metal cabinet. Key control cabinet shall have expansion capacity of 150% of the number of locks required for the project.
 - 1. Acceptable Manufacturers:
 - a. Lund Equipment (LU).

- b. MMF Industries (MM).

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install each hardware item in compliance with the manufacturer's instructions and as follows:
 - 1. Mount hardware at heights recommended in "Recommended Locations for Builder's Hardware", by NBHA, except as otherwise indicated to comply with governing regulations.
 - 2. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
 - 3. Drill and countersink units which are not prepared for anchorage fasteners.
- B. Whenever cutting and fitting is required to install hardware into or onto surfaces which are later to be painted, proceed as follows:
 - 1. Install each item completely and then remove and store during the finish application.
 - 2. Reinstall after completion of finishing operations.
 - 3. Do not install surface mounted items until finishes have been completed on the substrate.
- C. Install holders, stops or bumpers at all swing doors to prevent damage to doors, frames, hardware or wall surfaces.
- D. Install silencers in all hollow metal door frames, three silencers per lock jamb, two (2) for pairs of doors.

3.2 TOOLS

- A. Furnish a set of specialized tools adequate to provide for Owner's continued adjustment, maintenance, and replacement of builder's hardware.

3.3 ADJUSTMENT AND CLEANING

- A. Adjust and check each operating item of hardware at each door to ensure proper operation and function.
 - 1. Lubricate moving parts with lubricant recommended by manufacturer using graphite type, if no other is recommended.
 - 2. Replace units which cannot be adjusted to operate freely and smoothly.
- B. Final Adjustment:
 - 1. If hardware installation has been made more than one month prior to acceptance of project, return to the work immediately before occupancy and make a final check and

adjustment of all hardware items.

2. Clean and lubricate as necessary to restore proper function and finish.
3. Adjust door control devices to compensate for effect of heating and ventilating equipment.

END OF SECTION

SECTION 08 8000 - GLAZING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Glass and glazing required for this work is indicated on the drawings.

1.2 REFERENCE STANDARDS

- A. 16 CFR 1201 - Safety Standard for Architectural Glazing Materials Current Edition.
- B. ANSI Z97.1 - American National Standard for Safety Glazing Materials Used in Buildings - Safety Performance Specifications and Methods of Test 2015 (Reaffirmed 2020).
- C. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM C864 - Standard Specification for Dense Elastomeric Compression Seal Gaskets, Setting Blocks, and Spacers 2005 (Reapproved 2019).
- E. ASTM C920 - Standard Specification for Elastomeric Joint Sealants 2018.
- F. ASTM C1048 - Standard Specification for Heat-Strengthened and Fully Tempered Flat Glass 2018.
- G. ASTM C1193 - Standard Guide for Use of Joint Sealants 2016.
- H. ASTM C1376 - Standard Specification for Pyrolytic and Vacuum Deposition Coatings on Flat Glass 2021a.
- I. ASTM E1300 - Standard Practice for Determining Load Resistance of Glass in Buildings 2016.
- J. ASTM E2190 - Standard Specification for Insulating Glass Unit Performance and Evaluation 2010.
- K. GANA (SM) - GANA Sealant Manual 2008.

1.3 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.
- B. Product Data on Glazing Compounds and Accessories: Provide chemical, functional, and environmental characteristics, limitations, special application requirements, and identify available colors.
- C. Warranty Documentation: Submit manufacturer warranty and ensure that forms have been completed in Owner's name and registered with manufacturer.

1.4 QUALITY ASSURANCE

- A. Qualifications of Installers:

1. Provide at least one person who shall be thoroughly trained and experienced in the skills required, who shall be completely familiar with the referenced standards and the requirements of this work, and who shall personally direct all installation performed under this section of these specifications.
- B. Glazing to comply with Federal Specifications DD-G-45 LD, ANSI 297.1-1975, in addition wire glass shall meet Underwriters Laboratories, Inc.
- C. All glazing shall be in accordance with the procedures recommended in the "Glazing Manual of the Flat Glass Marketing Association", with special attention to the following requirements:
 1. Before glazing, check openings to see if they are square, plumb and true to plane. If found unsatisfactory, glazing shall not proceed until proper corrections are made.
 2. Glazing beads or stops shall be carefully removed and reset as required. Do not mar, deface or damage any part of sash frame, door or trim.
 3. All glass shall be bedded and face glazed.
- D. Glazing installer to be a member of "Sealed Glass Manufacturer's Association" and comply or exceed all standards.

1.5 PRODUCT HANDLING

- A. Protection: Use all means to protect glass and glazing materials before, during and after installation and to protect the installed work and materials of all other trades.
- B. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.6 FIELD CONDITIONS

- A. Do not install glazing when ambient temperature is less than 40 degrees F/40 degrees F.
- B. Maintain minimum ambient temperature before, during and 24 hours after installation of glazing compounds.

1.7 WARRANTY

McGill Section 017700

- A. See ~~Section 01 7800 - Closeout Submittals~~, for additional warranty requirements.
- B. Insulating Glass Units: Provide a 25-year manufacturer warranty to include coverage for seal failure, interpane dusting or misting, including providing products to replace failed units.

PART 2 PRODUCTS

2.1 GLASS

- A. All glass shall bear the label of its manufacturer and shall conform in all respects with the pertinent requirements of Federal Specification DD-G-451C, shall be relatively distortion-free with all distortion shown in the horizontal direction, shall be in the thickness and types shown

on the drawing, and shall be the products of Pittsburgh Plate Glass Company, L.O.F., Saint Gobain or an approved equal. Glass to carry a Manufacturer's Seal Warranty of 10 Years.

2.2 TEMPERED SAFETY GLASS

- A. 1/4" thick, clear tempered safety glass, tempered horizontally to obtain a flat, low-distortion glass product.

2.3 LOW 'E' GLASS INSULATING GLASS

- A. 1" thick Low 'E' Insulating Glass with pyrolytic coating on #3 surface, 1/4" grey tint float outer panel, 1/2" air space, and 1/4" clear tempered inner panel; hermetically sealed. L.O.F. thermopane or approved equal.

2.4 INSULATING GLASS UNITS

- A. Insulating Glass Units: Types as indicated.
 - 1. Durability: Certified by an independent testing agency to comply with ASTM E2190.
 - 2. Coated Glass: Comply with requirements of ASTM C1376 for pyrolytic (hard-coat) or magnetic sputter vapor deposition (soft-coat) type coatings on flat glass; coated vision glass, Kind CV; coated overhead glass, Kind CO; or coated spandrel glass, Kind CS.
 - 3. Metal Edge Spacers: Aluminum, bent and soldered corners.
 - 4. Spacer Color: Black.
 - 5. Edge Seal:
 - a. Color: Black.
 - 6. Purge interpane space with dry air, hermetically sealed.
- B. Insulating Glass Units: Vision glass, double glazed.
 - 1. Applications: Exterior glazing unless otherwise indicated.
 - 2. Space between lites filled with argon.
 - 3. Outboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Clear.
 - b. Coating: Low-E (passive type), on #2 surface.
 - 4. Inboard Lite: Fully tempered float glass, 1/4 inch thick, minimum.
 - a. Tint: Gray.
 - 5. Total Thickness: 1 inch.
 - 6. Thermal Transmittance (U-Value), Winter - Center of Glass: 0.38, nominal.

7. Visible Light Transmittance (VLT): 20 percent, nominal.
8. Shading Coefficient: .23, nominal.
9. Solar Heat Gain Coefficient (SHGC): .4, nominal.
10. Visible Light Reflectance, Outside: 21 percent, nominal.
11. Glazing Method: Dry glazing method, gasket glazing.

2.5 ACCESSORIES

- A. Setting Blocks: Neoprene, with 80 to 90 Shore A durometer hardness; ASTM C864 Option II. Length of 0.1 inch for each square foot of glazing or minimum 4 inch by width of glazing rabbet space minus 1/16 inch by height to suit glazing method and pane weight and area.
- B. Spacer Shims: Neoprene, 50 to 60 Shore A durometer hardness; ASTM C864 Option II. Minimum 3 inch long by one half the height of the glazing stop by thickness to suit application, self adhesive on one face.
- C. Glazing Tape, Back Bedding Mastic Type: Preformed, butyl-based, 100 percent solids compound with integral resilient spacer rod applicable to application indicated; 5 to 30 cured Shore A durometer hardness; coiled on release paper; black color.
 1. Width: As required for application.
 2. Thickness: As required for application.
- D. Glazing Splines: Resilient silicone extruded shape to suit glazing channel retaining slot; ASTM C864 Option II; color black.

PART 3 EXECUTION

3.1 VERIFICATION OF CONDITIONS

- A. Inspection:
 1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
 2. Verify that all glazing may be performed in accordance with all pertinent codes and regulations, the original design, and the referenced standards.
- B. Discrepancies:
 1. In the event of discrepancy, immediately notify the Architect.
 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION

- A. Clean contact surfaces with appropriate solvent and wipe dry within maximum of 24 hours before glazing. Remove coatings that are not tightly bonded to substrates.
- B. Seal porous glazing channels or recesses with substrate compatible primer or sealer.
- C. Prime surfaces scheduled to receive sealant where required for proper sealant adhesion.

3.3 INSTALLATION, GENERAL

- A. Install glazing in compliance with written instructions of glass, gaskets, and other glazing material manufacturers, unless more stringent requirements are indicated, including those in glazing referenced standards.
- B. Install glazing sealants in accordance with ASTM C1193, GANA (SM), and manufacturer's instructions.
- C. Do not exceed edge pressures around perimeter of glass lites as stipulated by glass manufacturer.
- D. Set glass lites in proper orientation so that coatings face exterior or interior as indicated.
- E. Prevent glass from contact with any contaminating substances that may be the result of construction operations such as, and not limited to the following; weld splatter, fire-safing, plastering, mortar droppings, etc.

3.4 INSTALLATION - DRY GLAZING METHOD (GASKET GLAZING)

- A. Application - Exterior and/or Interior Glazed: Set glazing infills from either the exterior or the interior of the building.
- B. Place setting blocks at 1/4 points with edge block no more than 6 inch from corners.
- C. Rest glazing on setting blocks and push against fixed stop with sufficient pressure on gasket to attain full contact.
- D. Install removable stops without displacing glazing gasket; exert pressure for full continuous contact.

3.5 CLEANING

- A. Remove excess glazing materials from finish surfaces immediately after application using solvents or cleaners recommended by manufacturers.
- B. Remove non-permanent labels immediately after glazing installation is complete.
- C. Clean glass and adjacent surfaces after sealants are fully cured.
- D. Clean glass on both exposed surfaces not more than 4 days prior to Date of Substantial Completion in accordance with glass manufacturer's written recommendations.

END OF SECTION

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SECTION 09 9110 - PAINTING

PART 1 GENERAL

1.1 DESCRIPTION

- A. Work Included: The type of material to be used and the number of coats to be applied are listed in the "Painting Schedule" in Part 3.00 of this section of these specifications.

1.2 RELATED REQUIREMENTS

- A. Section 01 1000 - Summary

McGill Division 01
- B. ~~Section 01 3000 - Administrative Requirements~~: Submittal procedures, project meetings, progress schedules and documentation, reports, coordination.
- C. Section 07 9200 - Joint Sealants

1.3 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.

McGill Section 013300
- B. Materials List:
 - 1. Within 35 days after award of Contract, and before any paint materials are delivered to the job site, submit to the Architect in accordance with the provisions of Section 01300 of these specifications a complete list of all materials proposed to be furnished and installed under this portion of the work.
 - 2. This shall in no way be construed as permitting substitution of materials for those specified or approved for this work by the Architect.
- C. Samples:
 - 1. Accompanying the materials list, submit to the Architect two copies of the full range of colors available in each of the proposed products.
 - 2. Upon direction of the Architect, prepare and deliver to the Architect two identical sets of Samples of each of the selected colors and glosses painted onto 8-1/2" X 11" X 1/4" thick material; whenever possible, the material for Samples shall be the same material as that on which the coating shall be applied in the work.

1.4 QUALITY ASSURANCE

- A. Qualifications of Painters: Use only qualified journeyman painters for the mixing and application of paint on exposed surfaces; in the acceptance or rejection of installed painting, no allowance will be made for lack of skill on the part of the painters.
- B. Codes and Standards: In addition to complying with all pertinent codes and regulations, comply with "Standard (Type 1)" as defined by the Painting and Decorating Contractors of America in their "Modern Guide to Paint Specifications", current edition.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver all paint materials to the job site in their original unopened containers with all labels intact and legible at time of use.
- B. Protection:
 - 1. Store only the approved materials at the job site, and store only in a suitable and designated area restricted to the storage of paint materials and related equipment.
 - 2. Use all means necessary to ensure the safe storage and use of paint materials and the prompt and safe disposal of waste.
 - 3. Use all means necessary to protect paint materials before, during and after application and to protect the installed work and materials of all other trades.
- C. Replacements: In the event of damage, immediately make all repairs and replacements necessary to the approval of the Architect and at no additional cost to the Owner.

1.6 EXTRA STOCK

- A. Upon completion of this portion of the work, deliver to the Owner an extra stock of paint equaling two (2) gallons of each color and gloss used in each coating material used, with all such extra stock tightly sealed in clearly labeled containers.

PART 2 PRODUCTS

2.1 PAINT MATERIALS

- A. Manufacturer:
 - 1. All paint materials selected for coating systems for each type of surface shall be the product of a single manufacturer.
 - 2. Paint materials listed herein, unless otherwise designated in the "Painting Schedule", are the product of ICI Dulux Glidden Devco and require no further approval as to manufacturer or catalog number.
 - 3. Equivalent products of Pratt & Lambert, Sherwin- Williams, and Benjamin Moore shall be used subject to approval by the Architect of the materials list required to be submitted under Article 1.03-A above.
 - 4. Equivalent products of other major paint manufacturers shall be used subject to approval by the Architect of the materials list and manufacturer's recommendations required to be submitted under Article 1.03 above.
- B. Compatibility:
 - 1. All paint materials and equipment shall be compatible in use; finish coats shall be compatible with prime coats; prime coats shall be compatible with the surface to be coated; all tools and equipment shall be compatible with the coating to be applied.

2. Thinners, when used, shall be only those thinners recommended for that purpose by the manufacturer of the material to be thinned.
- C. Colors and Glosses: All colors and glosses shall be as selected by the Architect and will be limited to not more than four paint colors and three paint glosses in any one room and to not more than sixteen paint colors and three paint glosses in the total work. Refer to color schedule on drawings.

PART 3 EXECUTION

3.1 SURFACE CONDITIONS

- A. Inspection:
 1. Prior to all work of this section, carefully inspect the installed work of all other trades and verify that all such work is complete to the point where this installation may properly commence.
 2. Verify that paint finishes may be applied in strict accordance with all pertinent codes and regulations and the requirements of these specifications.
- B. Discrepancies:
 1. In the event of discrepancy, immediately notify the Architect.
 2. Do not proceed with installation in areas of discrepancy until all such discrepancies have been fully resolved.

3.2 PREPARATION OF SURFACES, GENERAL

- A. Protection: Prior to all surface preparation and painting operations, completely mask, remove, or otherwise adequately protect all hardware, accessories, machined surfaces, plates, lighting fixtures, and similar items in contact with painted surfaces but not scheduled to receive paint.
- B. Priming: Spot prime all exposed nails and other metals which are to be painted with emulsion paints, using ICI Dulux Glidden Devoe DEVGUARD Rustmaster Primer or an approved equal.
- C. Cleaning:
 1. Before applying paint or other surface treatment, thoroughly clean all surfaces involved.
 2. Schedule all cleaning and painting so that dusts and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.

3.3 PREPARATION OF METAL SURFACES

- A. Galvanized Metal:
 1. Clean all surfaces thoroughly with a chlorinated hydrocarbon, such as trichlorethylene until they are completely free from dirt, oil and grease.
- B. Other Metals:

1. Thoroughly clean all surfaces until they are completely free from dirt, oil and grease.
 2. Allow to dry thoroughly before application of paint.
- C. Concrete Floor:
1. Thoroughly clean.
 2. Acid etch or sand to fully expose bare concrete surface.

3.4 PAINT APPLICATION

- A. General:
1. Paint all surfaces, except glass, masonry, flat concrete, and similar items, not pre-finished and not called out as unfinished.
 2. Modify the period as recommended by the material manufacturer to suit adverse weather conditions.
 3. Oil base and oleo resinous solvent type paints shall be considered dry for recoating when the paint feels firm, does not deform or feel sticky under moderate pressure of the thumb, and the application of another coat of paint does not cause lifting or loss of adhesion of the undercoat.
- B. Environmental Conditions:
1. Comply with the manufacturer's recommendations as to environmental conditions under which the coating systems may be applied.
 2. Do not apply paint in areas where dust is being generated.
 3. Keep an ABC U.L. listed dry chemical fire extinguisher with each painting crew.
- C. Moisture Content:
1. Use a moisture-meter approved by the Architect to test surfaces.
 2. Do not apply the initial coating until moisture- meter reading is within limits recommended by the paint materials manufacturer.
- D. Defects: Sand and dust between coats to remove all defects visible to the unaided eye from a distance of five feet.
- E. Color of Undercoats: Slightly vary the color of succeeding coats.

3.5 INSPECTION

- A. General: Do not apply additional coats until completed coat has been inspected and approved by the Architect.

- B. Number of Coats: Only inspected and approve coats of paint will be considered in determining the number of coats applied.

3.6 DRY MIL THICKNESS

- A. General: Apply all coatings to the dry mil thickness indicated in the "Painting Schedule".
- B. Measurement: Provide and use a "Tooke Dry Film Thickness Gauge", or other gauge approved by the Architect, to prove the dry mil thickness of paint applied if requested.

3.7 REINSTALLATION OF REMOVED ITEMS

- A. Following completion of painting in each space, promptly reinstall all items removed for painting, using only workmen skilled in the particular trade.

3.8 GRAPHICS

- A. Use only paints and glosses compatible with scheduled paints. Graphics applicator will be a trained craftsman with previous experience in the application and development of wall painted graphics and able to produce or verify previous graphics work quality.

3.9 CLEANING UP

- A. General:
 - 1. During progress of the work, do not allow the accumulation of empty containers or other excess items except in areas specifically set aside for that purpose.
 - 2. Prevent accidental spilling of paint materials and, in event of such spill, immediately remove all spilled material and the waste or other equipment used to clean up the spill, and wash the surfaces to their original undamaged condition, all at no additional cost to the Owner.
- B. Prior to Final Inspection: Upon completion of this portion of the work visually inspect all surfaces and remove all paint and traces of paint from surfaces not scheduled to be painted.

3.10 PAINTING SCHEDULE

- A. Apply the following finishes to the area designated:
- B. Painting Schedule - Exterior:
 - 1. All exposed Ferrous Metal (including Hollow Metal Doors, Metal Frames, Pipe Railing, Exposed Structural Steel and Miscellaneous Steel Items):
 - a. 1 Coat DEVGUARD 4100-7100 Alkyd Primer.
 - b. 2 Coats DEVGUARD Alkyd Industrial Enamel.
 - 2. Galvanized Metals:
 - a. 1 Coat DEVGUARD 4120-1000 Galvanized Primer.

- b. 2 Coats ULTRA-HIDE DURUS Exterior Alkyd Finish #2516.
- C. Painting Schedule-Interior:
 - 1. Block Masonry - Units:
 - a. 1 Coat ULTRA-HIDE Acrylic Block Filler 3010-1200.
 - b. 2 Coats ULTRA-HIDE Latex Semi-Gloss.
 - 2. Ferrous Metal Work (at Exposed Structure):
 - a. 1 Coat DEVGUARD Multi-Purpose Primer.
 - b. 2 Coats Alkyd Dry Fog #1582.
 - 3. Ferrous Metal Work (Door Frames, Steel Angles, Hollow Metal Doors, Miscellaneous Metals):
 - a. 1 Coat DEVGUARD Multi-Purpose Primer.
 - b. 2 Coats ULTRA-HIDE Alkyd Semi-Gloss.
 - 4. Ductwork - applies to Ductwork not concealed by Ceiling
 - a. 1 Coat DEVGUARD Galvanized Metal Primer 4120-1000.
 - b. 2 Coats DEVGUARD Alkyd Industrial Enamel.

3.11 FIRE PROTECTION

- A. Each painting crew shall have in their possession at all times a 10# U.L. Listed ABC dry chemical fire extinguisher.

END OF SECTION

SECTION 13 3419 - METAL BUILDING SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Manufacturer-engineered, shop-fabricated structural steel building secondary members.
- B. Metal wall and roof panels including soffits and gutters and downspouts.
- C. Batt insulation where indicated on the drawings.
- D. Exterior doors, overhead doors, and louvers.

1.2 RELATED REQUIREMENTS

- A. Section 07 9200 - Joint Sealants: Sealing joints between accessory components and wall system.
- B. Section 08 1113 - Hollow Metal Doors and Frames.
- C. Section 08 3613 - Sectional Doors.
- D. Section 08 5113 - Aluminum Windows.

1.3 REFERENCE STANDARDS

- A. AISC 360 - Specification for Structural Steel Buildings 2016 (Revised 2021).
- B. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- C. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- D. ASTM A500/A500M - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes 2021a.
- E. ASTM A529/A529M - Standard Specification for High-Strength Carbon-Manganese Steel of Structural Quality 2019.
- F. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process 2020.
- G. ASTM A792/A792M - Standard Specification for Steel Sheet, 55% Aluminum-Zinc Alloy-Coated by the Hot-Dip Process 2021a.
- H. ASTM A992/A992M - Standard Specification for Structural Steel Shapes 2020.
- I. ASTM C827/C827M - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens of Cementitious Mixtures 2016.

- J. ASTM C1107/C1107M - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink) 2020.
- K. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- L. ASTM E96/E96M - Standard Test Methods for Water Vapor Transmission of Materials 2016.
- M. ASTM F1554 - Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength 2020.
- N. ASTM F3125/F3125M - Standard Specification for High Strength Structural Bolts and Assemblies, Steel and Alloy Steel, Heat Treated, Inch Dimensions 120 ksi and 150 ksi Minimum Tensile Strength, and Metric Dimensions 830 MPa and 1040 MPa Minimum Tensile Strength 2019, with Editorial Revision (2020).
- O. AWS A2.4 - Standard Symbols for Welding, Brazing, and Nondestructive Examination 2020.
- P. AWS D1.1/D1.1M - Structural Welding Code - Steel 2020.
- Q. MBMA (MBSM) - Metal Building Systems Manual 2019.
- R. UL 580 - Standard for Tests for Uplift Resistance of Roof Assemblies Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Preinstallation Meeting: Convene one week before starting work of this section.

1.5 SUBMITTALS

McGill Section 013300

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.
- B. Product Data: Provide data on profiles, component dimensions, fasteners.
- C. Shop Drawings: Indicate assembly dimensions, locations of structural members, connections; wall and roof system dimensions, panel layout, general construction details, anchors and methods of anchorage, and installation; framing anchor bolt settings, sizes, locations from datum, and column reactions; indicate welded connections with AWS A2.4 welding symbols; indicate net weld lengths; provide professional seal and signature.
- D. Erection Drawings: Indicate members by label, assembly sequence, and temporary erection bracing.
- E. Designer's Qualification Statement.
- F. Manufacturer's Qualification Statement: Provide documentation showing metal building manufacturer is accredited under MBMA (MBSM).
 - 1. Include statement that manufacturer designs and fabricates metal building system as integrated components and assemblies, including but not limited to primary structural members, secondary members, joints, roof, and wall cladding components specifically

designed to support and transfer loads and properly assembled components form a complete or partial building shell.

G. Erector's Qualification Statement.

H. Project Record Documents: Record actual locations of concealed components and utilities.

1.6 QUALITY ASSURANCE

A. Designer Qualifications: Design structural components, develop shop drawings, and perform shop and site work under direct supervision of a Professional Structural Engineer experienced in design of this type of work.

1. Design Engineer Qualifications: Licensed in the Commonwealth of Virginia.
2. Comply with Virginia Uniform Statewide Building Code for submission of design calculations and reviewed shop and erection drawings as required for acquiring permits.

B. Perform work in accordance with AISC 360 and MBMA (MBSM).

1. Maintain one copy on site.

C. Perform welding in accordance with AWS D1.1/D1.1M.

D. Manufacturer Qualifications: Company specializing in the manufacture of products similar to those required for this project.

1. Not less than five years of documented experience.
2. Accredited by MBMA (MBSM).

E. Erector Qualifications: Company specializing in performing the work of this section with minimum five years experience.

1.7 WARRANTY

McGill Section 017700

A. See ~~Section 01 7800 Closeout Submittals~~, for additional warranty requirements.

PART 2 PRODUCTS

2.1 ASSEMBLIES

- A. Single span rigid frame.
- B. Bay Spacing: As Indicated.
- C. Primary Framing: Rigid frame of rafter beams and columns, braced end frames and end wall columns, and wind bracing.
- D. Secondary Framing: Purlins, Girts, Eave struts, Flange bracing, Sill supports, and Clips, and other items detailed.

- E. Wall System: Preformed metal panels of vertical profile, with insulation and liner sheets, and accessory components.
- F. Roof System: Preformed metal panels oriented parallel to slope, with sub-girt framing/anchorage assembly, insulation, and liner panels, and accessory components.
- G. Roof Slope: Varies, refer to the drawings.

2.2 PERFORMANCE REQUIREMENTS

- A. Installed Thermal Resistance of Wall System: R-13 + R-13 CI (Continuous Insulation).
- B. Installed Thermal Resistance of Roof System: R-19 + R-11 LS (Liner System) with thermal spacer blocks.
- C. Provide drainage to exterior for water entering or condensation occurring within wall or roof system.
- D. Permit movement of components without buckling, failure of joint seals, undue stress on fasteners or other detrimental effects.
- E. Size and fabricate wall and roof systems free of distortion or defects detrimental to appearance or performance.

2.3 MATERIALS - FRAMING

- A. Structural Steel Members: ASTM A992/A992M. Galvaznized.
- B. Plate or Bar Stock: ASTM A529/A529M, Grade 50. Galvanized.
- C. Anchor Bolts: ASTM F1554, Grade 36, Class 1A, with hot dip type for protective coating.
- D. Bolts, Nuts, and Washers: ASTM F3125/F3125M, Grade A325, Type 1; galvanized to ASTM A153/A153M.
- E. Fasteners: Galvanized hardened steel, self-tapping.
- F. Welding Materials: Type required for materials being welded.
- G. All structural steel members, plates, angles, and primary framing members shall be hot-dipped galvanized in accordance with ASTM A123/A123M. Provide minimum 2.0 oz/sq ft galvanized coating.
- H. All purlins and girts shall be glavanized sheet steel, ASTM A653/A653M, structural steel(SS) Grade 33 or 50 with G90 galvanized coating.
- I. Base plates shall have a minimum of four anchor bolts per column. Bolt holes for anhor bolts shall be coordinated to not conflict with remaining portion of existing anchor bolts cast in concrete.

2.4 MATERIALS - WALLS AND ROOF

- A. Steel Sheet: Hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating.
- B. Liner Panel: Provide hot-dipped galvanized steel sheet, ASTM A653/A653M, Designation SS (structural steel), Grade 33 (230), with G90/Z275 coating up to a minimum of 7'-4" above finished floor.
- C. Insulation: ASTM C665 Type I; thickness as required to achieve R-value.
 - 1. Facing: Sheet vinyl, white.
- D. Metal Building Type, Factory Applied, Vapor-Barrier Insulation Facings: Water vapor permeance no greater than 0.10 perm when tested in accordance with ASTM E96/E96M; flame spread index of 25 or less, and smoke developed index of 40 or less when tested in accordance with ASTM E84.
- E. Joint Seal Gaskets: Manufacturer's standard type.
- F. Fasteners: Manufacturer's standard type, galvanized to comply with requirements of ASTM A153/A153M, finish to match adjacent surfaces when exterior exposed.
- G. Bituminous Paint: Asphaltic type.
- H. Sealant: Manufacturer's standard type.
- I. Trim, Closure Pieces, Caps, Flashings, Gutters, Downspouts, Rain Water Diverter, Fascias, and Infills: Same material, thickness and finish as exterior sheets; brake formed to required profiles.

2.5 COMPONENTS

- A. Doors and Frames: Specified in Sections 08 1100 and 08 1213. Doors and frames shall be galvanized.
- B. Overhead Coiling Doors: Pre-engineered metal building manufacturer shall provide overhead coiling door and support track. Overhead coiling door shall have a Thermal Insulation R value of R-4.75 or greater. Coiling door shall be galvanized.
- C. Ventilators: Refer to Mechanical Drawings.
- D. Wall Louvers: Refer to Mechanical Drawings.

2.6 DESIGN CRITERIA

- A. Design members to withstand dead load, applicable snow load, and design loads due to pressure and suction of wind calculated in accordance with VUSBC code.
- B. Design members for a dead load equal to the weight of the metal building system and as determined by the system manufacturer.
- C. Design members for collateral loads as indicated on the drawings. Collateral loads shall not be applied to the roof deck. Collateral loads shall not be used to resist uplift.

- D. Design members to withstand 20 psf reducible live load.
- E. Design members to withstand minimum 30 psf roof snow load. Unbalanced snow load and snow drift may be calculated on a 20 psf ground snow load.
- F. The metal building system shall be designed using wind load parameters as indicated on the drawings.
- G. The metal building system shall be designed using seismic load parameters as indicated on the drawings.
- H. Design members to withstand UL 580 Uplift Class 90.
- I. Exterior roof system shall withstand imposed loads with maximum allowable deflection of 1/240 of span.

2.7 FABRICATION - FRAMING

- A. Fabricate members in accordance with AISC 360 for plate, bar, tube, or rolled structural shapes.
- B. Anchor Rods: Formed with straight shank, drilled and epoxied into existing concrete to depth determined during shop drawing review of final reactions.
- C. Provide wall opening framing for doors, windows, and other accessory components.

2.8 FABRICATION - WALL AND ROOF PANELS

- A. Siding: Minimum 22 gauge metal thickness, ribbed profile indicated, 1 1/2 inch deep, lapped edges fitted with continuous gaskets.
- B. Roofing: Minimum 22 gauge metal thickness, 1 1/4" high ribs profile, lapped edges fitted with continuous gaskets.
- C. Soffit Panels: Minimum 22 gauge metal thickness, flat profile indicated, perforated for ventilation.
- D. Girts/Purlins: Rolled formed structural shape to receive siding, roofing and liner sheet.
- E. Internal and External Corners: Same material thickness and finish as adjacent material, profile brake formed to required angles. Back brace mitered internal corners.
- F. Expansion Joints: Same material and finish as adjacent material where exposed, 1 inch thick, manufacturer's standard brake formed type, of profile to suit system.
- G. Flashings, Closure Pieces, Fascia: Same material and finish as adjacent material, profile to suit system.
- H. Fasteners: To maintain load requirements and weather tight installation, same finish as cladding, non-corrosive type.
- I. Thermal spacers: As required for insulation system and panel clip.

- J. Provide continuous mastic as recommended by manufacturer at seams for weathertight seal.

2.9 FABRICATION - GUTTERS AND DOWNSPOUTS

- A. Fabricate of same material and finish as roofing metal.
- B. Form gutters and downspouts and scuppers of profile and sized to collect and remove water. Fabricate with connection pieces.
- C. Form sections in maximum possible lengths. Hem exposed edges. Allow for expansion at joints.
- D. Fabricate support straps of same material and finish as roofing metal, color as selected.

2.10 FINISHES

- A. Framing Members: Clean, prepare, and galvanize to ASTM A123/A123M.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that foundation, floor slab, mechanical and electrical utilities, and placed anchors are in correct position
- B. Verify existing concrete structure is cleaned, existing anchors are ground smooth and topped with a protective coating and ready to receive new PEMB members.
- C. Verify base plate anchor bolt locations have been coordinated to miss locations of existing anchor bolts.
- D. Verify that all steel framing has been galvanized before erecting and installing steel framing.

3.2 ERECTION - FRAMING

- A. Erect framing in accordance with AISC 360.
- B. Provide for erection and wind loads. Provide temporary bracing to maintain structure plumb and in alignment until completion of erection and installation of permanent bracing. Locate braced bays as indicated.
- C. Do not field cut or alter structural members without approval.
- D. Repair damage to galvanized coatings using ASTM A780/A780M zinc rich paint for galvanizing damaged by handling, transporting, cutting, welding, or bolting. Do not heat surfaces to which repair paint has been applied.

3.3 ERECTION - WALL AND ROOF PANELS

- A. Install in accordance with manufacturer's instructions.

- B. Exercise care when cutting prefinished material to ensure cuttings do not remain on finish surface.
- C. Fasten cladding system to structural supports, aligned level and plumb.
- D. Locate end laps over supports. End laps minimum 2 inches. Place side laps over bearing.
- E. Provide expansion joints where indicated.
- F. Use concealed fasteners.
- G. Install insulation and vapor retarder utilizing thermal clips for attachment.
- H. Install sealant and gaskets, providing weather tight installation.

3.4 ERECTION - GUTTERS AND DOWNSPOUTS

- A. Rigidly support and secure components. Join lengths with formed seams sealed watertight. Flash and seal gutters to downspouts.
- B. Slope gutters minimum 1/8 inch/ft.
- C. Connect downspouts to storm sewer system.

3.5 INSTALLATION - ACCESSORY COMPONENTS IN WALL SYSTEM

- A. Install door frames, doors, overhead doors, and louvers in accordance with manufacturer's instructions.

3.6 TOLERANCES

- A. Framing Members: 1/4 inch from level; 1/8 inch from plumb.
- B. Siding and Roofing: 1/8 inch from true position.

END OF SECTION

SECTION 23 0513 - COMMON MOTOR REQUIREMENTS FOR HVAC EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Section includes general requirements for single-phase and polyphase, general- purpose, horizontal, small and medium, squirrel-cage induction motors for use on ac power systems up to 600 V and installed at equipment manufacturer's factory or shipped separately by equipment manufacturer for field installation.

1.2 COORDINATION

- A. Coordinate features of motors, installed units, and accessory devices to be compatible with the following:
 - 1. Motor controllers.
 - 2. Torque, speed, and horsepower requirements of the load.
 - 3. Ratings and characteristics of supply circuit and required control sequence.
 - 4. Ambient and environmental conditions of installation location.

PART 2 PRODUCTS

2.1 GENERAL MOTOR REQUIREMENTS

- A. Comply with NEMA MG 1 unless otherwise indicated.
- B. Comply with IEEE 841 for severe-duty motors.

2.2 MOTOR CHARACTERISTICS

- A. Duty: Continuous duty at ambient temperature of 40 deg C and at altitude of 3300 feet above sea level.
- B. Capacity and Torque Characteristics: Sufficient to start, accelerate, and operate connected loads at designated speeds, at installed altitude and environment, with indicated operating sequence, and without exceeding nameplate ratings or considering service factor.

2.3 POLYPHASE MOTORS

- A. Description: NEMA MG 1, Design B, medium induction motor.
- B. Efficiency: Premium efficiency.
- C. Service Factor: 1.15.
- D. Multispeed Motors: Variable torque.
 - 1. For motors with 2:1 speed ratio, consequent pole, single winding.

- 2. For motors with other than 2:1 speed ratio, separate winding for each speed.
- E. Multispeed Motors: Separate winding for each speed.
- F. Rotor: Random-wound, squirrel cage.
- G. Bearings: Regreasable, shielded, antifriction ball bearings suitable for radial and thrust loading.
- H. Temperature Rise: Match insulation rating.

2.4 POLYPHASE MOTORS WITH ADDITIONAL REQUIREMENTS

- A. Motors Used with Variable Frequency Controllers:
 - 1. Windings: Copper magnet wire with moisture-resistant insulation varnish, designed and tested to resist transient spikes, high frequencies, and short time rise pulses produced by pulse-width modulated inverters.
 - 2. Premium-Efficient Motors: Class B temperature rise; Class F insulation.
 - 3. Inverter-Duty Motors: Class F temperature rise; Class H insulation.
 - 4. Thermal Protection: Comply with NEMA MG 1 requirements for thermally protected motors.

2.5 SINGLE-PHASE MOTORS

- A. Motors larger than 1/20 hp shall be one of the following, to suit starting torque and requirements of specific motor application:
 - 1. Permanent-split capacitor.
 - 2. Split phase.
 - 3. Capacitor start, inductor run.
 - 4. Capacitor start, capacitor run.
- B. Multispeed Motors: Variable-torque, permanent-split-capacitor type.
- C. Bearings: Prelubricated, antifriction ball bearings or sleeve bearings suitable for radial and thrust loading.
- D. Motors 1/20 HP and Smaller: Shaded-pole type.
- E. Thermal Protection: Internal protection to automatically open power supply circuit to motor when winding temperature exceeds a safe value calibrated to temperature rating of motor insulation. Thermal-protection device shall automatically reset when motor temperature returns to normal range.

PART 3 EXECUTION - NOT USED

END OF SECTION

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SECTION 23 0593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Balancing Air Systems:
 - a. Fans.

1.2 DEFINITIONS

- A. AABC: Associated Air Balance Council.
- B. NEBB: National Environmental Balancing Bureau.
- C. TAB: Testing, adjusting, and balancing.
- D. TABB: Testing, Adjusting, and Balancing Bureau.
- E. TAB Specialist: An entity engaged to perform TAB Work.

1.3 INFORMATIONAL SUBMITTALS

- A. Qualification Data: Within 30 days of Contractor's Notice to Proceed, submit documentation that the TAB contractor and this Project's TAB team members meet the qualifications specified in "Quality Assurance" Article.
- B. Contract Documents Examination Report: Within 30 days of Contractor's Notice to Proceed, submit the Contract Documents review report as specified in Part 3.
- C. Strategies and Procedures Plan: Within 60 days of Contractor's Notice to Proceed, submit TAB strategies and step-by-step procedures as specified in "Preparation" Article.
- D. Certified TAB reports.
- E. Sample report forms.
- F. Instrument calibration reports, to include the following:
 - 1. Instrument type and make.
 - 2. Serial number.
 - 3. Application.
 - 4. Dates of use.
 - 5. Dates of calibration.

1.4 QUALITY ASSURANCE

- A. TAB Contractor Qualifications: Engage a TAB entity certified by AABC, NEBB, or TABB.
 - 1. TAB Field Supervisor: Employee of the TAB contractor and certified by AABC, NEBB, or, TABB.
 - 2. TAB Technician: Employee of the TAB contractor and who is certified by AABC NEBB or TABB as a TAB technician.
- B. TAB Conference: Meet with Architect on approval of the TAB strategies and procedures plan to develop a mutual understanding of the details. Require the participation of the TAB field supervisor and technicians. Provide seven days' advance notice of scheduled meeting time and location.
 - 1. Agenda Items:
 - a. The Contract Documents examination report.
 - b. The TAB plan.
 - c. Coordination and cooperation of trades and subcontractors.
 - d. Coordination of documentation and communication flow.
- C. Certify TAB field data reports and perform the following:
 - 1. Review field data reports to validate accuracy of data and to prepare certified TAB reports.
 - 2. Certify that the TAB team complied with the approved TAB plan and the procedures specified and referenced in this Specification.
- D. Instrumentation Type, Quantity, Accuracy, and Calibration: As described in ASHRAE 111, Section 5, "Instrumentation."
- E. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- F. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.7.2.3 - "System Balancing."

1.5 PROJECT CONDITIONS

- A. Full Owner Occupancy: Owner will occupy the site and existing building during entire TAB period. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.
- B. Partial Owner Occupancy: Owner may occupy completed areas of building before Substantial Completion. Cooperate with Owner during TAB operations to minimize conflicts with Owner's operations.

1.6 COORDINATION

- A. Notice: Provide seven days' advance notice for each test. Include scheduled test dates and times.
- B. Perform TAB after leakage and pressure tests on air and water distribution systems have been satisfactorily completed.

PART 2 PRODUCTS - NOT USED

PART 3 EXECUTION

3.1 TAB SPECIALISTS

- A. Subject to compliance with requirements, engage a TAB entity certified by AABC, NEBB, or TABB

3.2 EXAMINATION

- A. Examine the Contract Documents to become familiar with Project requirements and to discover conditions in systems' designs that may preclude proper TAB of systems and equipment.
- B. Examine systems for manual volume dampers and other balancing devices. Verify that locations of these balancing devices are accessible.
- C. Examine the approved submittals for HVAC systems and equipment.
- D. Examine design data including HVAC system descriptions, statements of design assumptions for environmental conditions and systems' output, and statements of philosophies and assumptions about HVAC system and equipment controls.
- E. Examine equipment performance data including fan and pump curves.
 - 1. Relate performance data to Project conditions and requirements, including system effects that can create undesired or unpredicted conditions that cause reduced capacities in all or part of a system.
 - 2. Calculate system-effect factors to reduce performance ratings of HVAC equipment when installed under conditions different from the conditions used to rate equipment performance. To calculate system effects for air systems, use tables and charts found in AMCA 201, "Fans and Systems," or in SMACNA's "HVAC Systems - Duct Design." Compare results with the design data and installed conditions.
- F. Examine system and equipment installations and verify that field quality-control testing, cleaning, and adjusting specified in individual Sections have been performed.
- G. Examine test reports specified in individual system and equipment Sections.
- H. Examine HVAC equipment and verify that bearings are greased, belts are aligned and tight, and equipment with functioning controls is ready for operation.
- I. Examine operating safety interlocks and controls on HVAC equipment.

- J. Report deficiencies discovered before and during performance of TAB procedures.
- K. Observe and record system reactions to changes in conditions. Record default set points if different from indicated values.

3.3 PREPARATION

- A. Prepare a TAB plan that includes strategies and step-by-step procedures.
- B. Complete system-readiness checks and prepare reports. Verify the following:
 - 1. Permanent electrical-power wiring is complete.
 - 2. Equipment and duct access doors are securely closed.
 - 3. Balance dampers are open.
 - 4. Isolating and balancing valves are open and control valves are operational.
 - 5. Windows and doors can be closed so indicated conditions for system operations can be met.

3.4 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems" and in this Section.
 - 1. Comply with requirements in ASHRAE 62.1, Section 7.2.2 - "Air Balancing."
- B. Install test probes to the minimum extent necessary for TAB procedures.
 - 1. After testing and balancing, patch probe holes in ducts with same material and thickness as used to construct ducts.
 - 2. After testing and balancing, install test ports and duct access doors that comply with requirements in Section 233300 "Air Duct Accessories."
- C. Mark equipment and balancing devices, including damper-control positions, fan-speed-control levers, and similar controls and devices, with paint or other suitable, permanent identification material to show final settings.
- D. Take and report testing and balancing measurements in inch-pound (IP) units.

3.5 GENERAL PROCEDURES FOR BALANCING AIR SYSTEMS

- A. Prepare test reports for both fans and outlets. Obtain manufacturer's outlet factors and recommended testing procedures. Crosscheck the summation of required outlet volumes with required fan volumes.
- B. Prepare schematic diagrams of systems' "as-built" layouts.

- C. Determine the best locations in main and branch ducts for accurate duct-airflow measurements.
- D. Check airflow patterns from the louvers and dampers and the exhaust-air dampers through the supply-fan discharge and mixing dampers.
- E. Locate start-stop and disconnect switches, electrical interlocks, and motor starters.
- F. Verify that motor starters are equipped with properly sized thermal protection.
- G. Check dampers for proper position to achieve desired airflow path.
- H. Check for airflow blockages.
- I. Check condensate drains for proper connections and functioning.
- J. Verify that air duct system is sealed as specified in Section 233113 "Metal Ducts."

3.6 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer's name, model number, and serial number.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, each phase.
 - 6. Nameplate and measured amperage, each phase.
 - 7. Starter thermal-protection-element rating.
- B. Motors Driven by Variable-Frequency Controllers: Test for proper operation at speeds varying from minimum to maximum. Test the manual bypass of the controller to prove proper operation. Record observations including name of controller manufacturer, model number, serial number, and nameplate data.

3.7 TOLERANCES

- A. Set HVAC system's air flow rates and within the following tolerances:
 - 1. Exhaust Fans, exhaust grilles and Equipment with Fans: Plus or minus 10 percent.

3.8 REPORTING

- A. Initial Construction-Phase Report: Based on examination of the Contract Documents as specified in "Examination" Article, prepare a report on the adequacy of design for systems' balancing devices. Recommend changes and additions to systems' balancing devices to

facilitate proper performance measuring and balancing. Recommend changes and additions to HVAC systems and general construction to allow access for performance measuring and balancing devices.

- B. Status Reports: Prepare monthly progress reports to describe completed procedures, procedures in progress, and scheduled procedures. Include a list of deficiencies and problems found in systems being tested and balanced. Prepare a separate report for each system and each building floor for systems serving multiple floors.

3.9 FINAL REPORT

- A. General: Prepare a certified written report; tabulate and divide the report into separate sections for tested systems and balanced systems.
 - 1. Include a certification sheet at the front of the report's binder, signed and sealed by the certified testing and balancing engineer.
 - 2. Include a list of instruments used for procedures, along with proof of calibration.
- B. Final Report Contents: In addition to certified field-report data, include the following:
 - 1. Fan curves.
 - 2. Manufacturers' test data.
 - 3. Field test reports prepared by system and equipment installers.
 - 4. Other information relative to equipment performance; do not include Shop Drawings and product data.
- C. General Report Data: In addition to form titles and entries, include the following data:
 - 1. Title page.
 - 2. Name and address of the TAB contractor.
 - 3. Project name.
 - 4. Project location.
 - 5. Architect's name and address.
 - 6. Engineer's name and address.
 - 7. Contractor's name and address.
 - 8. Report date.
 - 9. Signature of TAB supervisor who certifies the report.
 - 10. Table of Contents with the total number of pages defined for each section of the report. Number each page in the report.

11. Summary of contents including the following:
 - a. Indicated versus final performance.
 - b. Notable characteristics of systems.
 - c. Description of system operation sequence if it varies from the Contract Documents.
 12. Nomenclature sheets for each item of equipment.
 13. Notes to explain why certain final data in the body of reports vary from indicated values.
 14. Test conditions for fan performance forms including the following:
 - a. Settings for exhaust-air dampers.
 - b. Fan drive settings including settings and percentage of maximum pitch diameter.
 - c. Other system operating conditions that affect performance.
- D. System Diagrams: Include schematic layouts of air systems. Present each system with single-line diagram and include the following:
1. Quantities of supply and exhaust airflows.
 2. Duct, outlet, and inlet sizes.
 3. Exhaust grille airflow.
- E. Apparatus-Coil Test Reports:
- F. Fan Test Reports: For exhaust fans, include the following:
1. Fan Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and size.
 - e. Manufacturer's serial number.
 - f. Arrangement and class.
 - g. Sheave make, size in inches, and bore.
 - h. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 2. Motor Data:

- a. Motor make, and frame type and size.
 - b. Horsepower and rpm.
 - c. Volts, phase, and hertz.
 - d. Full-load amperage and service factor.
 - e. Sheave make, size in inches, and bore.
 - f. Center-to-center dimensions of sheave, and amount of adjustments in inches.
 - g. Number, make, and size of belts.
3. Test Data (Indicated and Actual Values):
- a. Total airflow rate in cfm.
 - b. Total system static pressure in inches wg.
 - c. Fan rpm.
 - d. Discharge static pressure in inches wg.
 - e. Suction static pressure in inches wg.

3.10 INSPECTIONS

A. Initial Inspection:

- 1. After testing and balancing are complete, operate each system and randomly check measurements to verify that the system is operating according to the final test and balance readings documented in the final report.
- 2. Check the following for each system:
 - a. Measure airflow of at least 10 percent of air outlets.
 - b. Measure room temperature at each thermostat/temperature sensor.
 - c. Compare the reading to the set point.
 - d. Verify that balancing devices are marked with final balance position.
 - e. Note deviations from the Contract Documents in the final report.

B. Final Inspection:

- 1. After initial inspection is complete and documentation by random checks verifies that testing and balancing are complete and accurately documented in the final report, request that a final inspection be made by Architect.

2. The TAB contractor's test and balance engineer shall conduct the inspection in the presence of Architect.
 3. Architect shall randomly select measurements, documented in the final report, to be rechecked. Rechecking shall be limited to either 10 percent of the total measurements recorded or the extent of measurements that can be accomplished in a normal 8-hour business day.
 4. If rechecks yield measurements that differ from the measurements documented in the final report by more than the tolerances allowed, the measurements shall be noted as "FAILED."
 5. If the number of "FAILED" measurements is greater than 10 percent of the total measurements checked during the final inspection, the testing and balancing shall be considered incomplete and shall be rejected.
- C. TAB Work will be considered defective if it does not pass final inspections. If TAB Work fails, proceed as follows:
1. Recheck all measurements and make adjustments. Revise the final report and balancing device settings to include all changes; resubmit the final report and request a second final inspection.
 2. If the second final inspection also fails, Owner may contract the services of another TAB contractor to complete TAB Work according to the Contract Documents and deduct the cost of the services from the original TAB contractor's final payment.
- D. Prepare test and inspection reports.

3.11 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional TAB to verify that balanced conditions are being maintained throughout and to correct unusual conditions.
- B. Seasonal Periods: If initial TAB procedures were not performed during near-peak summer and winter conditions, perform additional TAB during near-peak summer and winter conditions.

END OF SECTION

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SECTION 23 3113 - METAL DUCTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Single-wall rectangular ducts and fittings.
2. Sheet metal materials.
3. Sealants and gaskets.
4. Hangers and supports.

B. Related Sections:

1. Section 23 0593 "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing requirements for metal ducts.
2. Section 23 3300 "Air Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.

1.2 PERFORMANCE REQUIREMENTS

- A. Delegated Duct Design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and under conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- C. Airstream Surfaces: Surfaces in contact with the airstream shall comply with requirements in ASHRAE 62.1.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Plans, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Duct installation in congested spaces, indicating coordination with general construction, building components, and other building services. Indicate proposed changes to duct layout.
 2. Suspended ceiling components.
 3. Structural members to which duct will be attached.
 4. Size and location of initial access modules for acoustical tile.

5. Penetrations of smoke barriers and fire-rated construction.
6. Items penetrating finished ceiling including the following:
 - a. Lighting fixtures.
 - b. Air outlets and inlets.
 - c. Sprinklers.
 - d. Access panels.
 - e. Perimeter moldings.
- B. Welding certificates.
- C. Field quality-control reports.

1.4 QUALITY ASSURANCE

- A. Welding Qualifications: Qualify procedures and personnel according to the following:
 1. AWS D1.1/D1.1M, "Structural Welding Code - Steel," for hangers and supports.
 2. AWS D9.1M/D9.1, "Sheet Metal Welding Code," for duct joint and seam welding.
- B. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Start-up."
- C. ASHRAE/IESNA Compliance: Applicable requirements in ASHRAE/IESNA 90.1, Section 6.4.4 - "HVAC System Construction and Insulation."

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated duct design: Duct construction, including sheet metal thicknesses, seam and joint construction, reinforcements, and hangers and supports, shall comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and with performance requirements and design criteria indicated in "Duct Schedule" Article.
- B. Structural Performance: Duct hangers and supports shall withstand the effects of gravity loads and stresses within limits and conditions described in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" and applicable local codes.
- C. Airstream Surfaces: Surfaces in contact with airstream shall comply with requirements in ASHRAE 62.1.
- D. ASHRAE Compliance: Applicable requirements in ASHRAE 62.1 Section 5 - "Systems and Equipment" and Section 7 - "Construction and System Startup."

- E. ASHRAE/IES Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6.4.4. - "HVAC System Construction and Insulation."
- F. Duct Dimensions: Unless otherwise indicated, all duct dimensions indicated on Drawings are inside clear dimensions and do not include any insulation or duct wall thickness."

2.2 SINGLE-WALL RECTANGULAR DUCTS AND FITTINGS

- A. General Fabrication Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" based on indicated static-pressure class unless otherwise indicated.
- B. Transverse Joints: Select joint types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-1, "Rectangular Duct/Transverse Joints," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 - 1. For ducts with longest side less than 36 inches, select joint types in accordance with Figure 2-1.
 - 2. For ducts with longest side 36 inches or greater, use flange joint connector type T-22, T-24, T-24A, T-25A, or T-25b. Factory fabricated flanged duct connections system may be used if submitted and approved by engineer of record.
- C. Longitudinal Seams: Select seam types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 2-2, "Rectangular Duct/Longitudinal Seams," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Elbows, Transitions, Offsets, Branch Connections, and Other Duct Construction: Select types and fabricate according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 4, "Fittings and Other Construction," for static-pressure class, applicable sealing requirements, materials involved, duct-support intervals, and other provisions in SMACNA's "HVAC Duct E. Construction Standards - Metal and Flexible."

2.3 SINGLE WALL ROUND DUCTS AND FITTINGS

- A. General fabrication requirements.: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible." Ch. 3, "Round, Oval, and Flexible Duct," based on indicated static pressure class unless otherwise indicated.
 - 1. Construct ducts of galvanized sheet steel unless otherwise indicated.
 - 2. For ducts exposed to weather, construct of Type 316 stainless steel indicated by the manufacturer to be suitable for outdoor installation.
 - 3. Manufacturers: Subject to compliance with requirements, Provide products by one of the following:

- a. Ductmate Industries
 - b. Elgen Manufacturing
 - c. Linx Industries
 - d. McGill Airflow
 - e. MKT Metal Manufacturing
 - f. Nordfab Ducting
 - g. SEMCO LLC
 - h. Set Duct Manufacturing
 - i. Sheet Metal Connectors
 - j. Spiral Manufacturing CO
 - k. Stamped Fittings
- B. Transverse Joints: Select joint types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-1, "Round Duct Transverse Joints" for static pressure class, applicable sealing requirements, materials involved, duct support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- 1. Transverse Joints in Ducts larger than 60 inches in diameter: Flanged
- C. Longitudinal Seams: Select seam types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" Figure 3-2, "Round Duct Longitudinal Seams" for static pressure class, applicable sealing requirements, materials involved, duct support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
- D. Tees and Laterals: Select types and fabricate in accordance with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" figure 3-5, "90 degree Tees and Laterals," and Figure 3-6, "Conicals Tees" for static pressure class, applicable sealing requirements, materials involved, duct support intervals, and other provisions in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

2.4 SHEET METAL MATERIALS

- A. General Material Requirements: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.
- B. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
- 1. Galvanized Coating Designation: G90 shall be installed indoors and outdoors.

2. Finishes for Surfaces Exposed to View: Mill phosphatized.
- C. Stainless Steel: ASTM A480/A 480 M, Type 316, sheet form with No. 4 finish for surfaces of ducts exposed to view and type 304, sheet form No. 1 finish for concealed ducts.
- D. Reinforcement shapes and plates: Galvanized steel reinforcement where installed on galvanized, sheet metal ducts; compatible materials for stainless steel ducts.
- E. Tie Rods: galvanized steel, ¼ inch minimum diameter for 36 inch length or less; .3/8 inch minimum diameter for lengths longer than 36 inches.
- F. All ducts shall be galvanized steel except as follows:
 1. Fabricate ductwork (exhaust and intake) for pump station from stainless steel.

2.5 SEALANT AND GASKETS

- A. General Sealant and Gasket Requirements: Surface-burning characteristics for sealants and gaskets shall be a maximum flame-spread index of 25 and a maximum smoke-developed index of 50 when tested according to UL 723; certified by an NRTL.
- B. Two part tape sealing system:
 1. Tape: Woven cotton fiber impregnated with mineral gypsum and modified acrylic/silicone activator to react exothermically with tape to form a hard, durable, airtight seal.
 2. Tape width: 4 inches
 3. Sealant: Modified styrene acrylic
 4. Water resistant
 5. Mold and Mildew resistant
 6. Maximum static pressure class: 10 inch wg, positive or negative
 7. Service: indoor or outdoor
 8. Service Temperature: Minus 40 to plus 200 degrees F.
 9. Substrate: Compatible with galvanized sheet steel and stainless steel.
 10. Sealant shall have a VOC content of 420g/L or less.
 11. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemicals Emissions from Indoor Sources Using Environmental Chambers."
- C. Water Based Joint and Seam Sealant

1. Application Method: Roll On
2. Solids content: Minimum 65 percent
3. Shore A Hardness: Minimum 20
4. Water Resistant
5. Mold and Mildew resistant
6. VOC: Maximum 75 g/L (less water)
7. Maximum static pressure class: 10 inch w.g. positive or negative
8. Service: Indoor or outdoor
9. Substrate: Compatible with galvanized sheet steel and stainless steel.

D. Solvent-Based Joint and Seam Sealant:

1. Application Method: Brush on.
2. base: Synthetic rubber resin.
3. Solvent: Toluene and heptane
4. Solids Content: Minimum 60 percent.
5. Shore A Hardness: Minimum 60.
6. Water resistant.
7. Mold and mildew resistant.
8. Sealant shall have a VOC: content of 420 g/L or less.
9. Sealant shall comply with the testing and product requirements of the California Department of Public Health's "Standard Method for the Testing and Evaluation of Volatile Organic Chemicals Emissions from Indoor Sources Using Environmental Chambers."
10. Maximum Static-Pressure Class: 10-inch wg, positive and negative.
11. Service: Indoor or outdoor.
12. Substrate: Compatible with galvanized sheet steel (both PVC coated and bare), stainless steel, or aluminum sheets.

E. Flanged Joint Sealant: Comply with ASTM C 920.

1. General: Single-component, acid-curing, silicone, elastomeric.
2. Type: S.

3. Grade: NS.
 4. Class: 25.
 5. Use: O
 6. For indoor applications, sealant shall have a VOC content of 250 g/L or less when calculated according to 40 CFR 59, Subpart D (EPA Method 24).
 7. Sealant shall comply with the testing and product requirements of the California Department of Health Services' "Standard Practice for the Testing of Volatile Organic Emissions from Various Sources Using Small-Scale Environmental Chambers."
- F. Flange Gaskets: Butyl rubber, neoprene, or EPDM polymer with polyisobutylene plasticizer.
- G. Round Duct Joint O-Ring Seals:
1. Seal shall provide maximum leakage class of 3 cfm/100 sq. ft. at 1-inch wg and shall be rated for 10-inch wg static-pressure class, positive or negative.
 2. EPDM O-ring to seal in concave bead in coupling or fitting spigot.
 3. Double-lipped, EPDM O-ring seal, mechanically fastened to factory-fabricated couplings and fitting spigots.

2.6 HANGERS AND SUPPORTS

- A. Hanger Rods for Noncorrosive Environments: Cadmium-plated steel rods and nuts.
- B. Hanger Rods for Corrosive Environments: Electrogalvanized, all-thread rods or galvanized rods with threads painted with zinc-chromate primer after installation.
- C. Strap and Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct."
- D. Steel Cables for Galvanized-Steel Ducts: Galvanized steel complying with ASTM A 603.
- E. Steel Cables for Stainless-Steel Ducts: Stainless steel complying with ASTM A 492.
- F. Steel Cable End Connections: Cadmium-plated steel assemblies with brackets, swivel, and bolts designed for duct hanger service; with an automatic-locking and clamping device.
- G. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.
- H. Trapeze and Riser Supports:
1. Supports for Galvanized-Steel Ducts: Galvanized-steel shapes and plates shall comply with ASTM A 36/A 36 M.
 2. Supports for stainless steel ducts: Stainless steel shapes and plates.

2.7 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction with galvanized sheet steel, according to SMACNA's "HVAC Duct Construction Standards-Metal and Flexible." Comply with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
- B. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure classification.
- C. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's HVAC Duct Construction Standards-Metal and Flexible.
- D. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing and joint reinforcement.

PART 3 EXECUTION

3.1 DUCT INSTALLATION

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of duct system. Indicated duct locations, configurations, and arrangements were used to size ducts and calculate friction loss for air-handling equipment sizing and for other design considerations. Install duct systems as indicated unless deviations to layout are approved on Shop Drawings and Coordination Drawings.
- B. Install ducts according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" unless otherwise indicated.
- C. Install round ducts in lengths not less than 12 feet, unless interrupted by fittings.
- D. Install ducts with fewest possible joints.
- E. Install factory- or shop-fabricated fittings for changes in direction, size, and shape and for branch connections.
- F. Unless otherwise indicated, install ducts vertically and horizontally, and parallel and perpendicular to building lines.
- G. Install ducts close to walls, overhead construction, columns, and other structural and permanent enclosure elements of building.
- H. Install ducts with a clearance of 1 inch.
- I. Coordinate layout with suspended ceiling, fire and smoke control dampers, lighting layouts and similar finished work.
- J. Route ducts to avoid passing through transformer vaults and electrical equipment rooms and enclosures.

- K. Where ducts pass through non-fire-rated interior partitions and exterior walls and are exposed to view, cover the opening between the partition and duct or duct insulation with sheet metal flanges of same metal thickness as the duct. Overlap openings on four sides by at least 1-1/2 inches.
- L. Where ducts pass through fire-rated interior partitions and exterior walls, install fire dampers. Comply with requirements in Section 23 3300 "Air Duct Accessories" for fire and smoke dampers.
- M. Protect duct interiors from moisture, construction debris and dust, and other foreign materials. Comply with SMACNA's "IAQ Guidelines for Occupied Buildings Under Construction," Appendix G, "Duct Cleanliness for New Construction Guidelines."

3.2 INSTALLATION OF EXPOSED DUCTWORK

- A. Protect ducts exposed in finished spaces from being dented, scratched, or damaged.
- B. Trim duct sealants flush with metal. Create a smooth and uniform exposed bead.
- C. Do not use two-part tape sealing system.
- D. Grind welds to provide smooth surface free of burrs, sharp edges, and weld splatter. When welding stainless steel with a No. 3 or 4 finish, grind the welds flush, polish the exposed welds, and treat the welds to remove discoloration caused by welding.
- E. Maintain consistency, symmetry, and uniformity in the arrangement and fabrication of fittings, hangers and supports, duct accessories, and air outlets.
- F. Repair or replace damaged sections and finished work that does not comply with these requirements.

3.3 DUCTWORK EXPOSED TO WEATHER

- A. All external joints are to be welded. Seal all openings to provide weather proof construction.
- B. Construct ductwork to resist external loads of wind, snow, ice , and other effects of weather. Provide necessary supporting structures.
- C. Single Wall:
 - 1. Ductwork shall be Type 316 stainless steel.
 - a. If duct outer surface is uninsulated, protect outer surface with suitable paint. Paint materials and application requirements are specified in Section 099113 "Exterior Painting"

3.4 DUCT SEALING

- A. Seal ducts for duct static-pressure, seal classes, and leakage classes specified in "Duct Schedule" Article according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."

- B. Seal ducts to the following seal classes according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible":
1. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible."
 2. Outdoor, Supply-Air Ducts: Seal Class A.
 3. Outdoor, Exhaust Ducts: Seal Class C.
 4. Outdoor, Return-Air Ducts: Seal Class C.
 5. Unconditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class B.
 6. Unconditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-inch wg: Seal Class A.
 7. Unconditioned Space, Exhaust Ducts: Seal Class C.
 8. Unconditioned Space, Return-Air Ducts: Seal Class B.
 9. Conditioned Space, Supply-Air Ducts in Pressure Classes 2-Inch wg and Lower: Seal Class C.
 10. Conditioned Space, Supply-Air Ducts in Pressure Classes Higher Than 2-Inch wg: Seal Class B.
 11. Conditioned Space, Exhaust Ducts: Seal Class B.
 12. Conditioned Space, Return-Air Ducts: Seal Class C.

3.5 HANGER AND SUPPORT INSTALLATION

- A. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Chapter 5, "Hangers and Supports."
- B. Building Attachments: Concrete inserts, powder-actuated fasteners, or structural-steel fasteners appropriate for construction materials to which hangers are being attached.
1. Where practical, install concrete inserts before placing concrete.
 2. Install powder-actuated concrete fasteners after concrete is placed and completely cured.
 3. Use powder-actuated concrete fasteners for standard-weight aggregate concretes or for slabs more than 4 inches thick.
 4. Do not use powder-actuated concrete fasteners for lightweight-aggregate concretes or for slabs less than 4 inches thick.
 5. Do not use powder-actuated concrete fasteners for seismic restraints.

- C. Hanger Spacing: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 5-1, "Rectangular Duct Hangers Minimum Size," and Table 5-2, "Minimum Hanger Sizes for Round Duct," for maximum hanger spacing; install hangers and supports within 24 inches of each elbow and within 48 inches of each branch intersection.
- D. Hangers Exposed to View: Threaded rod and angle or channel supports.
- E. Support vertical ducts with steel angles or channel secured to the sides of the duct with welds, bolts, sheet metal screws, or blind rivets; support at each floor and at a maximum intervals of 16 feet.
- F. Install upper attachments to structures. Select and size upper attachments with pull-out, tension, and shear capacities appropriate for supported loads and building materials where used.
- G. Roof Supports for Ductwork: Horizontal ductwork on the roof shall be supported with equipment mounting supports that shall consist of a minimum of welded 18 gauge galvanized steel shell, base plate, and counter flashing, factory installed 2x4 or 2x6 wood nailer, and in internal bulkhead reinforcement. Heights of the roof supports shall be coordinated in field with air handler discharge heights.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hranec Inc.
 - b. The Pate Company.
 - c. Thycurb.

3.6 CONNECTIONS

- A. Make connections to equipment with flexible connectors complying with Section 23 3300 "Air Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

3.7 PAINTING

- A. Paint interior of metal ducts that are visible through registers and grilles and that do not have duct liner. Apply one coat of flat, black, latex paint over a compatible galvanized-steel primer. Paint materials and application requirements are specified in Section 09 9113 "Exterior Painting" and Section 09 9123 "Interior Painting."

3.8 FIELD QUALITY CONTROL

- A. Perform tests and inspections.
- B. Leakage Tests:

1. Comply with SMACNA's "HVAC Air Duct Leakage Test Manual." Submit a test report for each test.
 2. Test the following systems:
 - a. Ducts with a Pressure Class Higher Than 3-Inch wg: Test representative duct sections, selected by Architect from sections installed, totaling no less than 25 percent of total installed duct area for each designated pressure class.
 - b. Supply Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - c. Return Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct sections, selected by Architect from sections installed, totaling no less than 50 percent of total installed duct area for each designated pressure class.
 - d. Exhaust Ducts with a Pressure Class of 2-Inch wg or Higher: Test representative duct section totaling no less than 100 percent of total installed duct area for each designated pressure class.
 3. Disassemble, reassemble, and seal segments of systems to accommodate leakage testing and for compliance with test requirements.
 4. Test for leaks before applying external insulation.
 5. Conduct tests at static pressures equal to maximum design pressure of system or section being tested. If static-pressure classes are not indicated, test system at maximum system design pressure. Do not pressurize systems above maximum design operating pressure.
 6. Give seven days' advance notice for testing.
- C. Duct System Cleanliness Tests:
1. Visually inspect duct system to ensure that no visible contaminants are present.
 2. Test sections of metal duct system, chosen randomly by Owner, for cleanliness according to "Vacuum Test" in NADCA ACR, "Assessment,
 3. Cleaning and Restoration of HVAC Systems."
 - a. Acceptable Cleanliness Level: Net weight of debris collected on the filter media shall not exceed 0.75 mg/100 sq. cm.
- D. Duct system will be considered defective if it does not pass tests and inspections.
- E. Prepare test and inspection reports.
- F. Exterior ductwork shall be sealed water tight with mastic.

3.9 DUCT CLEANING

- A. Clean new duct systems before testing, adjusting, and balancing.
- B. Use duct cleaning methodology as indicated in NADCA ACR.
- C. Use service openings for entry and inspection.
 - 1. Create new openings and install access panels appropriate for duct static-pressure class if required for cleaning access. Provide insulated panels for insulated or lined duct. Patch insulation and liner as recommended by duct liner manufacturer. Comply with Section 23 3300 "Air Duct Accessories" for access panels and doors.
 - 2. Disconnect and reconnect flexible ducts as needed for cleaning and inspection.
 - 3. Remove and reinstall ceiling to gain access during the cleaning process.
- D. Particulate Collection and Odor Control:
 - 1. When venting vacuuming system inside the building, use HEPA filtration with 99.97 percent collection efficiency for 0.3-micron-size (or larger) particles.
 - 2. When venting vacuuming system to outdoors, use filter to collect debris removed from HVAC system, and locate exhaust downwind and away from air intakes and other points of entry into building.
- E. Clean the following components by removing surface contaminants and deposits:
 - 1. Air outlets and inlets (registers, grilles, and diffusers).
 - 2. Supply, return, and exhaust fans including fan housings, plenums (except ceiling supply and return plenums), scrolls, blades or vanes, shafts, baffles, dampers, and drive assemblies.
 - 3. Air-handling unit internal surfaces and components including mixing box, coil section, air wash systems, spray eliminators, condensate drain pans, humidifiers and dehumidifiers, filters and filter sections, and condensate collectors and drains.
 - 4. Coils and related components
 - 5. Return-air ducts, dampers, actuators, and turning vanes except in ceiling plenums and mechanical equipment rooms.
 - 6. Supply-air ducts, dampers, actuators, and turning vanes.
 - 7. Dedicated exhaust components.
- F. Mechanical Cleaning Methodology:
 - 1. Clean metal duct systems using mechanical cleaning methods that extract contaminants from within duct systems and remove contaminants from building.
 - 2. Use vacuum-collection devices that are operated continuously during cleaning. Connect vacuum device to downstream end of duct sections so areas being cleaned are under

negative pressure.

3. Use mechanical agitation to dislodge debris adhered to interior duct surfaces without damaging integrity of metal ducts, duct liner, or duct accessories.
4. Clean fibrous-glass duct liner with HEPA vacuuming equipment; do not permit duct liner to get wet. Replace fibrous-glass duct liner that is damaged, deteriorated, or delaminated or that has friable material, mold, or fungus growth.
5. Clean coils and coil drain pans according to NADCA 1992. Keep drain pan operational. Rinse coils with clean water to remove latent residues and cleaning materials; comb and straighten fins.
6. Provide drainage and cleanup for wash-down procedures.
7. Antimicrobial Agents and Coatings: Apply EPA-registered antimicrobial agents if fungus is present. Apply antimicrobial agents according to manufacturer's written instructions after removal of surface deposits and debris.

3.10 START UP

- A. Air Balance: Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."

3.11 DUCT SCHEDULE

- A. Intake Ductwork:
 1. Round and Rectangular
 2. Pressure Class: Positive 2-inch wg.
 3. Minimum SMACNA Seal Class: A.
- B. Exhaust Ducts:
 1. Ducts Connected to Fans Exhausting (ASHRAE 62.1, Class 1 and 2) Air:
 - a. Pressure Class: Negative 1-inch wg
 - b. Minimum SMACNA Seal Class: C.
- C. Exterior Ductwork:
 1. Pressure Class: Positive 4-inch wg.
 2. Minimum SMACNA Seal Class: A.
- D. Intermediate Reinforcement:
 1. Galvanized-Steel Ducts: Galvanized steel
- E. Elbow Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Velocity 1000 fpm or Lower:
 - 1) Radius Type RE 1 with minimum 0.5 radius-to-diameter ratio
 - 2) Mitered Type RE 4 without vanes
 - b. Velocity 1000 to 1500 fpm:
 - 1) Radius Type RE 1 with minimum 1.0 radius to diameter ratio
 - 2) Radius Type RE 3 with minimum 0.5 radius to diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" Figure 4-3, "Vanes and Vane Runners," Figure 4-4, "Vane Support in Elbows."
 - c. Velocity 1500 fpm or Higher:
 - 1) Radius Type RE 1 with minimum 1.5 radius to diameter ratio.
 - 2) Radius Type RE 3 with minimum 1.0 radius to diameter ratio and two vanes.
 - 3) Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" Figure 4-3, "Vanes and Vane Runners," Figure 4-4, "Vane Support in Elbows."
2. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-2, "Rectangular Elbows."
 - a. Radius Type RE 1 with minimum 1.5 radius-to-diameter ratio.
 - b. Radius Type RE 3 with minimum 1.0 radius-to-diameter ratio and two vanes.
 - c. Mitered Type RE 2 with vanes complying with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-3, "Vanes and Vane Runners," and Figure 4-4, "Vane Support in Elbows."
3. Round Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-4, "Round Duct Elbows."
 - a. Minimum Radius-to-Diameter Ratio and Elbow Segments: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Table 3-1, "Mitered Elbows." Elbows with less than 90-degree change of direction have proportionately fewer segments.
 - b. Round Elbows, 12 Inches and Smaller in Diameter: Stamped or pleated.
 - c. Round Elbows, 14 Inches and Larger in Diameter: Standing seam or welded.

F. Branch Configuration:

1. Rectangular Duct: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 4-6, "Branch Connection."
 - a. Rectangular Main to Rectangular Branch: 45-degree entry.
 - b. Rectangular Main to Round Branch: Spin in.
2. Round and Flat Oval: Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible," Figure 3-5, "90 Degree Tees and Laterals," and Figure 3-6, "Conical Tees." Saddle taps are permitted in existing duct.
 - a. Velocity 1000 fpm or Lower: 90-degree tap.
 - b. Velocity 1000 to 1500 fpm: Conical tap.
 - c. Velocity 1500 fpm or Higher: 45-degree lateral.

END OF SECTION

SECTION 23 3300 - AIR DUCT ACCESSORIES

ART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Backdraft and pressure relief dampers.
 - 2. Manual volume dampers.
 - 3. Control dampers.
 - 4. Duct-mounted access doors.
 - 5. Flexible connectors.
 - 6. Duct accessory hardware.

1.2 ACTION SUBMITTALS

- A. Shop Drawings: For duct accessories. Include plans, elevations, sections, details and attachments to other work.
 - 1. Detail duct accessories fabrication and installation in ducts and other construction. Include dimensions, weights, loads, and required clearances; and method of field assembly into duct systems and other construction. Include the following:
 - a. Special fittings.
 - b. Manual volume damper installations.
 - c. Control-damper installations.
 - d. Fire-damper, ceiling, and corridor damper installations, including sleeves; and duct-mounted access doors and remote damper operators.
 - e. Wiring Diagrams: For power, signal, and control wiring.

1.3 INFORMATIONAL SUBMITTALS

- A. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which ceiling-mounted access panels and access doors required for access to duct accessories are shown and coordinated with each other, using input from Installers of the items involved.
- B. Source quality-control reports.

1.4 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For air duct accessories to include in operation and maintenance manuals.

PART 2 - PRODUCTS

2.1 ASSEMBLY DESCRIPTION

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and with NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."
- B. Comply with SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for acceptable materials, material thicknesses, and duct construction methods unless otherwise indicated. Sheet metal materials shall be free of pitting, seam marks, roller marks, stains, discolorations, and other imperfections.

2.2 MATERIALS

- A. Galvanized Sheet Steel: Comply with ASTM A 653/A 653M.
 - 1. Galvanized Coating Designation: G90.
 - 2. Exposed-Surface Finish: Mill phosphatized.

2.3 BACKDRAFT DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Air Balance Inc.; a division of Mestek, Inc.
 - 2. American Warming and Ventilating; a division of Mestek, Inc.
 - 3. Cesco Products; a division of Mestek, Inc.
 - 4. Greenheck Fan Corporation.
 - 5. Lloyd Industries, Inc.
 - 6. Nailor Industries Inc.
 - 7. NCA Manufacturing, Inc.
 - 8. Pottorff.
 - 9. Ruskin Company.
 - 10. Vent Products Company, Inc.
- B. Description: Gravity balanced.
- C. Maximum Air Velocity: 2500 fpm.
- D. Maximum System Pressure: 4-inch wg.

- E. Frame: Hat-shaped, extruded aluminum with welded corners or mechanically attached and mounting flange.
- F. Blades: Multiple single-piece blades, extruded aluminum with sealed edges.
- G. Blade Action: Parallel.
- H. Blade Seals: Extruded vinyl, mechanically locked.
- I. Blade Axles:
 - 1. Material: metallic.
- J. Return Spring: Adjustable tension.
- K. Bearings: synthetic pivot bushings.
- L. Accessories:
 - 1. Adjustment device to permit setting for varying differential static pressure.
 - 2. Counterweights and spring-assist kits for vertical airflow installations.
 - 3. Electric actuators.

2.4 MANUAL VOLUME DAMPERS

- A. Standard, Steel, Manual Volume Dampers:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following] [available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Air Balance Inc.; a division of Mestek, Inc.
 - b. American Warming and Ventilating; a division of Mestek, Inc.
 - c. Flexmaster U.S.A., Inc.
 - d. McGill AirFlow LLC.
 - e. Nailor Industries Inc.
 - f. Pottorff.
 - g. Ruskin Company.
 - h. Trox USA Inc.
 - i. Vent Products Company, Inc.
 - 2. Standard leakage rating, with linkage outside airstream.

3. Suitable for horizontal or vertical applications.
4. Frames:
 - a. Frame: Hat-shaped, 16 gauge minimum, galvanized sheet steel.
 - b. Mitered and welded corners.
 - c. Flanges for attaching to walls and flangeless frames for installing in ducts.
5. Blades:
 - a. Multiple or single blade.
 - b. Parallel- or opposed-blade design.
 - c. Stiffen damper blades for stability.
 - d. Galvanized-steel, 16 gauge minimum.
6. Blade Axles: Plated steel.
7. Bearings:
 - a. Synthetic.
 - b. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 - c. Tie Bars and Brackets: Galvanized steel.

2.5 CONTROL DAMPERS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Arrow United Industries; a division of Mestek, Inc.
 3. Cesco Products; a division of Mestek, Inc.
 4. Greenheck Fan Corporation.
 5. Lloyd Industries, Inc.
 6. McGill AirFlow LLC.
 7. Metal Form Manufacturing, Inc.
 8. Nailor Industries Inc.

9. NCA Manufacturing, Inc.
 10. Pottorff.
 11. Ruskin Company.
 12. Vent Products Company, Inc.
 13. Young Regulator Company.
- B. Low-leakage rating, with linkage outside airstream, and bearing AMCA's Certified Ratings Seal for both air performance and air leakage.
- C. Frames:
1. Hat shaped.
 2. 0.094-inch thick, galvanized sheet steel.
- D. Blades:
1. Multiple blade with maximum blade width of 6 inches.
 2. Parallel- and opposed-blade design.
 3. Galvanized-steel.
 4. Blade thickness: 16 gauge
 5. Blade Edging: PVC.
 6. Blade Edging: Inflatable seal blade edging, or replaceable rubber seals.
- E. Blade Axles: 1/2-inch diameter; plated steel; blade-linkage hardware of zinc-plated steel and brass; ends sealed against blade bearings.
1. Operating Temperature Range: From minus 40 to plus 200 deg F.
- F. Bearings:
1. Molded synthetic.
 2. Dampers in ducts with pressure classes of 3-inch wg or less shall have axles full length of damper blades and bearings at both ends of operating shaft.
 3. Thrust bearings at each end of every blade.

2.6 DUCT-MOUNTED ACCESS DOORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. American Warming and Ventilating; a division of Mestek, Inc.
 2. Cesco Products; a division of Mestek, Inc.
 3. Ductmate Industries, Inc.
 4. Elgen Manufacturing.
 5. Flexmaster U.S.A., Inc.
 6. Greenheck Fan Corporation.
 7. McGill AirFlow LLC.
 8. Nailor Industries Inc.
 9. Pottorff.
 10. Ventfabrics, Inc.
 11. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Duct-Mounted Access Doors: Fabricate access panels according to SMACNA's "HVAC Duct Construction Standards - Metal and Flexible"; Figures 7-2, "Duct Access Doors and Panels," and 7-3, "Access Doors - Round Duct."
1. Door:
 - a. Double wall, rectangular.
 - b. Galvanized sheet metal with insulation fill and thickness as indicated for duct pressure class.
 - c. Vision panel.
 - d. Hinges and Latches: 1-by-1-inch butt or piano hinge and cam latches.
 - e. Fabricate doors airtight and suitable for duct pressure class.
 2. Frame: Galvanized sheet steel, with bend-over tabs and foam gaskets.
 3. Number of Hinges and Locks:
 - a. Access Doors Less Than 12 Inches Square: No hinges and two sash locks.
 - b. Access Doors up to 18 Inches Square: Two hinges or Continuous and two sash locks.
 - c. Access Doors up to 24 by 48 Inches: Three hinges or continuous and two compression latches with outside and inside handles.
 - d. Access Doors Larger Than 24 by 48 Inches: Four hinges or Continuous and two compression latches with outside and inside handles.

C. Pressure Relief Access Door:

1. Door and Frame Material: Galvanized sheet steel.
2. Door: Double wall with insulation fill with metal thickness applicable for duct pressure class.
3. Operation: Open outward for positive-pressure ducts and inward for negative-pressure ducts.
4. Factory set at 3.0- to 8.0-inch wg.
5. Doors close when pressures are within set-point range.
6. Hinge: Continuous piano.
7. Latches: Cam.
8. Seal: Neoprene or foam rubber.
9. Insulation Fill: 1-inch- thick, fibrous-glass or polystyrene-foam board.

2.7 FLEXIBLE CONNECTORS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Ductmate Industries, Inc.
 2. Duro Dyne Inc.
 3. Elgen Manufacturing.
 4. Ventfabrics, Inc.
 5. Ward Industries, Inc.; a division of Hart & Cooley, Inc.
- B. Materials: Flame-retardant or noncombustible fabrics.
- C. Coatings and Adhesives: Comply with UL 181, Class 1.
- D. Metal-Edged Connectors: Factory fabricated with a fabric strip 5-3/4 inches wide attached to two strips of 2-3/4-inch wide, 0.028-inch thick, galvanized sheet steel.
- E. Indoor System, Flexible Connector Fabric: Glass fabric double coated with neoprene.
1. Minimum Weight: 26 oz./sq. yd.
 2. Tensile Strength: 480 lbf / inch in the warp and 360 lbf / inch in the filling.
 3. Service Temperature: Minus 40 to plus 200 deg F.

- F. Outdoor System, Flexible Connector Fabric: Glass fabric double coated with weatherproof, synthetic rubber resistant to UV rays and ozone.

1. Minimum Weight: 24 oz./sq. yd.
2. Tensile Strength: 530 lbf / inch in the warp and 440 lbf / inch in the filling.
3. Service Temperature: Minus 50 to plus 250 deg F.

2.8 DUCT ACCESSORY HARDWARE

- A. Instrument Test Holes: Cast iron or cast aluminum to suit duct material, including screw cap and gasket. Size to allow insertion of pitot tube and other testing instruments and of length to suit duct-insulation thickness.
- B. Adhesives: High strength, quick setting, neoprene based, waterproof, and resistant to gasoline and grease.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install duct accessories according to applicable details in SMACNA's "HVAC Duct Construction Standards - Metal and Flexible" for metal ducts and in NAIMA AH116, "Fibrous Glass Duct Construction Standards," for fibrous-glass ducts.
- B. Install duct accessories of materials suited to duct materials; use galvanized-steel accessories in galvanized-steel and fibrous-glass ducts, stainless-steel accessories in stainless-steel ducts, and aluminum accessories in aluminum ducts.
- C. Install backdraft dampers at inlet of exhaust fans or exhaust ducts as close as possible to exhaust fan unless otherwise indicated.
- D. Set dampers to fully open position before testing, adjusting, and balancing.
- E. Install test holes at fan inlets and outlets and elsewhere as indicated.
- F. Install duct access doors on sides of ducts to allow for inspecting, adjusting, and maintaining accessories and equipment at the following locations:
1. Downstream from manual volume dampers, control dampers, backdraft dampers, and equipment.
 2. At each change in direction and at maximum 50-foot spacing.
 3. Control devices requiring inspection.
 4. Elsewhere as indicated.
- G. Install access doors with swing against duct static pressure.
- H. Access Door Sizes:

1. One-Hand or Inspection Access: 8 by 5 inches.
 2. Two-Hand Access: 12 by 6 inches.
 3. Head and Hand Access: 18 by 10 inches.
 4. Head and Shoulders Access: 21 by 14 inches.
 5. Body Access: 25 by 14 inches.
 6. Body plus Ladder Access: 25 by 17 inches.
- I. Label access doors according to indicate the purpose of access door.
 - J. Install flexible connectors to connect ducts to equipment.
 - K. Install duct test holes where required for testing and balancing purposes.

3.2 FIELD QUALITY CONTROL

- A. Tests and Inspections:
 1. Operate dampers to verify full range of movement.
 2. Inspect locations of access doors and verify that purpose of access door can be performed.
 3. Operate fire, smoke, and combination fire and smoke dampers to verify full range of movement and verify that proper heat-response device is installed.
 4. Inspect turning vanes for proper and secure installation.
 5. Operate remote damper operators to verify full range of movement of operator and damper.

END OF SECTION

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SECTION 23 3416 - CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes: For each product.

1. Sidewall Propeller Fans.
2. Inline Centrifugal Fans
3. Roof mounted fans
4. Utility Fan

1.2 REFERENCES

A. Air Movement and Control Association Inc. (AMCA)

1. 99 - Standards Handbook
2. 200 - Publication, Air Systems
3. 201-90 - Publication, Fans and Systems
4. 202-88 - Publication, Troubleshooting
5. 203-90 - Publication, Field Performance Measurement of Fan Systems
6. 211-05 - Publication, Certified Ratings Program - Product Rating Manual for Fan Air Performance
7. 300-96 - Standard Reverberant Room Method for Sound Testing of Fans
8. 311-05 - Publication Certified Ratings Program - Product Rating Manual for Fan Sound Performance
9. 99-0401-86 - Classification for Spark Resistant Construction
10. 99-2408-69 - Operating Limits for Centrifugal Fans

B. Air Movement and Control Association Inc. (AMCA), American National Standards Institute (ANSI):

1. 204-05 - Standard Balance Quality and Vibration Levels for Fans
2. 210-99 Standard Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

C. American National Standards Institute (ANSI):

1. 11-r1999 - Method of Evaluating Load Ratings of Bearings

- D. American Society of Civil Engineers (ASCE):
 - 1. 7-02 - Minimum Design Loads for Building and Other Structures
- E. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc (ASHRAE):
 - 1. Chapter 45 - 2003 Handbook, HVAC Applications
 - 2. Chapter 7 - 2001 Fundamentals handbook, sound vibration
 - 3. Chapter 32- 2001 Fundamentals handbook, Duct Design
 - 4. Chapter 18 - 1992 HVAC System and Equipment handbook, Fans
- F. American Society for Testing and Materials (ASTM):
 - 1. E330-02 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylight and Curtain Walls by Uniform Static Air Pressure Difference
- G. National Fire Protection Association (NFPA)
 - 1. 70 - National Electric Code
 - 2. 90A-02 - Standard for the Installation of Air Conditioning and Ventilating Systems
- H. Occupational Safety and Health Administration (OSHA):
 - 1. 1910.212 - General requirements for Machine Guarding
 - 2. 1910.219 - General requirements for guarding safe use of mechanical power transmission apparatus

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include rated capacities, furnished specialties, and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
 - 6. Dampers, including housings, linkages, and operators.

1.4 QUALITY ASSURANCE

- A. Performance ratings: conform to AMCA standard 211 and 311. Fans shall be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air and sound

performance seal.

- B. Classification for Spark Resistant Construction, Levels A, B, C, conform to AMCA 99.
- C. Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces.
- D. Comply with the National Electrical Manufacturer's Association (NEMA), standards for motor and electrical accessories.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Delivery: Deliver materials to site in manufacturer's original, unopened containers and packing, with labels clearly indicating manufacturer, material, products included, and location of installation.
- B. Storage: Store materials in a dry area indoors, protected from damage, and in accordance with manufacturer's instructions. For long term storage, follow manufacturer's Installation, Operations, and Maintenance Manual.
- C. Handling: Handle and lift fans in accordance with the manufacturer's instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer.

1.6 WARRANTY

- A. Manufacturer's Warranty: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner, may have under contract documents:
 - 1. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove to be defective during the warranty period shall be replaced at the manufacturer's option when returned to manufacturer, transportation prepaid.
 - 2. Fan motor is warranted by the motor manufacturer for a period of one year. Should motors prove to be defective during this period, they should be returned to the motor manufacturer.

1.7 MAINTENANCE

- A. Refer to Manufacturer's Installation, Operation and Maintenance Manual (IOM), to find maintenance procedures.

1.8 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

PART 2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 - 1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
 - 2. Operating Limits: Classify according to AMCA 99.
- B. 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.

2.2 SIDEWALL PROPELLER FANS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Loren Cook Company.
 - 2. New York Blower Company.
 - 3. Greenheck Fan Corporation.
- B. Description:
 - 1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven propeller exhaust fans.
 - 2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
 - 3. Factory-installed and -wired disconnect switch.
 - 4. Permanently affixed manufacturer's nameplate containing the model number and individual serial number.
- C. Wheel:
 - 1. Propeller shall be aluminum blade riveted to a steel hub.
 - 2. Statically and dynamically balanced in accordance to AMCA 204-05.
 - 3. The propeller and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency.
- D. Motors:
 - 1. Motor enclosure: totally enclosed fan cooled
 - 2. The motor shall be permanently lubricated and accessible for maintenance
 - 3. The motor shall have thermal overload protection.
- E. Frame:

1. Motor drive frame assemblies and fan panels shall be galvanized steel. Drive frame assemblies shall be welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges, and deep formed inlet venturi. Drive frames and panels shall be bolted construction or welded construction.
- F. Speed Control:
1. Fans shall come with a remote speed control to adjust to 60 percent of full speed.
- G. Accessories:
1. See fan schedule on drawings for accessories.

2.3 INLINE CENTRIFUGAL DIRECT DRIVE FANS

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
1. Loren Cook Company.
 2. New York Blower Company.
 3. Greenheck Fan Corporation.
- B. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, direct-driven propeller exhaust fans.
 2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
 3. Factory-installed and -wired disconnect switch.
 4. Permanently affixed manufacturer's nameplate containing the model number and individual serial number.
- C. Wheel:
1. Non-overloading, backward inclined centrifugal wheel.
 2. Single thickness blades are securely riveted or welded to a heavy gauge back plate and wheel cone.
 3. Statically and dynamically balanced in accordance to AMCA 204-05.
- D. Motors:
1. Motor enclosure: totally enclosed fan cooled
 2. The motor shall be permanently lubricated and accessible for maintenance
 3. The motor shall have thermal overload protection.

E. Frame:

1. Housing supports shall be constructed of structural steel with formed flanges.
2. Drive frame shall be welded steel which support the motor.
3. Duct collars shall be square design
4. Fans shall have two-sided access panels located perpendicular to the motor mounting panel.

F. Speed Control:

1. Fans shall come with a speed control to adjust to 60 percent of full speed.

G. Accessories:

1. See fan schedule on drawings for accessories.

2.4 ROOF MOUNTED EXHAUST FANS

A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

1. Loren Cook Company.
2. New York Blower Company.
3. Greenheck Fan Corporation.

B. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, centrifugal exhaust fans.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
3. Factory-installed and -wired disconnect switch.
4. Permanently affixed manufacturer's nameplate containing the model number and individual serial number.

C. Construction:

1. The fan shall be centrifugal backward inclined, constructed of aluminum and shall include a wheel cone carefully matched to the inlet cone for precise running tolerances. The fan housing shall be constructed of heavy gauge aluminum with a rigid internal support structure. Windbands shall have a rolled bead for added strength and shall be joined to curb caps with a leakproof, continuously welded seam.

D. Motors and drives:

1. Motors shall be heavy duty ball bearing type, carefully matched to the fan load. Motors and drives shall be mounted on vibration isolators, out of the airstream. Fresh air for motor cooling shall be drawn into the motor compartment from an area free of discharge contaminants. Motors shall be readily accessible for maintenance. Drive frame assemblies shall be constructed of heavy gauge steel and mounted on vibration isolators.
2. Precision ground and polished fan shafts shall be mounted in permanently sealed, lubricated pillow block ball bearings. Bearings shall be selected for a minimum life in excess of 100,000 hours at maximum cataloged operating speed. Drives shall be sized for a minimum of 150% of driven horsepower. Pulleys shall be of the fully machined cast iron type, keyed and securely attached to the wheel and motor shaft. Motor pulleys shall be adjustable for final system balancing. A disconnect switch shall be factory installed and wired from the fan motor to a junction box installed within the motor compartment. A conduit chase shall be provided through the curb cap to the motor compartment for ease of electrical wiring.
3. Fan shall be UL Listed and shall bear the AMCA Certified Ratings Seal for sound and air performance.

2.5 UTILITY FANS (WET WELL EXHAUST FAN)

- A. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 1. Loren Cook Company.
 2. New York Blower Company.
 3. Greenheck Fan Corporation.
- B. Description:
 1. Factory-fabricated, -assembled, -tested, and -finished, utility fan.
 2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.
 3. Factory-installed and -wired disconnect switch.
 4. Permanently affixed manufacturer's nameplate containing the model number and individual serial number.
- C. Construction:
 1. Fan shall be AMCA type A construction.
 2. Fan housing shall be aerodynamically designed with high efficiency inlet, engineered to reduce incoming air turbulence.
 3. Fan housing and bearing support shall be constructed of bolted framework.

4. Fan is to be equipped with lifting lugs.
5. An OSHA compliant belt guard shall be included to completely cover the motor pulleys and belt.
6. Fan shall be UL Listed.

D. Wheel:

1. The fan wheel shall be of the non-overloading single width backward inclined centrifugal type. Wheels shall be statically and dynamically balanced to balance grade G6.3 per ANSI S2.19.
2. Fan wheel shall be manufactured of single thickness blades securely riveted to a heavy gauge back plate and wheel cone.
3. The wheel and fan inlet shall be carefully matched and shall have precise running tolerances for maximum performance and operating efficiency.

E. Fan Motors and Drive

1. Motors shall meet or exceed EISA efficiencies.
2. Motor to be explosion proof.
3. Drive belts and sheaves shall be sized for 150% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required.
4. Fan shaft shall be sized so the first critical speed is at least 25% over the maximum operating speed for each pressure class.
5. Fan shaft bearings shall be Air Handler quality, bearings shall be heavy duty grease lubricated, self aligning or roller pillow block type.
6. Air Handler bearings to be designed with low swivel torque to allow the outer race of the bearing to pivot or swivel within the cast pillow block. Bearing shall be 100% tested for noise and vibration by the manufacturer. Bearings shall be 100% tested to insure the inner race diameter is within tolerance to prevent vibration.
7. Bearings shall be selected for a basis rating fatigue life of 80,000 hours at maximum operating speed for each pressure class.
8. Bearings shall have Zerk fittings to allow for lubrication.

2.6 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.7 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install fan, motor and drive in accordance with manufacturer's instructions.
- B. Install fans level and plumb.
- C. Ensure roof openings are square, accurately aligned, correctly located, and in tolerance.
- D. Ensure duct is plumb, sized correctly and to proper elevation above roof deck.

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories.
- B. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- C. Install ducts adjacent to fans to allow service and maintenance.

3.3 PRE-OPERATION MAINTENANCE

- A. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.

3.4 ADJUSTING

- A. Adjust exhaust fans to function properly
- B. Adjust belt tension
- C. Adjust drive for final system balancing
- D. Lubricate bearings
- E. Check Wheel overlap.

3.5 CLEANING

- A. Clean as recommended by manufacturer. Do not use materials or methods which may damage finish surface or surrounding construction.

3.6 PROTECTION

- A. Protect installed product and finished surfaces from damage during construction.
- B. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion.

END OF SECTION

SECTION 23 3700 - AIR OUTLETS AND INLETS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Louvered Penthouse

1.2 REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating 2015.
- B. AMCA 511 - Certified Ratings Program Product Rating Manual for Air Control Devices 2021.
- C. ASHRAE Std 70 - Method of Testing the Performance of Air Outlets and Inlets 2006 (Reaffirmed 2021).
- D. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials 2021a.
- E. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems 2021.
- F. NFPA 90B - Standard for the Installation of Warm Air Heating and Air-Conditioning Systems 2018.
- G. SMACNA (ASMM) - Architectural Sheet Metal Manual 2012.
- H. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible 2005 (Revised 2009).

1.3 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements for submittal procedures.
- B. Product Data: Provide data for equipment required for this project. Review outlets and inlets as to size, finish, and type of mounting prior to submission. Submit schedule of outlets and inlets showing type, size, location, application, and noise level.
- C. Project Record Documents: Record actual locations of air outlets and inlets.

1.4 QUALITY ASSURANCE

- A. Test and rate louver performance in accordance with AMCA 500-L.
- B. Manufacturer Qualifications: Company specializing in manufacturing the type of products specified in this section, with minimum three years of documented experience.

PART 2 PRODUCTS

2.1 LOUVERED PENTHOUSES

- A. Manufacturers:
 - 1. NCA, a brand of Metal Industries

- 2. Ruskin Company
- 3. Greenheck.
- B. Description: low silhouette louvered penthouse for intake applications
- C. Fabrication: All aluminum construction
- D. Cover: Units shall have a removable aluminum cover for internal access and shall be lined with fiberglass insulation to prevent condensation. Cover shall be securely fastened to the unit by corrosion resistant fasteners.
- E. Birdscreen: Birdscreen shall be constructed of 1/2 inch mesh securely mounted across intake openings.
- F. Louvers: Units shall have a weather resistant 0.080 inch aluminum louver with mitered corners. Louvers shall be mounted 4 inches from the throat for maximum weather protection. Louver design shall result in low pressure drops, low hood heights, and maintain maximum weather resistance.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Comply with SMACNA (ASMM) for flashing/counter-flashing of roof penetrations and supports for roof curbs and roof mounted equipment.
- C. Check location of outlets and inlets and make necessary adjustments in position to conform with architectural features, symmetry, and lighting arrangement.
- D. Provide balancing dampers as shown on plans.
- E. Paint ductwork visible behind air outlets and inlets matte black. Refer to Section 09 9123.

END OF SECTION

SECTION 23 8216 - ELECTRIC RESISTANCE HEATERS

PART 1 GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. Section includes electric resistance air coils.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each air coil.
 - 2. Include rated capacities, operating characteristics, and pressure drops for each air coil.
- B. Shop Drawings: Include diagrams for power, signal, and control wiring.

1.4 COORDINATION

- A. Coordinate size, location and installation of coils with air-handling units to suit conditions and to ensure proper operation.

PART 2 PRODUCTS

2.1 DESCRIPTION

- A. ASHRAE Compliance: Comply with applicable requirements in ASHRAE 62.1, Section 5 "Systems and Equipment" and Section 7 - "Construction and Startup."

2.2 ELECTRIC UNIT HEATERS

- A. Manufacturers: Provide products by one of the following or an approved equal.
 - 1. Markel
 - 2. Qmark
 - 3. Marley
- B. Description: Provide and install heavy duty wall mounted forced air electric heater of the wattage, voltage, and phase indicated on the plans. The heater shall have an 18-gauge steel housing with powder coated finish and control compartment housing a master terminal board with a hinged and latched access door. The heating element shall consist of a copper clad steel sheath element with continuously brazed steel fins. Heater shall also have an automatic reset type limit controls to de-energize the heater should an over temperature event occur. The fan shall have a totally enclosed 1-speed, 1-phase, permanently lubricated thermally protected

motor with sleeve bearings. Motors shall be mounted on rubber insulators. Heaters shall have louvers that are individually adjustable for directional control of air. Heaters shall include an integral thermostat with an adjustable range of 40 to 110 degrees F. All heaters shall be listed by ETL. Heating elements shall have a one-year manufacturer's warranty.

- C. Accessories: Provide accessories indicated on heater schedule.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Examine heaters to verify that the heaters are clean and in good condition before installation.
- B. Clean all dirt and debris from heaters before installation.
- C. Notify manufacturer of any defects.

3.2 INSTALLATION

- A. Coordinate heater locations with other disciplines before rough-in of heaters.
- B. Install heaters level and plumb.
- C. Install heaters in accordance with the manufacturer's instructions and applicable electrical codes.

END OF SECTION

SECTION 26 0505 - SELECTIVE DEMOLITION FOR ELECTRICAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical demolition.

PART 2 PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work: As specified in individual sections.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Report discrepancies to Architect/Engineer before disturbing existing installation.
- D. Beginning of demolition means installer accepts existing conditions.

3.2 PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company and owner.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.

3.3 DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultra-violet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
- B. Remove, relocate, and extend existing installations to accommodate new construction.

- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.
- G. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- H. Repair adjacent construction and finishes damaged during demolition and extension work.
- I. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- J. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified.

3.4 CLEANING AND REPAIR

- A. See Section 01 7419 - Construction Waste Management and Disposal for additional requirements.
- B. Clean and repair existing materials and equipment that remain or that are to be reused.
- C. Panelboards: Clean exposed surfaces and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.

END OF SECTION

SECTION 26 0519 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single conductor building wire.
- B. Wiring connectors.
- C. Electrical tape.
- D. Heat shrink tubing.
- E. Oxide inhibiting compound.
- F. Wire pulling lubricant.
- G. Cable ties.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems: Additional requirements for grounding conductors and grounding connectors.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- ~~C. Section 31 2316 - Excavation.~~
- D. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- ~~E. Section 31 2323 - Fill: Bedding and backfilling.~~

1.3 REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire 2013 (Reapproved 2018).
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft 2011 (Reapproved 2017).
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes 2010, with Editorial Revision (2020).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation 2004 (Reapproved 2020).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape 2017.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes 2020.

- G. FS A-A-59544 - Cable and Wire, Electrical (Power, Fixed Installation); Federal Specification 2008a (Validated 2019).
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- I. NEMA WC 70 - Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy 2021.
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- K. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- L. UL 44 - Thermoset-Insulated Wires and Cables Current Edition, Including All Revisions.
- M. UL 83 - Thermoplastic-Insulated Wires and Cables Current Edition, Including All Revisions.
- N. UL 486A-486B - Wire Connectors Current Edition, Including All Revisions.
- O. UL 486C - Splicing Wire Connectors Current Edition, Including All Revisions.
- P. UL 486D - Sealed Wire Connector Systems Current Edition, Including All Revisions.
- Q. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.7 FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F, unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Architect/Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.1 CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.
- H. Manufactured wiring systems are not permitted.

2.2 CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Comply with FS A-A-59544 where applicable.
- G. Thermoplastic-Insulated Conductors and Cables: Listed and labeled as complying with UL 83.
- H. Thermoset-Insulated Conductors and Cables: Listed and labeled as complying with UL 44.
- I. Conductors for Grounding and Bonding: Also comply with Section 26 0526.
- J. Conductor Material:

1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 2. Copper Conductors: Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 3. Tinned Copper Conductors: Comply with ASTM B33.
- K. Minimum Conductor Size:
1. Branch Circuits: 12 AWG.
 2. Control Circuits: 14 AWG.
- L. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- M. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method: Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 3. Color Code:
 - a. 480Y/277 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Brown.
 - 2) Phase B: Orange.
 - 3) Phase C: Yellow.
 - 4) Neutral/Grounded: Gray.
 - b. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Phase C: Blue.
 - 4) Neutral/Grounded: White.
 - c. 240/120 V, 1 Phase, 3 Wire System:

- 1) Phase A: Black.
 - 2) Phase B: Red.
 - 3) Neutral/Grounded: White.
- d. Equipment Ground, All Systems: Green.
 - e. For control circuits, comply with manufacturer's recommended color code.

2.3 SINGLE CONDUCTOR BUILDING WIRE

- A. Description: Single conductor insulated wire.
- B. Conductor Stranding:
 1. Feeders and Branch Circuits:
 2. Control Circuits: Stranded.
- C. Insulation Voltage Rating: 600 V.
- D. Insulation:
 1. Copper Building Wire: Type THHN/THWN or THHN/THWN-2.

2.4 WIRING CONNECTORS

- A. Description: Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding: Comply with Section 26 0526.
- C. Wiring Connectors for Splices and Taps:
 1. Copper Conductors Size 8 AWG and Smaller: Use twist-on insulated spring connectors or mechanical connectors.
 2. Copper Conductors Size 6 AWG and Larger: Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations:
 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less

than required for the rating of the overcurrent protective device.

4. Provide motor pigtail connectors for connecting motor leads in order to facilitate disconnection.
5. Copper Conductors Size 8 AWG and Larger: Use mechanical connectors or compression connectors where connectors are required.
6. Stranded Conductors Size 10 AWG and Smaller: Use crimped terminals for connections to terminal screws.
7. Conductors for Control Circuits: Use crimped terminals for all connections.
- E. Do not use insulation-piercing or insulation-displacement connectors designed for use with conductors without stripping insulation.
- F. Do not use push-in wire connectors as a substitute for twist-on insulated spring connectors.
- G. Twist-on Insulated Spring Connectors: Rated 600 V, 221 degrees F for standard applications and 302 degrees F for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- H. Mechanical Connectors: Provide bolted type or set-screw type.
- I. Compression Connectors: Provide circumferential type or hex type crimp configuration.
- J. Crimped Terminals: Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.5 WIRING ACCESSORIES

- A. Electrical Tape:
 1. Vinyl Color Coding Electrical Tape: Integrally colored to match color code indicated; listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; suitable for continuous temperature environment up to 221 degrees F.
 2. Vinyl Insulating Electrical Tape: Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil; resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F and suitable for continuous temperature environment up to 221 degrees F.
 3. Rubber Splicing Electrical Tape: Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil; suitable for continuous temperature environment up to 194 degrees F and short-term 266 degrees F overload service.
 4. Electrical Filler Tape: Rubber-based insulating moldable putty, minimum thickness of 125 mil; suitable for continuous temperature environment up to 176 degrees F.
 5. Varnished Cambric Electrical Tape: Cotton cambric fabric tape, with or without adhesive, oil-primed and coated with high-grade insulating varnish; minimum thickness of 7 mil;

suitable for continuous temperature environment up to 221 degrees F.

6. Moisture Sealing Electrical Tape: Insulating mastic compound laminated to flexible, all-weather vinyl backing; minimum thickness of 90 mil.
- B. Heat Shrink Tubing: Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Oxide Inhibiting Compound: Listed; suitable for use with the conductors or cables to be installed.
- D. Wire Pulling Lubricant: Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- E. Cable Ties: Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.3 INSTALLATION

- A. Circuiting Requirements:
 1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated without specific routing, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 5. Maintain separation of wiring for emergency systems in accordance with NFPA 70.

6. Circuiting Adjustments: Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is permitted, under the following conditions:
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 7. Common Neutrals: Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway:
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.
 4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Paralleled Conductors: Install conductors of the same length and terminate in the same manner.
- F. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
 2. Installation in Vertical Raceways: Provide supports where vertical rise exceeds permissible limits.
- G. Terminate cables using suitable fittings.
- H. Install conductors with a minimum of 12 inches of slack at each outlet.

- I. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet of slack.
- J. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- K. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- L. Make wiring connections using specified wiring connectors.
 - 1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 - 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 - 3. Do not remove conductor strands to facilitate insertion into connector.
 - 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminates. Do not use wire brush on plated connector surfaces.
 - 5. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 - 6. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- M. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
 - 1. Dry Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 - b. For taped connections likely to require re-entering, including motor leads, first apply varnished cambric electrical tape, followed by adequate amount of rubber splicing electrical tape, followed by outer covering of vinyl insulating electrical tape.
 - 2. Damp Locations: Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.

- 3. Wet Locations: Use heat shrink tubing.
- N. Insulate ends of spare conductors using vinyl insulating electrical tape.
- O. Field-Applied Color Coding: Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- P. Identify conductors and cables in accordance with Section 26 0553.
- Q. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is required for all conductors. The resistance test for parallel conductors listed as optional is not required.
 - 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 26 0526 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground rod electrodes.
- E. Ground access wells.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA GR 1 - Ground Rod Electrodes and Ground Rod Electrode Couplings 2017.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- E. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- F. UL 467 - Grounding and Bonding Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify exact locations of underground metal water service pipe entrances to building.
 - 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode located in the building footings.
 - 3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:

1. Do not install ground rod electrodes until final backfill and compaction is complete.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
- B. Project Record Documents: Record actual locations of grounding electrode system components and connections.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work: Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.
- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance:
 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Architect/Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 2. Grounding Electrode System: Not greater than 25 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
- F. Grounding Electrode System:

1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - c. Where grounding electrode is installed outside, install in conduit from connection enclosure to 6" below finished grade. Provide
 2. Metal Underground Water Pipe(s):
 - a. Provide connection to underground metal water service pipe(s) that are in direct contact with earth for at least 10 feet at an accessible location not more than 5 feet from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 3. Concrete-Encased Electrode:
 - a. Provide connection to concrete-encased electrode as indicated on the plans, embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.
 4. Ground Rod Electrode(s):
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 - d. Provide ground access well for first connected electrode.
 5. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- G. Grounding for Separate Building or Structure Supplied by Feeder(s) or Branch Circuits:
1. Provide grounding electrode system for each separate building or structure.
 2. Provide equipment grounding conductor routed with supply conductors.

3. For each disconnecting means, provide grounding electrode conductor to connect equipment ground bus to grounding electrode system.
 4. Do not make any connections and remove any factory-installed jumpers between neutral (grounded) conductors and ground.
- H. Separately Derived System Grounding:
1. Separately derived systems include, but are not limited to:
 - a. Transformers (except autotransformers such as buck-boost transformers).
 2. Outdoor Source: Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
 3. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.
 4. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.
- I. Bonding and Equipment Grounding:
1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
 2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as equipment grounding conductor.
 3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
 4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
 5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
 6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
 7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:

- a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
- 8. Provide bonding for metal building frame.
- 9. Provide bonding for metal siding not effectively bonded through attachment to metal building frame.

2.2 GROUNDING AND BONDING COMPONENTS

A. General Requirements:

- 1. Provide products listed, classified, and labeled as suitable for the purpose intended.
- 2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 26 0526:

- 1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions:
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding:

- 1. Description: Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
- 2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
 - a. Exceptions:
 - 1) Use mechanical connectors for connections to electrodes at ground access wells.
- 3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.
 - a. Exceptions:
 - 1) Use exothermic welded connections for connections to metal building frame.

D. Ground Rod Electrodes:

- 1. Comply with NEMA GR 1.

2. Material: Copper-bonded (copper-clad) steel.
3. Size: 3/4 inch diameter by 10 feet length, unless otherwise indicated.

E. Ground Access Wells:

1. Description: Open bottom round or rectangular well with access cover for testing and inspection; suitable for the expected load at the installed location.
2. Size: As required to provide adequate access for testing and inspection, but not less than minimum size requirements specified.
 - a. Round Wells: Not less than 8 inches in diameter.
 - b. Rectangular Wells: Not less than 12 by 12 inches.
3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 10 inches.
4. Cover: Factory-identified by permanent means with word "GROUND".

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes: Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70.
 1. Outdoor Installations: Unless otherwise indicated, install with top of rod 12 inches (300mm) below finished grade.
- D. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.

2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 3. Exothermic Welds: Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.
 4. Mechanical Connectors: Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors: Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 26 0553.
- F. Identify each ground conductor at ground bar with equipment served.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Perform inspection, testing, and adjusting in accordance with Section 01 4000.
- C. Inspect and test in accordance with NETA ATS except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.13.
- E. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- F. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- G. Submit detailed reports indicating inspection and testing results and corrective actions taken to engineer for approval.

END OF SECTION

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SECTION 26 0529 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Support and attachment requirements and components for equipment, conduit, cable, boxes, and other electrical work.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0533.13 - Conduit for Electrical Systems: Additional support and attachment requirements for conduits.
- C. Section 26 0533.16 - Boxes for Electrical Systems: Additional support and attachment requirements for boxes.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 5100 - Interior Lighting: Additional support and attachment requirements for interior luminaires.

1.3 REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel 2019.
- D. MFMA-4 - Metal Framing Standards Publication 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- F. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- G. UL 5B - Strut-Type Channel Raceways and Fittings Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.

3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
 4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.5 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable building code.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements:
1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 125%. Include consideration for vibration, equipment operation, and shock loads where applicable.
 4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.

6. Steel Components: Use corrosion resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations: Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated.
 - c. Zinc-Plated Steel: Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel: Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Components for Vibration Isolation and/or Seismic Controls: Comply with Section 26 0548.
- C. Conduit and Cable Supports: Straps, clamps, etc. suitable for the conduit or cable to be supported.
 1. Conduit Straps: One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps: Bolted type unless otherwise indicated.
- D. Outlet Box Supports: Hangers, brackets, etc. suitable for the boxes to be supported.
- E. Metal Channel (Strut) Framing Systems: Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
 1. Comply with MFMA-4.
 2. Channel (Strut) Used as Raceway (only where specifically indicated): Listed and labeled as complying with UL 5B.
 3. Channel Material:
 - a. Indoor Dry Locations: Use painted steel, zinc-plated steel, or galvanized steel.
 - b. Outdoor and Damp or Wet Indoor Locations: Use galvanized steel.
 4. Minimum Channel Dimensions: 1-5/8 inch width by 13/16 inch height.
- F. Hanger Rods: Threaded zinc-plated steel unless otherwise indicated.
 1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports: 1/2 inch diameter.
 - b. Single Conduit up to 1 inch (27 mm) trade size: 1/4 inch diameter.
 - c. Single Conduit larger than 1 inch (27 mm) trade size: 3/8 inch diameter.

d. Trapeze Support for Multiple Conduits: 3/8 inch diameter.

e. Outlet Boxes: 1/4 inch diameter.

f. Luminaires: 1/4 inch diameter.

G. Anchors and Fasteners:

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete: Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry: Use expansion anchors or screw anchors.
4. Hollow Masonry: Use toggle bolts.
5. Hollow Stud Walls: Use toggle bolts.
6. Steel: Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal: Use sheet metal screws.
8. Wood: Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Powder-actuated fasteners are not permitted.
11. Hammer-driven anchors and fasteners are not permitted.
12. Preset Concrete Inserts: Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material: Use galvanized steel.
 - c. Minimum Channel Thickness: Steel sheet, 12 gage, 0.1046 inch minimum base metal thickness.
 - d. Manufacturer: Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Architect/Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Architect/Engineer, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Provide required vibration isolation and/or seismic controls in accordance with Section 26 0548.
- H. Equipment Support and Attachment:
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface-mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- I. Conduit Support and Attachment: Also comply with Section 26 0533.13.
- J. Box Support and Attachment: Also comply with Section 26 0533.16.
- K. Interior Luminaire Support and Attachment: Also comply with Section 26 5100.
- L. Preset Concrete Inserts: Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- M. Secure fasteners according to manufacturer's recommended torque settings.
- N. Remove temporary supports.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect support and attachment components for damage and defects.
- C. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- D. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 26 0533.13 - CONDUIT FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RMC).
- B. Intermediate metal conduit (IMC).
- C. PVC-coated galvanized steel rigid metal conduit (RMC).
- D. Flexible metal conduit (FMC).
- E. Liquidtight flexible metal conduit (LFMC).
- F. Electrical metallic tubing (EMT).
- G. Rigid polyvinyl chloride (PVC) conduit.
- H. Conduit fittings.
- I. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
 - 1. Includes additional requirements for fittings for grounding and bonding.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- ~~G. Section 31 2316 - Excavation.~~
- H. Section 31 2316.13 - Trenching: Excavating, bedding, and backfilling.
- ~~I. Section 31 2323 - Fill: Bedding and backfilling.~~

1.3 REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC) 2020.
- B. ANSI C80.3 - American National Standard for Electrical Metallic Tubing -- Steel (EMT-S) 2020.
- C. ANSI C80.6 - American National Standard for Electrical Intermediate Metal Conduit 2018.

- D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- E. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT) 2013.
- F. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC) 2017.
- G. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- H. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Metal Conduit and Intermediate Metal Conduit 2018.
- I. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit 2020.
- J. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing 2021.
- K. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- L. UL 1 - Flexible Metal Conduit Current Edition, Including All Revisions.
- M. UL 6 - Electrical Rigid Metal Conduit-Steel Current Edition, Including All Revisions.
- N. UL 360 - Liquid-Tight Flexible Metal Conduit Current Edition, Including All Revisions.
- O. UL 514B - Conduit, Tubing, and Cable Fittings Current Edition, Including All Revisions.
- P. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings Current Edition, Including All Revisions.
- Q. UL 797 - Electrical Metallic Tubing-Steel Current Edition, Including All Revisions.
- R. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.
- S. UL 1242 - Electrical Intermediate Metal Conduit-Steel Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.

5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- C. Underground:
 1. Under Slab on Grade: Use galvanized steel rigid metal conduit or rigid PVC conduit.
 2. Exterior, Direct-Buried: Use galvanized steel rigid metal conduit or rigid PVC conduit.
 3. Exterior, Embedded Within Concrete: Use galvanized steel rigid metal conduit or rigid PVC conduit.
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from underground.
 5. Where rigid polyvinyl (PVC) conduit larger than 2 inch (53 mm) trade size is provided, use galvanized steel rigid metal conduit elbows for bends.
 6. Where steel conduit emerges from concrete into soil, use corrosion protection tape to provide supplementary corrosion protection for a minimum of 4 inches on either side of where conduit emerges or use PVC-coated galvanized steel rigid metal conduit.

- D. Embedded Within Concrete:
1. Within Slab on Grade: Not permitted.
 2. Within Slab Above Ground: Not permitted.
 3. Within Concrete Walls Above Ground: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), PVC-coated galvanized steel rigid metal conduit, or rigid PVC conduit.
 4. Where rigid polyvinyl (PVC) conduit is provided, transition to galvanized steel rigid metal conduit where emerging from concrete.
- E. Concealed Within Masonry Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- F. Concealed Within Hollow Stud Walls: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- G. Concealed Above Accessible Ceilings: Use galvanized steel rigid metal conduit, intermediate metal conduit (IMC), or electrical metallic tubing (EMT).
- H. Interior, Damp or Wet Locations: Use galvanized steel rigid metal conduit.
- I. Exposed, Interior, Not Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- J. Exposed, Interior, Subject to Physical Damage: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
1. Locations subject to physical damage include, but are not limited to:
 - a. Where exposed up to 12ft.
- K. Exposed, Exterior: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- L. Concealed, Exterior, Not Embedded in Concrete or in Contact With Earth: Use galvanized steel rigid metal conduit or intermediate metal conduit (IMC).
- M. Corrosive Locations Above Ground: Use PVC-coated galvanized steel rigid metal conduit.
- N. Hazardous (Classified) Locations: Use galvanized steel rigid metal conduit or PVC-coated galvanized steel rigid metal conduit.
- O. Connections to Luminaires Above Accessible Ceilings: Use flexible metal conduit.
1. Maximum Length: 6 feet.
- P. Connections to Vibrating Equipment:
1. Dry Locations: Use flexible metal conduit.

2. Damp, Wet, or Corrosive Locations: Use liquidtight flexible metal conduit.
3. Maximum Length: 6 feet unless otherwise indicated.
4. Vibrating equipment includes, but is not limited to:
 - a. Transformers.
 - b. Motors.

2.2 CONDUIT REQUIREMENTS

- A. Existing Work: Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Fittings for Grounding and Bonding: Also comply with Section 26 0526.
- C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Minimum Conduit Size, Unless Otherwise Indicated:
 1. Branch Circuit Homeruns: 3/4 inch (21 mm) trade size.
 2. Underground, Exterior: 1 inch (27 mm) trade size.
- F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.

2.3 GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings:
 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.4 INTERMEDIATE METAL CONDUIT (IMC)

- A. Description: NFPA 70, Type IMC galvanized steel intermediate metal conduit complying with ANSI C80.6 and listed and labeled as complying with UL 1242.
- B. Fittings:
 - 1. Non-Hazardous Locations: Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 - 2. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 3. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 - 4. Connectors and Couplings: Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.5 PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT (RMC)

- A. Description: NFPA 70, Type RMC galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating: Polyvinyl chloride (PVC), nominal thickness of 40 mil.
- C. Interior Coating: Urethane, minimum thickness of 2 mil.
- D. PVC-Coated Fittings:
 - 1. Manufacturer: Same as manufacturer of PVC-coated conduit to be installed.
 - 2. Non-Hazardous Locations: Use fittings listed and labeled as complying with UL 514B.
 - 3. Hazardous (Classified) Locations: Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 - 4. Material: Use steel or malleable iron.
 - 5. Exterior Coating: Polyvinyl chloride (PVC), minimum thickness of 40 mil.
 - 6. Interior Coating: Urethane, minimum thickness of 2 mil.
- E. PVC-Coated Supports: Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil.

2.6 FLEXIBLE METAL CONDUIT (FMC)

- A. Description: NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- B. Fittings:

1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
2. Material: Use steel or malleable iron.

2.7 LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description: NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings:
 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.

2.8 ELECTRICAL METALLIC TUBING (EMT)

- A. Description: NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings:
 1. Description: Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 2. Material: Use steel or malleable iron.
 - a. Do not use die cast zinc fittings.
 3. Connectors and Couplings: Use compression (gland) or set-screw type.
 - a. Do not use indenter type connectors and couplings.
 4. Damp or Wet Locations (where permitted): Use fittings listed for use in wet locations.

2.9 RIGID POLYVINYL CHLORIDE (PVC) CONDUIT

- A. Description: NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C. Use schedule 80 in areas with vehicle traffic and schedule 40 in non-vehicle traffic. Use Schedule 80 in areas where rock is encountered.
- B. Fittings:
 1. Manufacturer: Same as manufacturer of conduit to be connected.

2. Description: Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.10 ACCESSORIES

- A. Corrosion Protection Tape: PVC-based, minimum thickness of 20 mil.
- B. Conduit Joint Compound: Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- C. Solvent Cement for PVC Conduit and Fittings: As recommended by manufacturer of conduit and fittings to be installed.
- D. Pull Strings: Use nylon cord with average breaking strength of not less than 200 pound-force.
- E. Sealing Compound for Sealing Fittings: Listed for use with the particular fittings to be installed.
- F. Modular Seals for Conduit Penetrations: Rated for minimum of 40 psig; Suitable for the conduits to be installed.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel rigid metal conduit (RMC) in accordance with NECA 101.
- D. Install intermediate metal conduit (IMC) in accordance with NECA 101.
- E. Install PVC-coated galvanized steel rigid metal conduit (RMC) using only tools approved by the manufacturer.
- F. Install rigid polyvinyl chloride (PVC) conduit in accordance with NECA 111.
- G. Conduit Routing:
 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 2. When conduit destination is indicated without specific routing, determine exact routing required.

3. Conceal all conduits unless specifically indicated to be exposed.
4. Conduits in the following areas may be exposed, unless otherwise indicated:
 - a. Electrical rooms.
 - b. Mechanical equipment rooms.
 - c. Within joists in areas with no ceiling.
 - d. Where existing conduits are exposed.
5. Unless otherwise approved, do not route conduits exposed:
 - a. Across floors.
 - b. Across roofs.
 - c. Across top of parapet walls.
 - d. Across building exterior surfaces.
6. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
7. Arrange conduit to maintain adequate headroom, clearances, and access.
8. Arrange conduit to provide no more than the equivalent of four 90 degree bends between pull points.
9. Arrange conduit to provide no more than 150 feet between pull points.
10. Route conduits above water and drain piping where possible.
11. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
12. Maintain minimum clearance of 6 inches between conduits and piping for other systems.
13. Maintain minimum clearance of 12 inches between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
14. Group parallel conduits in the same area together on a common rack.

H. Conduit Support:

1. Secure and support conduits in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 0548.
 3. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
 4. Installation Above Suspended Ceilings: Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
 5. Use conduit strap to support single surface-mounted conduit.
 - a. Use clamp back spacer with conduit strap for damp and wet locations to provide space between conduit and mounting surface.
 6. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
 7. Use conduit clamp to support single conduit from beam clamp or threaded rod.
 8. Use trapeze hangers assembled from threaded rods and metal channel (strut) with accessory conduit clamps to support multiple parallel suspended conduits.
 9. Use of spring steel conduit clips for support of conduits is not permitted.
 10. Use of wire for support of conduits is not permitted.
 11. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.
- I. Connections and Terminations:
1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
 2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
 3. Use suitable adapters where required to transition from one type of conduit to another.
 4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
 5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
 6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.

7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

J. Penetrations:

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of Structural Engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Provide suitable modular seal where conduits penetrate exterior wall below grade.
7. Where conduits penetrate waterproof membrane, seal as required to maintain integrity of membrane.
8. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.

K. Underground Installation:

1. Provide trenching and backfilling in accordance with Section 31 2316 and Section 31 2323.
2. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior: 24 inches, 600volts and less.
 - b. Underground, Exterior: 36 inches (915mm), over 600 volts - primary voltage.
3. Provide underground warning tape in accordance with Section 26 0553 along entire conduit length.

L. Conduit Movement Provisions: Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:

1. Where conduits cross structural joints intended for expansion, contraction, or deflection.

2. Where calculated in accordance with NFPA 70 for rigid polyvinyl chloride (PVC) conduit installed above ground to compensate for thermal expansion and contraction.
 3. Where conduits are subject to earth movement by settlement or frost.
- M. Condensation Prevention: Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- N. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches at each end.
- O. Provide grounding and bonding in accordance with Section 26 0526.
- P. Identify conduits in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Where coating of PVC-coated galvanized steel rigid metal conduit (RMC) contains cuts or abrasions, repair in accordance with manufacturer's instructions.
- D. Correct deficiencies and replace damaged or defective conduits.

3.4 CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.5 PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 26 0533.16 - BOXES FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches, including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches.
- C. Boxes for hazardous (classified) locations.
- D. Underground boxes/enclosures.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0533.13 - Conduit for Electrical Systems:
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- D. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- E. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- F. Section 26 2726 - Wiring Devices:
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable 2014.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports 2013 (Reaffirmed 2020).
- E. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

- F. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- G. SCTE 77 - Specification for Underground Enclosure Integrity 2017.
- H. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- I. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- J. UL 508A - Industrial Control Panels Current Edition, Including All Revisions.
- K. UL 514A - Metallic Outlet Boxes Current Edition, Including All Revisions.
- L. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.
 - 7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
 - 8. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, and underground boxes/enclosures.

C. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See Section 01 6000 - Product Requirements, for additional provisions.
2. Keys for Lockable Enclosures: Two of each different key.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 BOXES

- A. General Requirements:
1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
- B. Outlet and Device Boxes Up to 100 cubic inches, Including Those Used as Junction and Pull Boxes:
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use suitable concrete type boxes where flush-mounted in concrete.
 5. Use suitable masonry type boxes where flush-mounted in masonry walls.

6. Use raised covers suitable for the type of wall construction and device configuration where required.
7. Use shallow boxes where required by the type of wall construction.
8. Do not use "through-wall" boxes designed for access from both sides of wall.
9. Sheet-Steel Boxes: Comply with NEMA OS 1, and list and label as complying with UL 514A.
10. Cast Metal Boxes: Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
11. Boxes for Supporting Luminaires: Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
12. Boxes for Ganged Devices: Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes unless specifically indicated or permitted.
13. Minimum Box Size, Unless Otherwise Indicated:
 - a. Wiring Devices: 4 inch square by 1-1/2 inch deep (100 by 38 mm) trade size.
 - b. Ceiling Outlets: 4 inch octagonal or square by 1-1/2 inch deep (100 by 38 mm) trade size.
14. Wall Plates: Comply with Section 26 2726.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches:
 1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. NEMA 250 Environment Type, Unless Otherwise Indicated:
 - a. Indoor Clean, Dry Locations: Type 1, painted steel.
 - b. Outdoor/Indoor Corrosive Environments or where subject to Hose Down: NEMA 4X.
 - c. Outdoor Locations: Type 3R, painted steel.
 - d. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
 3. Junction and Pull Boxes Larger Than 100 cubic inches:
 - a. Provide hinged-cover enclosures unless otherwise indicated.
 - b. Boxes 6 square feet and Larger: Provide hinged-cover enclosures.
 4. Cabinets and Hinged-Cover Enclosures, Other Than Junction and Pull Boxes:

- a. Provide lockable hinged covers, all locks keyed alike unless otherwise indicated.
 - b. Back Panels: Painted steel, removable.
 - c. Terminal Blocks: Provide voltage/current ratings and terminal quantity suitable for purpose indicated, with 25 percent spare terminal capacity.
- 5. Finish for Painted Steel Enclosures: Manufacturer's standard grey unless otherwise indicated.
- D. Boxes for Hazardous (Classified) Locations: Listed and labeled as complying with UL 1203 for the classification of the installed location.
- E. Underground Boxes/Enclosures-handholes for exterior locations:
 - 1. Description: In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 - 2. Size: As indicated on drawings.
 - 3. Depth: As required to extend below frost line to prevent frost upheaval, but not less than 12 inches.
 - 4. Provide logo on cover to indicate type of service.
 - 5. Applications:
 - a. Sidewalks and Landscaped Areas Subject Only to Occasional Nondeliberate Vehicular Traffic: Use enclosure with minimum SCTE77 Tier 8 load rating.
 - b. Parking Lots, in Areas Subject To deliberate Vehicular Traffic: Use enclosures with minimum AASHTO H-20 load rating.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.

- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations:
 - 1. Unless dimensioned, box locations indicated are approximate.
 - 2. Locate boxes as required for devices installed under other sections or by others.
 - a. Switches, Receptacles, and Other Wiring Devices: Comply with Section 26 2726.
 - 3. Locate boxes so that wall plates do not span different building finishes.
 - 4. Locate boxes so that wall plates do not cross masonry joints.
 - 5. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 6. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches horizontal separation unless otherwise indicated.
 - 7. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 26 0533.13.
- I. Box Supports:
 - 1. Secure and support boxes in accordance with NFPA 70 and Section 26 0529 using suitable supports and methods approved by the authority having jurisdiction.
 - 2. Provide required seismic controls in accordance with Section 26 0548.
 - 3. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 - 4. Installation Above Suspended Ceilings: Do not provide support from ceiling grid or ceiling support system.
 - 5. Use far-side support to secure flush-mounted boxes supported from single stud in hollow stud walls. Repair or replace supports for boxes that permit excessive movement.

- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes:
 - 1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch or does not project beyond finished surface.
 - 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 - 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch at the edge of the box.
- L. Floor-Mounted Cabinets: Mount on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
- M. Install boxes as required to preserve insulation integrity.
- N. Underground Boxes/Enclosures:
 - 1. Install enclosure on gravel base, minimum 8 inches deep.
 - 2. Flush-mount enclosures located in concrete or paved areas.
 - 3. Mount enclosures located in landscaped areas with top at 1 inch above finished grade.
 - 4. Provide cast-in-place concrete collar constructed in accordance with Section 03 3000, minimum 10 inches wide by 6 inches deep, around enclosures that are not located in concrete areas.
 - 5. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
- O. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- P. Close unused box openings.
- Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
- R. Provide grounding and bonding in accordance with Section 26 0526.
- S. Identify boxes in accordance with Section 26 0553.

3.3 CLEANING

- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.

3.4 PROTECTION

- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 26 0548 - VIBRATION AND SEISMIC CONTROLS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Seismic control requirements.
 - 1. Includes requirements for seismic qualification of equipment not specified in this section.
- B. Seismic restraint systems.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.

1.3 DEFINITIONS

- A. Electrical Component: Where referenced in this section in regards to seismic controls, applies to any portion of the electrical system subject to seismic evaluation in accordance with applicable codes, including distributed systems (e.g. conduit, cable tray).
- B. Seismic Restraint: Structural members or assemblies of members or manufactured elements specifically designed and applied for transmitting seismic forces between components and the seismic force-resisting system of the structure.

1.4 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads and Associated Criteria for Buildings and Other Structures Most Recent Edition Cited by Referring Code or Reference Standard.
- B. ASCE 19 - Structural Applications of Steel Cables for Buildings 2016.
- C. ASHRAE (HVACA) - ASHRAE Handbook - HVAC Applications Most Recent Edition Cited by Referring Code or Reference Standard.
- D. ASTM E580/E580M - Standard Practice for Installation of Ceiling Suspension Systems for Acoustical Tile and Lay-in Panels in Areas Subject to Earthquake Ground Motions 2020.
- E. FEMA 413 - Installing Seismic Restraints for Electrical Equipment 2004.
- F. FEMA E-74 - Reducing the Risks of Nonstructural Earthquake Damage 2012.
- G. MFMA-4 - Metal Framing Standards Publication 2004.
- H. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- I. SMACNA (SRM) - Seismic Restraint Manual Guidelines for Mechanical Systems 2008.
- J. NFPA 70 National Electrical Code, 2014 Edition.

K. ICC (IBC)-International Building Code; 2015.

1.5 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate selection and arrangement of seismic control components with the actual equipment to be installed.
2. Coordinate the work with other trades to provide additional framing and materials required for installation.
3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.
4. Seismic Controls:
 - a. Coordinate the arrangement of seismic restraints with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - b. Coordinate the work with other trades to accommodate relative positioning of essential and non-essential components in consideration of seismic interaction.
5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

B. Sequencing:

1. Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with Section 03 3000.

1.6 SUBMITTALS

A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

B. Design Documents: Prepare and submit all information required for plan review and permitting by authorities having jurisdiction, including but not limited to floor plans, details, and calculations.

C. Product Data: Provide manufacturer's standard catalog pages and data sheets for products, including materials, fabrication details, dimensions, and finishes.

1. Seismic Controls: Include seismic load capacities.

D. Shop Drawings - Seismic Controls:

1. Include dimensioned plan views and sections indicating proposed electrical component locations and distributed system routing, with locations and details of gravity supports and seismic restraints and associated attachments.
2. Identify mounting conditions required for equipment seismic qualification.

3. Identify anchor manufacturer, type, minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
4. Indicate proposed arrangement of distributed system trapeze support groupings.
5. Indicate proposed locations for distributed system flexible fittings and/or connections.
6. Indicate locations of seismic separations where applicable.
7. Include point load drawings indicating design loads transmitted to structure at each attachment location.

E. Seismic Design Data:

1. Compile information on project-specific characteristics of actual installed electrical components necessary for determining seismic design forces required to design appropriate seismic controls, including but not limited to the following.
 - a. Component operating weight and center of gravity.
 - b. Component elevation in the building in relation to the roof elevation (z/h).
 - c. Component importance factor (I_p).
 - d. For distributed systems, component materials and connection methods.
 - e. Component amplification factor (a_p) and component response modification factor (R_p), determined in accordance with ASCE 7 tables.
 - f. Applicability of overstrength factor (for certain anchorage in concrete and masonry).
2. Include structural calculations, stamped or sealed by seismic controls designer, demonstrating suitability of seismic controls for seismic design forces.

F. Evaluation Reports: For products specified as requiring evaluation and recognition by a qualified evaluation service, provide current evaluation reports.

G. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.7 QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with ICC (IBC).
- C. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.1 SEISMIC CONTROL REQUIREMENTS

- A. Design and provide electrical component restraints, supports, and attachments suitable for seismic loads determined in accordance with applicable codes, as well as gravity and operating loads and other structural design considerations of the installed location. Consider wind loads for outdoor electrical components.
- B. Seismic Design Criteria: ICC (IBC).
 - 1. Seismic Design Category: C.
- C. Component Importance Factor (Ip): Electrical components essential to life safety to be assigned a component importance factor (Ip) of 1.5 as indicated or as required. This includes but is not limited to:
 - 1. Electrical components required to function for life safety purposes after an earthquake.
 - 2. Electrical components that support or otherwise contain hazardous substances.
- D. Seismic Restraints:
 - 1. Provide seismic restraints for electrical components except where exempt according to applicable codes and specified seismic design criteria, as approved by authorities having jurisdiction.
 - 2. Seismic Restraint Exemptions:
 - a. Exemptions for Seismic Design Category C:
 - 1) Electrical components with component importance factor (Ip) of 1.0.
 - b. Raceway Exemptions, All Seismic Design Categories:
 - 1) Conduits less than 2-1/2 inch trade size.
 - 2) Trapeze supported raceways weighing less than 10 pounds per foot.
 - 3) Hanger supported raceways where each hanger in the raceway run is 12 inches or less in length from the raceway support to the supporting structure; rod hangers, where used, to be equipped with swivels.
 - c. Lighting Exemptions, All Seismic Design Categories:
 - 1) Suspended luminaires where attachments are designed to accommodate 1.4 times the operating weight acting in both the vertical and horizontal directions and connections to structure allow for 360 degree range of motion in the horizontal plane; arrange to prevent impact between luminaires and the

structure or other nonstructural components.

- 2) Lay-in luminaires weighing less than 56 pounds secured to ceiling grid and provided with safety wires in accordance with ASTM E580/E580M.
3. Comply with applicable general recommendations of the following, where not in conflict with applicable codes, seismic design criteria, or other specified requirements:
 - a. ASHRAE (HVACA).
 - b. FEMA 413.
 - c. FEMA E-74.
 - d. SMACNA (SRM).
4. Seismic restraint capacities to be verified by a Nationally Recognized Testing Laboratory (NRTL) or certified by an independent third party registered professional engineer acceptable to authorities having jurisdiction.
5. Seismic Restraint Systems:
 - a. Except where otherwise restricted, use of either cable or rigid restraints is permitted.
 - b. Use only cable restraints to restrain vibration-isolated electrical components, including distributed systems.
 - c. Use only one restraint system type for a given electrical component or distributed system (e.g. conduit, cable tray) run; mixing of cable and rigid restraints on a given component/run is not permitted.
 - d. Size restraint elements, including anchorage, to resist seismic loads as necessary to restrain electrical component in all lateral directions; consider bracket geometry in anchor load calculations.
 - e. Use rod stiffener clips to attach bracing to hanger rods as required to prevent rod buckling from vertical (upward) compressive load introduced by cable or rigid restraints loaded in tension, in excess of downward tensile load due to supported electrical component weight.
 - f. Select hanger rods and associated anchorage as required to accommodate vertical (downward) tensile load introduced by rigid restraints loaded in compression, in addition to downward tensile load due to supported electrical component weight.
 - g. Clevis hangers may only be used for attachment of transverse restraints; do not use for attachment of longitudinal restraints.
 - h. Where seismic restraints are attached to clevis hangers, provide clevis bolt reinforcement accessory to prevent clevis hanger deformation.

- i. Do not introduce lateral loads on open bar joist chords or the weak axis of beams or loads in any direction at other than panel points unless approved by project Structural Engineer of Record.

E. Seismic Attachments:

1. Attachments to be bolted, welded, or otherwise positively fastened without consideration of frictional resistance produced by the effects of gravity.
2. Post-Installed Concrete and Masonry Anchors: Evaluated and recognized by ICC Evaluation Service, LLC (ICC-ES) or qualified evaluation service acceptable to authorities having jurisdiction for compliance with applicable building code, and qualified for seismic applications; concrete anchors to be qualified for installation in both cracked and uncracked concrete.
3. Do not use power-actuated fasteners.
4. Do not use friction clips (devices that rely on mechanically applied friction to resist loads). Beam clamps may be used for supporting sustained loads where provided with restraining straps.
5. Comply with anchor minimum embedment, minimum spacing, minimum member thickness, and minimum edge distance requirements.
6. Concrete Housekeeping Pads:
 - a. Increase size of pad as required to comply with anchor requirements.
 - b. Provide pad reinforcement and doweling to ensure integrity of pad and connection and to provide adequate load path from pad to supporting structure.

F. Seismic Interactions:

1. Include provisions to prevent seismic impact between electrical components and other structural or nonstructural components.
2. Include provisions such that failure of a component, either essential or nonessential, does not cause the failure of an essential component.

G. Seismic Relative Displacement Provisions:

1. Use suitable fittings or flexible connections to accommodate:
 - a. Relative displacements at connections between components, including distributed systems (e.g. conduit, cable tray); do not exceed load limits for equipment utility connections.
 - b. Relative displacements between component supports attached to dissimilar parts of structure that may move differently during an earthquake.
 - c. Design displacements at seismic separations.

- d. Anticipated drifts between floors.

2.2 SEISMIC RESTRAINT SYSTEMS

- A. Description: System components and accessories specifically designed for field assembly and attachment of seismic restraints.
- B. Cable Restraints:
 - 1. Comply with ASCE 19.
 - 2. Cables: Pre-stretched, galvanized steel wire rope with certified break strength.
 - 3. Cable Connections: Use only swaged end fittings. Cable clips and wedge type end fittings are not permitted in accordance with ASCE 19.
 - 4. Use protective thimbles for cable loops where potential for cable damage exists.
- C. Rigid Restraints: Use MFMA-4 steel channel (strut), steel angle, or steel pipe for structural element; suitable for both compressive and tensile design loads.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as shown on the drawings.
- B. Verify that mounting surfaces are ready to receive seismic control components and associated attachments.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.2 CODE-REQUIRED SPECIAL INSPECTIONS

- A. Arrange work to accommodate tests and/or inspections performed by Special Inspection Agency employed by Owner or Architect/Engineer in accordance with Section 01 4533 and statement of special inspections as required by applicable building code.
- B. Frequency of Special Inspections: Where special inspections are designated as continuous or periodic, arrange work accordingly.
 - 1. Continuous Special Inspections: Special Inspection Agency to be present in the area where the work is being performed and observe the work at all times the work is in progress.
 - 2. Periodic Special Inspections: Special Inspection Agency to be present in the area where work is being performed and observe the work part-time or intermittently and at the completion of the work.
- C. Seismic special inspections include, but are not limited to:

1. Seismically Qualified Equipment: Verification that label, anchorage and mounting comply with certificate of compliance.
 2. Anchorage of electric equipment for emergency and standby power systems for Seismic Design Categories C; periodic inspection.
- D. Prior to starting work, Contractor to submit written statement of responsibility to authorities having jurisdiction and to Owner acknowledging awareness of special requirements contained in the statement of special inspections.
- E. Special Inspection Agency services do not relieve Contractor from performing inspections and testing specified elsewhere.

3.3 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install products in accordance with applicable requirements of NECA 1 (general workmanship).
- C. Install anchors and fasteners in accordance with ICC Evaluation Services, LLC (ICC-ES) evaluation report conditions of use where applicable.
- D. Secure fasteners according to manufacturer's recommended torque settings.
- E. Install flexible conduit and cable connections to provide sufficient slack for seismic relative displacements as indicated or as required.
- F. Seismic Controls:
1. Provide specified snubbing element air gap; remove any factory-installed spacers, debris or other obstructions.
 2. Use only specified components, anchorage, and hardware evaluated by seismic design. Comply with conditions of seismic certification where applicable.
 3. Where mounting hole diameter exceeds bolt diameter by more than 0.125 inch, use epoxy grout, elastomeric grommet, or welded washer to reduce clearance to 0.125 inch or less.
 4. Equipment with Sheet Metal Housings:
 - a. Use Belleville washers to distribute stress over a larger surface area of the sheet metal connection interface as approved by manufacturer.
 - b. Attach additional steel as approved by manufacturer where required to transfer loads to structure.
 - c. Where mounting surface is irregular, do not shim housing; reinforce housing with additional steel as approved by manufacturer.
 5. Concrete Housekeeping Pads:

- a. Size in accordance with seismic design to meet anchor requirements.
 - b. Install pad reinforcement and doweling in accordance with seismic design to ensure integrity of pad and associated connection to slab.
6. Seismic Restraint Systems:
- a. Do not attach seismic restraints and gravity supports to dissimilar parts of structure that may move differently during an earthquake.
 - b. Install restraints within permissible angles in accordance with seismic design.
 - c. Install cable restraints straight between component/run and structural attachment; do not bend around other nonstructural components or structural elements.
 - d. Install hanger rod stiffeners where indicated using only specified clamps; do not weld stiffeners to hanger rod.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect seismic control components for damage and defects.
- C. Seismic Controls:
 - 1. Verify snubbing element air gaps.
- D. Correct deficiencies and replace damaged or defective seismic control components.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

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SECTION 26 0553 - IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- B. Section 26 0526 Grounding and Bonding for Electrical Systems.
- C. Section 26 0573 - Power System Studies: Arc flash hazard warning labels.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs 2011 (Reaffirmed 2017).
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- C. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- D. UL 969 - Marking and Labeling Systems Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing:
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.

2. Do not install identification products until final surface finishes and painting are complete.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.6 FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.1 IDENTIFICATION REQUIREMENTS

- A. Existing Work: Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements.
- B. Identification for Equipment:
 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards:
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces.
 - 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Identify spares and spaces.
 - b. Transformers:
 - 1) Identify kVA rating.
 - 2) Identify voltage and phase for primary and secondary.
 - 3) Identify power source and circuit number. Include location.
 - 4) Identify load(s) served. Include location.

- c. Enclosed switches, circuit breakers, and motor controllers:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location.
 - 3) Identify load(s) served. Include location.
- d. Transfer Switches:
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location.
 - 3) Identify load(s) served. Include location.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
- 2. Service Equipment:
 - a. Use identification nameplate to identify each service disconnecting means.
- 3. Emergency System Equipment:
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.
 - b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
- 4. Use voltage marker to identify highest voltage present for each piece of electrical equipment.
- 5. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
- 6. Use identification label on inside of door at each fused switch to identify required NEMA fuse class and size.
- 7. Use identification label or identification nameplate on inside of door at each motor controller to identify nameplate horsepower, full load amperes, code letter, service factor, voltage, and phase of motor(s) controlled.
- 8. Use floor marking tape to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.

9. Available Fault Current Documentation: Use identification label to identify the available fault current and date calculations were performed at locations requiring documentation by NFPA 70 including but not limited to the following.
 - a. Service equipment.
 - b. Industrial control panels.
10. Arc Flash Hazard Warning Labels: Comply with Section 26 0573.
11. Use warning signs to identify electrical hazards for entrances to all rooms and other guarded locations that contain exposed live parts operating at 600 V nominal or less with the word message "DANGER; Electrical hazard; Authorized personnel only" or approved equivalent.
12. Use warning labels, identification nameplates, or identification labels to identify electrical hazards for equipment where multiple power sources are present with the word message "DANGER; Hazardous voltage; Multiple power sources may be present; Disconnect all electric power including remote disconnects before servicing" or approved equivalent.

C. Identification for Conductors and Cables:

1. Color Coding for Power Conductors 600 V and Less: Comply with Section 26 0519.
2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
4. Use wire and cable markers to identify connected grounding electrode system components for grounding electrode conductors.
5. Use underground warning tape to identify direct buried cables.

D. Identification for Raceways:

1. Use voltage markers to identify highest voltage present for accessible conduits at maximum intervals of 20 feet.

2. Use voltage markers or color-coded bands to identify systems other than normal power system for accessible conduits at maximum intervals of 20 feet.
 - a. Color-Coded Bands: Use vinyl color coding electrical tape to mark bands 3 inches wide.
 - 1) Color Code:
 - (a) Emergency Power System: Red.
 - 2) Vinyl Color Coding Electrical Tape: Comply with Section 26 0519.
 3. Use identification labels or plastic marker tags to identify circuits enclosed for accessible conduits at wall penetrations, at floor penetrations, at roof penetrations, and at equipment terminations when source is not within sight.
 4. Use identification labels or plastic marker tags to identify spare conduits at each end. Identify purpose and termination location.
 5. Use underground warning tape to identify underground raceways.
 6. Use voltage markers to identify highest voltage present for wireways at maximum intervals of 20 feet.
- E. Identification for Boxes:
1. Use voltage markers to identify highest voltage present.
 2. Use voltage markers to identify systems other than normal power system.
 3. Use identification labels to identify circuits enclosed.
- F. Identification for Devices:
1. Wiring Device and Wallplate Finishes: Comply with Section 26 2726.
 2. Use identification label or engraved wallplate to identify serving branch circuit for all receptacles.
 - a. For receptacles in all spaces, provide identification on inside surface of wallplate.
 3. Use identification label or engraved wallplate to identify load controlled for wall-mounted control devices controlling loads that are not visible from the control location and for multiple wall-mounted control devices installed at one location.
 4. Use identification label to identify receptacles protected by upstream GFI protection, where permitted.
- G. Identification for Ground Bars:
1. Use conductor label to identify each ground conductor connected to the ground bar. Identify equipment served on ground conductor.

2.2 IDENTIFICATION NAMEPLATES AND LABELS

A. Identification Nameplates:

1. Materials:
 - a. Indoor Clean, Dry Locations: Use plastic nameplates.
 - b. Outdoor Locations: Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
2. Plastic Nameplates: Two-layer or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch; engraved text.
 - a. Exception: Provide minimum thickness of 1/8 inch when any dimension is greater than 4 inches.
3. Stainless Steel Nameplates: Minimum thickness of 1/32 inch; engraved or laser-etched text.
4. Aluminum Nameplates: Anodized; minimum thickness of 1/32 inch; engraved or laser-etched text.
5. Mounting Holes for Mechanical Fasteners: Two, centered on sides for sizes up to 1 inch high; Four, located at corners for larger sizes.

B. Identification Labels:

1. Materials: Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.
2. Text: Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.

C. Format for Equipment Identification:

1. Minimum Size: 1 inch by 2.5 inches.
2. Legend:
 - a. System designation where applicable:
 - 1) Emergency Power System: Identify with text "EMERGENCY".
 - b. Equipment designation or other approved description.
 - c. Other information as indicated.
3. Text: All capitalized unless otherwise indicated.

4. Minimum Text Height:
 - a. System Designation: 1 inch.
 - b. Equipment Designation: 1/2 inch.
 - c. Other Information: 1/4 inch.
 - d. Exception: Provide minimum text height of 1 inch for equipment located more than 10 feet above floor or working platform.
 5. Color:
 - a. Normal Power System: White text on black background.
 - b. Emergency Power System: White text on red background.
- D. Format for General Information and Operating Instructions:
1. Minimum Size: 1 inch by 2.5 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/4 inch.
 5. Color: Black text on white background unless otherwise indicated.
 - a. Exceptions:
 - 1) Provide white text on red background for general information or operational instructions for emergency systems.
- E. Format for Caution and Warning Messages:
1. Minimum Size: 2 inches by 4 inches.
 2. Legend: Include information or instructions indicated or as required for proper and safe operation and maintenance.
 3. Text: All capitalized unless otherwise indicated.
 4. Minimum Text Height: 1/2 inch.
 5. Color: Black text on yellow background unless otherwise indicated.
- F. Format for Receptacle Identification:
1. Minimum Size: 3/8 inch by 1.5 inches.
 2. Legend: Power source and circuit number or other designation indicated.

- a. Include voltage and phase for other than 120 V, single phase circuits.
- 3. Text: All capitalized unless otherwise indicated.
- 4. Minimum Text Height: 3/16 inch.
- 5. Color: Black text on clear background.
- G. Format for Control Device Identification:
 - 1. Minimum Size: 3/8 inch by 1.5 inches.
 - 2. Legend: Load controlled or other designation indicated.
 - 3. Text: All capitalized unless otherwise indicated.
 - 4. Minimum Text Height: 3/16 inch.
 - 5. Color: Black text on clear background.

2.3 WIRE AND CABLE MARKERS

- A. Markers for Conductors and Cables: Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
- B. Markers for Conductor and Cable Bundles: Use plastic marker tags secured by nylon cable ties.
- C. Legend: Power source and circuit number or other designation indicated.
- D. Text: Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
 - 1. Do not use handwritten text.
- E. Minimum Text Height: 1/8 inch.
- F. Color: Black text on white background unless otherwise indicated.

2.4 VOLTAGE MARKERS

- A. Markers for Conduits: Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
- B. Markers for Boxes and Equipment Enclosures: Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
- C. Minimum Size:
 - 1. Markers for Equipment: 1 1/8 by 4 1/2 inches.

2. Markers for Conduits: As recommended by manufacturer for conduit size to be identified.
 3. Markers for Pull Boxes: 1 1/8 by 4 1/2 inches.
 4. Markers for Junction Boxes: 1/2 by 2 1/4 inches.
- D. Legend:
1. Markers for Voltage Identification: Highest voltage present.
 2. Markers for System Identification:
 - a. Emergency Power System: Text "EMERGENCY".
 - b. Other Systems: Type of service.
- E. Color: Black text on orange background unless otherwise indicated.

2.5 UNDERGROUND WARNING TAPE

- A. Materials: Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape: 3 inches wide, with minimum thickness of 5 mil, unless otherwise required for proper detection.
- C. Legend: Type of service, continuously repeated over full length of tape.
- D. Color:
 1. Tape for Buried Power Lines: Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines: Black text on orange background.

2.6 FLOOR MARKING TAPE

- A. Floor Marking Tape for Equipment Working Clearance Identification: Self-adhesive vinyl or polyester tape with overlamine, 3 inches wide, with alternating black and white stripes.

2.7 WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs:
 1. Materials:
 - a. Indoor Dry, Clean Locations: Use factory pre-printed rigid plastic or self-adhesive vinyl signs.

- b. Outdoor Locations: Use factory pre-printed rigid aluminum signs.
- 2. Rigid Signs: Provide four mounting holes at corners for mechanical fasteners.
- 3. Minimum Size: 7 by 10 inches unless otherwise indicated.
- C. Warning Labels:
 - 1. Materials: Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
 - a. Do not use labels designed to be completed using handwritten text.
 - 2. Machine-Printed Labels: Use thermal transfer process printing machines and accessories recommended by label manufacturer.
 - 3. Minimum Size: 2 by 4 inches unless otherwise indicated.

PART 3 EXECUTION

3.1 PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
 - 1. Surface-Mounted Equipment: Enclosure front.
 - 2. Flush-Mounted Equipment: Inside of equipment door.
 - 3. Free-Standing Equipment: Enclosure front; also enclosure rear for equipment with rear access.
 - 4. Elevated Equipment: Legible from the floor or working platform.
 - 5. Branch Devices: Adjacent to device.
 - 6. Interior Components: Legible from the point of access.
 - 7. Conduits: Legible from the floor.
 - 8. Boxes: Outside face of cover.
 - 9. Conductors and Cables: Legible from the point of access.
 - 10. Devices: Outside face of cover.

- C. Install identification products centered, level, and parallel with lines of item being identified.
- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
 - 1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 4 inch(es) below finished grade.
- G. Secure rigid signs using stainless steel screws.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

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SECTION 26 0573 - POWER SYSTEM STUDIES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Protective device coordination study.
- B. Arc flash and shock risk assessment.
 - 1. Includes arc flash hazard warning labels.
- C. Criteria for the selection and adjustment of equipment and associated protective devices not specified in this section, as determined by studies to be performed.

1.2 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Additional requirements for arc flash hazard warning labels.

1.3 REFERENCE STANDARDS

- A. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels 2011 (Reaffirmed 2017).
- B. IEEE 242 - IEEE Recommended Practice for Protection and Coordination of Industrial and Commercial Power Systems 2001, with Errata (2003).
- C. IEEE 399 - IEEE Recommended Practice for Industrial and Commercial Power Systems Analysis 1997.
- D. IEEE 1584 - IEEE Guide for Performing Arc-Flash Hazard Calculations 2018, with Errata (2019).
- E. NEMA MG 1 - Motors and Generators 2018.
- F. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- G. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- H. NFPA 70E - Standard for Electrical Safety in the Workplace 2021.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Existing Installations: Coordinate with equipment manufacturer(s) to obtain data necessary for completion of studies.
 - 2. Coordinate the work to provide equipment and associated protective devices complying with criteria for selection and adjustment, as determined by studies to be performed.

3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
- B. Sequencing:
1. Submit study reports prior to or concurrent with product submittals.
 2. **Do not order equipment until matching study reports and product submittals have both been evaluated by Architect/Engineer.**
 3. Verify naming convention for equipment identification prior to creation of final drawings, reports, and arc flash hazard warning labels (where applicable).
- C. Scheduling:
1. Arrange access to existing facility for data collection with Owner.
 2. Where work of this section involves interruption of existing electrical service, arrange service interruption with Owner.

1.5 SUBMITTALS

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.
- B. Study preparer's qualifications.
- C. Study reports, stamped or sealed and signed by study preparer.
- D. Product Data: In addition to submittal requirements specified in other sections, include manufacturer's standard catalog pages and data sheets for equipment and protective devices indicating information relevant to studies.
1. Include characteristic time-current trip curves for protective devices.
 2. Include impedance data for engine generators.
 3. Identify modifications made in accordance with studies that:
 - a. Can be made at no additional cost to Owner.
 - b. As submitted will involve a change to the contract sum.
- E. Project Record Documents: Revise studies as required to reflect as-built conditions.
1. Include hard copies with operation and maintenance data submittals.
 2. Include computer software files used to prepare studies with file name(s) cross-referenced to specific pieces of equipment and systems.

1.6 POWER SYSTEM STUDIES

- A. Scope of Studies:

1. Perform analysis of both new and existing portions of electrical distribution system.
 2. Except where study descriptions below indicate exclusions, analyze system at each bus from primary protective devices of utility source down to each piece of equipment involved, including parts of system affecting calculations being performed (e.g. fault current contribution from motors).
 3. Include in analysis alternate sources and operating modes (including known future configurations) to determine worst case conditions.
 - a. Known Operating Modes:
 - 1) Utility as source.
 - 2) Generator as source.
- B. General Study Requirements:
1. Comply with NFPA 70.
 2. Perform studies utilizing computer software complying with specified requirements; manual calculations are not permitted.
- C. Data Collection:
1. Compile information on project-specific characteristics of actual installed equipment, protective devices, feeders, etc. as necessary to develop single-line diagram of electrical distribution system and associated input data for use in system modeling.
 - a. Utility Source Data: Include primary voltage, maximum and minimum three-phase and line-to-ground fault currents, impedance, X/R ratio, and primary protective device information.
 - 1) Obtain up-to-date information from Utility Company.
 - b. Generators: Include manufacturer/model, kW and voltage ratings, and impedance.
 - c. Motors: Include manufacturer/model, type (e.g. induction, synchronous), horsepower rating, voltage rating, full load amps, and locked rotor current or NEMA MG 1 code letter designation.
 - d. Transformers: Include primary and secondary voltage ratings, kVA rating, winding configuration, percent impedance, and X/R ratio.
 - e. Protective Devices:
 - 1) Circuit Breakers: Include manufacturer/model, type (e.g. thermal magnetic, electronic trip), frame size, trip rating, voltage rating, interrupting rating, available field-adjustable trip response settings, and features (e.g. zone selective interlocking).

- 2) Fuses: Include manufacturer/model, type/class (e.g. Class J), size/rating, and speed (e.g. time delay, fast acting).
 - f. Protective Relays: Include manufacturer/model, type, settings, current/potential transformer ratio, and associated protective device.
 - g. Conductors: Include feeder size, material (e.g. copper, aluminum), insulation type, voltage rating, number per phase, raceway type, and actual length.
- 2. Existing Installations:
 - a. Collect data on existing electrical distribution system necessary for completion of studies, including field verification of available existing data (e.g. construction documents, previous studies). Include actual settings for field-adjustable devices.
- D. Protective Device Coordination Study:
 - 1. Comply with applicable portions of IEEE 242 and IEEE 399.
 - 2. Analyze alternate scenarios considering known operating modes (e.g. utility as source, generator as source).
 - 3. Analyze protective devices and associated settings for suitable margins between time-current curves to achieve full selective coordination while providing adequate protection for equipment and conductors.
- E. Arc Flash and Shock Risk Assessment:
 - 1. Comply with NFPA 70E.
 - 2. Perform incident energy and arc flash boundary calculations in accordance with IEEE 1584 (as referenced in NFPA 70E Annex D), where applicable.
 - a. Where reasonable, study preparer may assume a maximum clearing time of two seconds in accordance with IEEE 1584, provided that the conditions are such that a worker's egress from an arc flash event would not be inhibited.
 - 3. Analyze alternate scenarios considering conditions that may result in maximum incident energy, including but not limited to:
 - a. Maximum and minimum utility fault currents.
 - b. Maximum and minimum motor contribution.
 - c. Known operating modes (e.g. utility as source, generator as source, utility/generator in parallel, bus tie breaker open/close positions).
- F. Study Reports:
 - 1. General Requirements:
 - a. Identify date of study and study preparer.

- b. Identify study methodology and software product(s) used.
 - c. Identify scope of studies, assumptions made, implications of possible alternate scenarios, and any exclusions from studies.
 - d. Identify base used for per unit values.
 - e. Include single-line diagram and associated input data used for studies; identify buses on single-line diagram as referenced in reports, and indicate bus voltage.
 - f. Include conclusions and recommendations.
2. Protective Device Coordination Study:
- a. For each scenario, include time-current coordination curves plotted on log-log scale graphs.
 - b. For each graph include (where applicable):
 - 1) Partial single-line diagram identifying the portion of the system illustrated.
 - 2) Protective Devices: Time-current curves with applicable tolerance bands for each protective device in series back to the source, plotted up to the maximum available fault current at the associated bus.
 - 3) Conductors: Damage curves.
 - 4) Transformers: Inrush points and damage curves.
 - 5) Generators: Full load current, overload curves, decrement curves, and short circuit withstand points.
 - 6) Motors: Full load current, starting curves, and damage curves.
 - 7) Capacitors: Full load current and damage curves.
 - c. For each protective device, identify fixed and adjustable characteristics with available ranges and recommended settings.
 - 1) Circuit Breakers: Include long time pickup and delay, short time pickup and delay, and instantaneous pickup.
 - 2) Include ground fault pickup and delay.
 - 3) Include fuse ratings.
 - 4) Protective Relays: Include current/potential transformer ratios, tap, time dial, and instantaneous pickup.
 - d. Identify cases where either full selective coordination or adequate protection is not achieved, along with recommendations.

3. Arc Flash and Shock Risk Assessment:
 - a. For each scenario, identify at each bus location:
 - 1) Calculated incident energy and associated working distance.
 - 2) Calculated arc flash boundary.
 - 3) Bolted fault current.
 - 4) Arcing fault current.
 - 5) Clearing time.
 - 6) Arc gap distance.
 - b. For purposes of producing arc flash hazard warning labels, summarize the maximum incident energy and associated data reflecting the worst case condition of all scenarios at each bus location.
 - c. Include recommendations for reducing the incident energy at locations where the calculated maximum incident energy exceeds 8 calories per sq cm.

1.7 QUALITY ASSURANCE

- A. Study Preparer Qualifications: Professional electrical engineer licensed in the State in which the Project is located and with minimum five years' experience in the preparation of studies of similar type and complexity using specified computer software.
 1. Study preparer may be employed by the manufacturer of the electrical distribution equipment.
- B. Field Testing Agency Qualifications: Independent testing organization specializing in testing, analysis, and maintenance of electrical systems with minimum five years' experience; NETA Accredited Company.
 1. Field Supervisor: Certified electrical testing technician; NETA ETT Level III.
 2. Acceptable Testing Agencies:
- C. Computer Software for Study Preparation: Use the latest edition of commercially available software utilizing specified methodologies.

PART 2 PRODUCTS

2.1 ARC FLASH HAZARD WARNING LABELS

- A. Provide warning labels complying with ANSI Z535.4 to identify arc flash hazards for each work location analyzed by the arc flash and shock risk assessment.
 1. Materials: Comply with Section 26 0553.

2. Minimum Size: 4 by 6 inches.
3. Legend: Provide custom legend in accordance with NFPA 70E based on equipment-specific data as determined by arc flash and shock risk assessment.
 - a. Include orange header that reads "WARNING" where calculated incident energy is less than 40 calories per square cm.
 - b. Include red header that reads "DANGER" where calculated incident energy is 40 calories per square cm or greater.
 - c. Include the text "Arc Flash and Shock Hazard; Appropriate PPE Required" or approved equivalent.
 - d. Include the following information:
 - 1) Arc flash boundary.
 - 2) Available incident energy and corresponding working distance.
 - 3) Site-specific PPE (personnel protective equipment) requirements.
 - 4) Nominal system voltage.
 - 5) Limited approach boundary.
 - 6) Restricted approach boundary.
 - 7) Equipment identification.
 - 8) Date calculations were performed.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install arc flash warning labels in accordance with Section 26 0553.

3.2 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Adjust equipment and protective devices for compliance with studies and recommended settings.
- D. Notify Architect/Engineer of any conflicts with or deviations from studies. Obtain direction before proceeding.
- E. Submit detailed reports indicating inspection and testing results, and final adjusted settings.

3.3 CLOSEOUT ACTIVITIES

- A. See Section 01 7900 - Demonstration and Training, for additional requirements.
- B. Training: Include as part of the base bid training for Owner's personnel on electrical safety pertaining to arc flash and shock hazards.
 - 1. Use site-specific arc flash and shock risk assessment report as training reference, supplemented with additional training materials as required.

END OF SECTION



PROJECT MANUAL

VOLUME II OF II

Town of Richlands – 4.0 MGD WWTP Upgrades and Improvements Richlands, Virginia

Prepared for
Town of Richlands

T&L Project No. 14249
VCWRLF Project No. C-515667
Issued for Bids January 7, 2022



**THOMPSON
& LITTON** EST.
1956

PROJECT MANUAL

Town of Richlands - 4.0 MGD WWTP Upgrades and Improvements Richlands, Virginia

Prepared For
Town of Richlands

With Financial Assistance From

Department of Environmental Quality
Virginia Clean Water Revolving Fund (VCWRLF)

McGill Associates Note:

Project scope has been reduced from original design. Inapplicable specification sections and addenda have been omitted and inapplicable items have been crossed out in red strikethrough text to reflect the reduced scope.



This document and the ideas and designs incorporated herein, as an instrument of professional service, is the property of Thompson & Litton and is not to be used in whole or in part for any other project without the written authorization of Thompson & Litton.



THOMPSON & LITTON

103 East Main Street
P.O. Box 1307
Wise, Virginia 24293

T&L Project No. 14249
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APPENDICES

~~Appendix A: Geotechnical Data~~
Appendix B: Permits

SECTION 26 0583 - WIRING CONNECTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Electrical connections to equipment.

1.2 RELATED REQUIREMENTS

- A. Section 26 0519 - Low-Voltage Electrical Power Conductors and Cables.
- B. Section 26 0533.13 - Conduit for Electrical Systems.
- C. Section 26 0533.16 - Boxes for Electrical Systems.
- D. Section 26 2726 - Wiring Devices.
- E. Section 26 2816.16 - Enclosed Switches.

1.3 REFERENCE STANDARDS

- A. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2016.
- B. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing:
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.5 SUBMITTALS

McGill Section 013300

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.
- B. Product Data: Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.
- C. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Cords and Caps: NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors: Conform to NEMA WD 1.
 - 2. Cord Construction: NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size: Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches: As specified in Section 26 2816.16.
- C. Wiring Devices: As specified in Section 26 2726.
- D. Flexible Conduit: As specified in Section 26 0533.13.
- E. Wire and Cable: As specified in Section 26 0519.
- F. Boxes: As specified in Section 26 0533.16.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.2 ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.
- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.

- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

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SECTION 26 2200 - LOW-VOLTAGE TRANSFORMERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. General purpose transformers.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.13 - Conduit for Electrical Systems: Flexible conduit connections.
- E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- F. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. 10 CFR 431, Subpart K - Energy Efficiency Program for Certain Commercial and Industrial Equipment - Distribution Transformers Current Edition.
- B. IEEE C57.94 - IEEE Recommended Practice for Installation, Application, Operation, and Maintenance of Dry-Type Distribution and Power Transformers 2015.
- C. IEEE C57.96 - IEEE Standard Guide for Loading Dry-Type Distribution and Power Transformers 2013.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- E. NECA 409 - Standard for Installing and Maintaining Dry-Type Transformers 2015.
- F. NEMA ST 20 - Dry-Type Transformers for General Applications 2014.
- G. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- H. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- I. NFPA 70 - National Electrical Code; National Fire Protection Association; 2014.
- J. UL 506 - Standard for Specialty Transformers Current Edition, Including All Revisions.
- K. UL 1561 - Standard for Dry-Type General Purpose and Power Transformers Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Coordinate the work with placement of supports, anchors, etc. required for mounting.
4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. Product Data: Include voltage, kVA, impedance, tap configurations, insulation system class and rated temperature rise, efficiency, sound level, enclosure ratings, outline and support point dimensions, weight, required clearances, service condition requirements, and installed features.
- B. Shop Drawings: Provide dimensioned plan and elevation views of transformers and adjacent equipment with all required clearances indicated.
 1. Identify mounting conditions required for equipment seismic qualification.
- C. Manufacturer's equipment seismic qualification certification.
- D. Maintenance Data: Include recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to transformer internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Ambient Temperature: Do not exceed the following maximum temperatures during and after installation of transformers.
 - 1. Greater than 10 kVA: 104 degrees F maximum.
 - 2. Less than 10 kVA: 77 degrees F maximum.

1.9 WARRANTY

McGill Section 017700

- A. See ~~Section 01 7800 - Closeout Submittals~~, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish transformers produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 TRANSFORMERS - GENERAL REQUIREMENTS

- A. Description: Factory-assembled, dry type transformers for 60 Hz operation designed and manufactured in accordance with NEMA ST 20 and listed, classified, and labeled as suitable for the purpose intended.
- B. Seismic Qualification: Provide transformers suitable for application under seismic design criteria in accordance with Section 26 0548 where required. Include certification of compliance with submittals.
- C. Unless noted otherwise, transformer ratings indicated are for continuous loading according to IEEE C57.96 under the following service conditions:
 - 1. Altitude: Less than 3,300 feet.
 - 2. Ambient Temperature:
 - a. Greater than 10 kVA: Not exceeding 104 degrees F.
 - b. Less than 10 kVA: Not exceeding 77 degrees F.
- D. Core: High grade, non-aging silicon steel with high magnetic permeability and low hysteresis and eddy current losses. Keep magnetic flux densities substantially below saturation point, even at 10 percent primary overvoltage. Tightly clamp core laminations to prevent plate movement and maintain consistent pressure throughout core length.
- E. Impregnate core and coil assembly with non-hygroscopic thermo-setting varnish to effectively seal out moisture and other contaminants.
- F. Basic Impulse Level: 10 kV.
- G. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.

- H. Isolate core and coil from enclosure using vibration-absorbing mounts.
- I. Nameplate: Include transformer connection data, ratings, wiring diagrams, and overload capacity based on rated winding temperature rise.

2.3 GENERAL PURPOSE TRANSFORMERS

- A. Description: Self-cooled, two winding transformers listed and labeled as complying with UL 506 or UL 1561; ratings as indicated on the drawings.
- B. Primary Voltage: 480 volts delta, 3 phase.
- C. Secondary Voltage: 208Y/120 volts, 3 phase.
- D. Insulation System and Allowable Average Winding Temperature Rise:
 - 1. Less than 15 kVA: Class 180 degrees C insulation system with 115 degrees C average winding temperature rise.
 - 2. 15 kVA and Larger: Class 220 degrees C insulation system with 150 degrees C average winding temperature rise.
- E. Coil Conductors: Continuous aluminum windings with terminations brazed or welded.
- F. Winding Taps:
 - 1. Less than 3 kVA: None.
 - 2. 3 kVA through 15 kVA: Two 5 percent full capacity primary taps below rated voltage.
 - 3. 15 kVA through 300 kVA: Two 2.5 percent full capacity primary taps above and four 2.5 percent full capacity primary taps below rated voltage.
 - 4. 500 kVA and Larger: Two 2.5 percent full capacity primary taps above and two 2.5 percent full capacity primary taps below rated voltage.
- G. Energy Efficiency: Comply with 10 CFR 431, Subpart K.
- H. Sound Levels: Standard sound levels complying with NEMA ST 20
- I. Mounting Provisions:
 - 1. Less than 15 kVA: Suitable for wall mounting.
 - 2. 15 kVA through 75 kVA: Suitable for wall, floor, or trapeze mounting.
 - 3. Larger than 75 kVA: Suitable for floor mounting.
- J. Transformer Enclosure: Comply with NEMA ST 20.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:

- a. Indoor clean, dry locations: Type 2.
 - b. Outdoor locations: Type 3R.
 - c. Outdoor/Indoor Corrosive locations or where subject to Hose Down: NEMA 4X.
 - d. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
- 2. Construction: Steel.
 - a. Less than 15 kVA: Totally enclosed, non-ventilated.
 - b. 15 kVA and Larger: Ventilated.
- 3. Finish: Manufacturer's standard grey, suitable for outdoor installations.
- 4. Provide lifting eyes or brackets.
- K. Accessories:
 - 1. Mounting Brackets: Provide manufacturer's standard brackets.
 - 2. Weathershield Kits: Provide for ventilated transformers installed outdoors to provide a listed NEMA 250, type 3R assembly.
 - 3. Lug Kits: Sized as required for termination of conductors as indicated on the drawings.

2.4 SOURCE QUALITY CONTROL

- A. Factory test transformers according to NEMA ST 20.
- B. Sound Level Tests: Perform factory test designated in NEMA ST 20 as "design" test on each production unit.

PART 3 EXECUTION

- A. Mount wall-mounted transformers using integral flanges or accessory brackets furnished by the manufacturer.

3.2 EXAMINATION

- A. Mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
- B. Verify that field measurements are as indicated.
- C. Mount floor-mounted transformers using vibration isolators suitable for isolating the transformer noise from the building structure.
- D. Verify that suitable support frames and anchors are installed where required and that mounting surfaces are ready to receive transformers.

- E. Perform pre-installation tests and inspections on transformers per manufacturer's instructions and as specified in NECA 409. Correct deficiencies prior to installation.
- F. Mount trapeze-mounted transformers as indicated.
- G. Provide seismic restraints.
- H. Verify that conditions are satisfactory for installation prior to starting work.

3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install transformers in accordance with NECA 409 and IEEE C57.94.
- D. Use flexible conduit, under the provisions of Section 26 0533.13, 2 feet minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- E. Arrange equipment to provide minimum clearances as specified on transformer nameplate and in accordance with manufacturer's instructions and NFPA 70.
- F. Install transformers plumb and level.
- G. Transformer Support:
 - 1. Provide required support and attachment in accordance with Section 26 0529, where not furnished by transformer manufacturer.
 - 2. Provide required vibration isolation and/or seismic controls in accordance with Section 26 0548.
 - 3. Use integral transformer flanges, accessory brackets furnished by manufacturer, or field-fabricated supports to support wall-mounted transformers.
 - 4. Unless otherwise indicated, mount floor-mounted transformers on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.
 - 5. Use trapeze hangers assembled from threaded rods and metal channel (strut) to support suspended transformers. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Remove shipping braces and adjust bolts that attach the core and coil mounting bracket to the enclosure according to manufacturer's recommendations in order to reduce audible noise transmission.
- J. Where not factory-installed, install lugs sized as required for termination of conductors as indicated.

- K. Where furnished as a separate accessory, install transformer weathershield per manufacturer's instructions.
- L. Identify transformers in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Sections 7.2.1.1 and 7.2.1.2. Tests and inspections listed as optional are not required.

3.5 ADJUSTING

- A. Measure primary and secondary voltages and make appropriate tap adjustments.
- B. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.6 CLEANING

- A. Clean dirt and debris from transformer components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 2416 - PANELBOARDS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Power distribution panelboards.
- B. Lighting and appliance panelboards.
- C. Overcurrent protective devices for panelboards.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- F. Section 26 4300 - Surge Protective Devices.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e (Amended 2017).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards 2015.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- E. NEMA PB 1 - Panelboards 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less 2013.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- H. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.

- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- K. UL 67 - Panelboards Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.
- O. UL 1053 - Ground-Fault Sensing and Relaying Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted panelboards where indicated.
 - 4. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 5. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
 - 6. **Do not order equipment until matching power system study reports and product submittals have both been evaluated by Architect/Engineer.**

1.5 SUBMITTALS

McGill Section 013300

- A. See ~~Section 01 3000 – Administrative Requirements~~, for submittal procedures.
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.

2. Identify mounting conditions required for equipment seismic qualification.
- D. Manufacturer's equipment seismic qualification certification.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See ~~Section 01 6000 – Product Requirements~~, for additional provisions.
McGill Section 017823.
 2. Panelboard Keys: Two of each different key.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 1. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature:
 - a. Panelboards Containing Circuit Breakers: Between 23 degrees F and 104 degrees F.
- D. Short Circuit Current Rating:
 - 1. Provide panelboards with listed short circuit current rating as indicated on the drawings.
- E. Panelboards Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- F. Mains: Configure for top or bottom incoming feed as indicated or as required for the installation.
- G. Branch Overcurrent Protective Devices: Replaceable without disturbing adjacent devices. Full size breaker width to be provided.
- H. Bussing: Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
- J. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - c. Outdoor/Indoor Corrosive Locations or where subject to Hose Down: Type 4X.
 - d. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.

2. Boxes: Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - b. Increase gutter space as required where sub-feed lugs, feed-through lugs, gutter taps, or oversized lugs are provided.
 - c. Provide removable end walls for NEMA Type 1 enclosures.
 - d. Provide painted steel boxes for surface-mounted panelboards where indicated, finish to match fronts.
3. Fronts:
 - a. Fronts for Surface-Mounted Enclosures: Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures: Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts: Manufacturer's standard grey unless otherwise indicated.
4. Lockable Doors: All locks keyed alike unless otherwise indicated.
- K. Future Provisions: Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- L. Surge Protective Devices: Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 26 4300, list and label panelboards as a complete assembly including surge protective device.
- M. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 2. Where accessory ground fault sensing and relaying equipment is used, equip companion overcurrent protective devices with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
- N. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- O. Multi-Section Panelboards: Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- P. Load centers are not acceptable.

Q. Provide the following features and accessories where indicated or where required to complete installation:

1. Feed-through lugs.
2. Sub-feed lugs.

2.3 POWER DISTRIBUTION PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:
1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase and Neutral Bus Material: Aluminum.
 2. Ground Bus Material: Aluminum.
- D. Circuit Breakers:
1. Provide bolt-on type.
 2. Provide thermal magnetic circuit breakers unless otherwise indicated.
 3. Provide electronic trip circuit breakers where indicated.
- E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.4 LIGHTING AND APPLIANCE PANELBOARDS

- A. Description: Panelboards complying with NEMA PB 1, lighting and appliance branch circuit type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.
- B. Conductor Terminations:

1. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 2. Main and Neutral Lug Type: Mechanical.
- C. Bussing:
1. Phase Bus Connections: Arranged for sequential phasing of overcurrent protective devices.
 2. Phase and Neutral Bus Material: Aluminum.
 3. Ground Bus Material: Aluminum.
- D. Circuit Breakers: Thermal magnetic bolt-on type unless otherwise indicated.
- E. Enclosures:
1. Provide surface-mounted or flush-mounted enclosures as indicated.
 2. Fronts: Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
 3. Provide clear plastic circuit directory holder mounted on inside of door.

2.5 OVERCURRENT PROTECTIVE DEVICES

- A. Molded Case Circuit Breakers:
1. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489 and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 2. Interrupting Capacity:
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - 1) 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - 2) 14,000 rms symmetrical amperes at 480 VAC.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 3. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.

4. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - b. Provide interchangeable trip units where indicated.
5. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.
 - b. Provide zone selective interlocking capability where indicated, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
6. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
8. Do not use tandem circuit breakers.
9. Do not use 1/2 width circuit breakers.
10. Do not use handle ties in lieu of multi-pole circuit breakers.
11. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.
12. Provide the following features and accessories where indicated or where required to complete installation:

- a. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.
- b. Handle Pad-Lock Provision: For locking circuit breaker handle in OFF position.
- c. Undervoltage Release: For tripping circuit breaker upon predetermined drop in coil voltage with field-adjustable time delay to prevent nuisance tripping.

2.6 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- G. Install panelboards plumb.
- H. Install flush-mounted panelboards so that trims fit completely flush to wall with no gaps and rough opening completely covered.
- I. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches above the floor or working platform.
- J. Mount floor-mounted power distribution panelboards on properly sized 3 inch high concrete pad constructed in accordance with Section 03 3000.

- K. Provide minimum of six spare 1 inch trade size conduits out of each flush-mounted panelboard stubbed into accessible space above ceiling and below floor.
- L. Provide grounding and bonding in accordance with Section 26 0526.
 - 1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
- M. Install all field-installed branch devices, components, and accessories.
- N. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- O. Multi-Wire Branch Circuits: Group grounded and ungrounded conductors together in the panelboard as required by NFPA 70.
- P. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.
- Q. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- R. Provide filler plates to cover unused spaces in panelboards.
- S. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated. Also provide for the following:
 - 1. Emergency and night lighting circuits.
 - 2. Communications equipment circuits.
 - 3. Intrusion detection and access control system circuits.
 - 4. Video surveillance system circuits.
- T. Identify panelboards in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 225 amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.

- G. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing: For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.5 CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 2419 - MOTOR-CONTROL CENTERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Low-voltage (600 V and less) standard (non-arc-resistant) NEMA motor control centers.
- B. Motor control center units:
 - 1. Feeder units.
 - 2. Combination magnetic motor starter units.
- C. Overcurrent protective devices for motor control centers and associated units, including overload relays.
- D. Motor control accessories:
 - 1. Auxiliary contacts.
 - 2. Pilot devices.
 - 3. Control and timing relays.
 - 4. Control power transformers.
 - 5. Control terminal blocks.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete equipment pads.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2923 - Variable-Frequency Motor Controllers.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e (Amended 2017).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NECA 402 - Standard for Installing and Maintaining Motor Control Centers 2014.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

- E. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2000, with Errata (2008).
- F. NEMA ICS 2.3 - Industrial Control and Systems: Instructions for the Handling, Installation, Operation, and Maintenance of MCCs Rated Not More Than 600 Volts 2019.
- G. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices 2017.
- H. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).
- I. NEMA ICS 18 - Motor Control Centers 2001 (Reaffirmed 2007).
- J. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- K. NFPA 70 - National Electric Code; National Fire Protection Association; 2017.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.
- M. UL 845 - Motor Control Centers Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
 - 3. Coordinate the work to provide motor controllers and associated wiring suitable for interface with control devices to be installed.
 - 4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 6. Coordinate with manufacturer to provide shipping splits suitable for the dimensional constraints of the installation.
 - 7. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See Section ~~01 3000~~ Administrative Requirements, for submittal procedures.

McGill Section 013300

- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor control centers, enclosures, units, overcurrent protective devices, and other installed components and accessories.
 - 1. Include characteristic trip curves for each type and rating of overcurrent protective device upon request.
- C. Shop Drawings: Indicate dimensions, voltage, bus ampacities, unit arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 - 1. Include dimensioned plan and elevation views of motor control centers and adjacent equipment with all required clearances indicated.
 - 2. Include wiring diagrams showing all factory and field connections.
 - 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Field Quality Control Test Reports.
- F. Project Record Documents: Record actual installed locations of motor control centers and final equipment settings.
 - 1. Include nameplate data of actual installed motors and associated overload relay selections and settings.
 - 2. Motor Circuit Protectors: Include magnetic instantaneous trip settings.
- G. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- H. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. Enclosure Keys: Two of each different key.
 - 2. Indicating Lights: Two of each different type.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store motor control centers in accordance with NECA 402, NEMA ICS 2.3, NECA 402, NEMA ICS 2.3, NECA 402, and NEMA ICS 2.3.
- B. Store in a clean, dry space having a uniform temperature to prevent condensation. Where necessary, provide temporary enclosure space heaters or temporary power for permanent factory-installed space heaters.
- C. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- D. Handle carefully to avoid damage to internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish motor control centers and associated components produced by a single manufacturer and obtained from a single supplier.

2.2 MOTOR CONTROL CENTERS

- A. Provide motor control centers consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Dead-front standard (non-arc-resistant) type motor control center assemblies complying with NEMA ICS 18, and listed and labeled as complying with UL 845; ratings, configurations and features as indicated on the drawings.
- D. Configuration:
 - 1. Arrangement: Front-mounted units only (no rear-mounted units or back-to-back configuration).
 - 2. NEMA Classification and Wiring Type: NEMA ICS 18, Class I, Type B (B-T for units size 3 or smaller).
- E. Service Conditions:
 - 1. Provide motor control centers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- F. Short Circuit Current Rating:

1. Provide motor control centers and associated units with listed short circuit current rating to meet or exceed the ratings of the equipment being replaced not less than the available fault current at the installed location as indicated on the drawings.
 2. Minimum Rating: 25,000 rms symmetrical amperes.
 3. Listed series ratings are not acceptable.
- G. Main Devices: Configure for top or bottom incoming feed as indicated or as required for the installation. Provide top-mounted pullbox as indicated or as required to facilitate installation of incoming feed.
- H. Bussing:
1. Horizontal Main Bus: Size for a maximum temperature rise of 117 degrees F over an ambient temperature of 104 degrees F, in compliance with NEMA ICS 18 and UL 845 requirements.
 2. Vertical Bus: Minimum size of 300 A, in compliance with NEMA ICS 18 requirements.
 3. Provide fully rated neutral lug pad in incoming section, with a suitable lug for each feeder and branch circuit requiring a neutral connection.
 4. Provide solidly bonded equipment ground bus through full length of motor control center, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 5. Phase and Neutral Bus Material: Copper.
 6. Ground Bus Material: Copper.
- I. Conductor Terminations: Suitable for use with the conductors to be installed.
1. Line Conductor Terminations:
 - a. Main and Neutral Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 - b. Main and Neutral Lug Type: Mechanical.
- J. Enclosures:
1. Comply with NEMA ICS 6.
 2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Outdoor Locations: Type 3R.
 3. Finish: Manufacturer's standard unless otherwise indicated.
 4. Enclosure Space Heaters:

- a. Provide in each motor control center section installed outdoors and in unconditioned indoor spaces.
 - b. Size according to manufacturer's recommendations for worst case ambient temperature to prevent condensation and/or maintain required service conditions.
 - c. Heater Control: Thermostat.
 - d. Heater Power Source: Provide connection to transformer factory-installed in motor control center.
- 5. Outdoor Enclosures:
 - a. Enclosure Type: Non-walk-in type.
 - b. Color: Manufacturer's standard.
 - c. Access Doors: Lockable, with all locks keyed alike.
- K. Future Provisions:
 - 1. Prepare designated spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.

2.3 MOTOR CONTROL CENTER UNITS

- A. Feeder Units: Circuit breaker type.
- B. Combination Magnetic Motor Starter Units:
 - 1. Description: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
 - 2. Configuration: Full-voltage non-reversing type unless otherwise indicated.
 - 3. Disconnects: Circuit breaker type.
 - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
 - b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
 - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.
 - 4. Overload Relays: Bimetallic thermal type unless otherwise indicated.
 - 5. Pilot Devices Required:

- a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
- b. Single-Speed, Non-Reversing Starters:
 - 1) Pushbuttons: START-STOP.
 - 2) Selector Switches: HAND/OFF/AUTO.
 - 3) Indicating Lights: Red ON, Green OFF.
- C. Variable-Frequency AC Drive Units: Comply with Section 26 2923.

2.4 OVERCURRENT PROTECTIVE DEVICES

- A. Overload Relays:
 - 1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
 - 2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
 - 3. Trip-free operation.
 - 4. Visible trip indication.
 - 5. Resettable.
 - a. Employ manual reset unless otherwise indicated.
 - b. Do not employ automatic reset with two-wire control.
 - 6. Bimetallic Thermal Overload Relays:
 - a. Provide ambient temperature compensation.
 - b. Interchangeable current elements/heaters.
 - c. Adjustable trip; plus/minus 10 percent of nominal, minimum.
 - d. Designed for quicker trip response under phase loss condition.
 - e. Trip test function.
 - 7. Solid-State Overload Relays:
 - a. Adjustable full load current.
 - b. Phase loss protection.
 - c. Phase imbalance protection.

- d. Ambient temperature insensitive.
- e. Thermal memory.
- f. Trip test function.

B. Circuit Breakers:

1. Interrupting Capacity (not applicable to motor circuit protectors):
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
2. Motor Circuit Protectors:
 - a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
 - b. Provide field-adjustable magnetic instantaneous trip setting.
3. Molded Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489 and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - b. Minimum Interrupting Capacity:
 - 1) 14,000 rms symmetrical amperes at 480 VAC.
 - c. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - d. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Pad-Lock Provision: For locking circuit breaker handle in OFF position.

2.5 MOTOR CONTROL ACCESSORIES

A. Auxiliary Contacts:

1. Comply with NEMA ICS 5.
2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each starter unit, minimum.

B. Pilot Devices:

1. Comply with NEMA ICS 5; heavy-duty type.
2. Nominal Size: 30 mm.
3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
5. Indicating Lights: Push-to-test type unless otherwise indicated.
6. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:

1. Comply with NEMA ICS 5.
2. Provide number and type of relays indicated or required to perform necessary functions.

D. Control Power Transformers:

1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices.
2. Include primary and secondary fuses.

E. Control Terminal Blocks: Include 25 percent spare terminals.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the motor control centers and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive motor control centers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install motor control centers in accordance with NECA 1 (general workmanship), NECA 402, and NEMA ICS 2.3.
- C. Arrange equipment to provide required clearances and maintenance access, including accommodations for any drawout devices.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Install motor control centers plumb and level.
- F. Unless otherwise indicated, mount motor control centers on properly sized 4 inch high concrete pad constructed in accordance with Section 03 3000.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Install all field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable motor controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.
- K. Provide filler plates to cover unused spaces.
- L. Identify motor control centers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's reports with submittals.
- C. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Before energizing motor control center, perform insulation resistance testing in accordance with NECA 402 and NEMA ICS 2.3.
- E. Inspect and test in accordance with NETA ATS, except Section 4.
- F. Perform inspections and tests listed in NETA ATS, Section 7.16.2.1.
- G. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.
- H. Correct deficiencies and replace damaged or defective motor control centers or associated components.

- I. Submit detailed reports indicating inspection and testing results and corrective actions taken.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of motor control center covers and doors.

3.5 CLEANING

- A. Clean dirt and debris from motor control center enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred surfaces to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of motor controllers to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of motor control center and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.7 PROTECTION

- A. Protect installed motor control centers from subsequent construction operations.

END OF SECTION

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SECTION 26 2726 - WIRING DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- D. Section 26 0583 - Wiring Connections: Cords and plugs for equipment.

1.3 REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for 2017h.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification) 2017g.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices 2016.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices 1999 (Reaffirmed 2020).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications 2016.
- G. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- H. UL 20 - General-Use Snap Switches Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices Current Edition, Including All Revisions.
- K. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.
- L. UL 1472 - Solid-State Dimming Controls Current Edition, Including All Revisions.
- M. UL 1917 - Solid-State Fan Speed Controls Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

B. Sequencing:

1. Do not install wiring devices until final surface finishes and painting are complete.

1.5 SUBMITTALS

- A. See ~~Section 01 3000—Administrative Requirements~~, for submittal procedures.
McGill Section 013300
- B. Product Data: Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- C. Operation and Maintenance Data:
1. GFCI Receptacles: Include information on status indicators.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See ~~Section 01 6000—Product Requirements~~, for additional provisions.
McGill Section 017823.
 2. Extra Wall Plates: One of each style, size, and finish.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products: Listed, classified, and labeled as suitable for the purpose intended.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.1 WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. Provide GFCI devices where indicated on drawings.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet of sinks.
- E. Provide GFCI protection for receptacles serving electric drinking fountains.
- F. Unless noted otherwise, do not use combination switch/receptacle devices.

2.2 WIRING DEVICE FINISHES

- A. Wiring Devices, Unless Otherwise Indicated: Black with black galvanized steel wall plate.

2.3 WALL SWITCHES

- A. Wall Switches - General Requirements: AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable FS W-S-896; types as indicated on the drawings.
 - 1. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.
- B. Standard Wall Switches: Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, three way, or four way as indicated on the drawings.

2.4 FAN SPEED CONTROLLERS

- A. Description: 120 V AC, solid-state, full-range variable speed, slide control type with separate on/off switch, with integral radio frequency interference filtering, fan noise elimination circuitry, power failure preset memory, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 1917.
 - 1. Current Rating: 1.5 A unless otherwise indicated or required to control the load indicated on the drawings.

2.5 RECEPTACLES

- A. Manufacturers:
 - 1. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer.
- B. Receptacles - General Requirements: Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions: Terminal screws for side wiring with separate ground terminal screw.
 2. NEMA configurations specified are according to NEMA WD 6.
- C. Convenience Receptacles:
1. Standard Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
 2. Weather Resistant Convenience Receptacles: Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.
- D. GFCI Receptacles:
1. GFCI Receptacles - General Requirements: Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.
 2. Standard GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R.
 3. Weather Resistant GFCI Receptacles: Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.
- E. Locking Receptacles: Industrial specification grade, configuration as indicated on the drawings.
- F. Other Receptacle configurations as indicated on the plans.

2.6 WALL PLATES

- A. Manufacturers:
1. Source Limitations: Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wallplates by the same manufacturer.
- B. Wall Plates: Comply with UL 514D.
1. Configuration: One-piece cover as required for quantity and types of corresponding wiring devices.
 2. Size: Standard.
 3. Screws: Metal with slotted heads finished to match wall plate finish.
- C. Galvanized Steel Wall Plates: Rounded corners and edges, with corrosion resistant screws.

- D. Weatherproof Covers for Damp Locations: Gasketed, cast aluminum, with self-closing hinged cover and corrosion-resistant screws; listed as suitable for use in wet locations with cover closed.
- E. Weatherproof Covers for Wet Locations: Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- F. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130.
- B. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of wiring devices provided under this section.
 - 1. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 2. Where multiple receptacles or wall switches are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 3. Locate wall switches on strike side of door with edge of wall plate 3 inches from edge of door frame. Where locations are indicated otherwise, notify Architect/Engineer to obtain direction prior to proceeding with work.
- C. Install wiring devices in accordance with manufacturer's instructions.

- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Do not use push-in pressure terminals.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.
- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with OFF position down.
- K. Do not share neutral conductor on branch circuits utilizing wall dimmers.
- L. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- M. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- N. Install blank wall plates on junction boxes and on outlet boxes (existing or new) with no wiring devices installed or designated for future use.
- O. Identify wiring devices in accordance with Section 26 0553.

3.4 FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Test each receptacle to verify operation and proper polarity.
- C. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- D. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.5 ADJUSTING

- A. Adjust devices and wall plates to be flush and level.

3.6 CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

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SECTION 26 2813 - FUSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Fuses.

1.2 RELATED REQUIREMENTS

- A. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- B. Section 26 0573 - Power System Studies: Additional criteria for the selection of protective devices specified in this section.
- C. Section 26 2816.16 - Enclosed Switches: Fusible switches.

1.3 REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses 2012.
- B. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses Current Edition, Including All Revisions.
- E. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Enclosed Switches: See Section 26 2816.16.
 - 2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
 - 3. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.
- B. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.

1. See ~~Section 01-6000—Product Requirements~~, for additional provisions.
McGill Section 017823.
2. Extra Fuses: One set(s) of three for each type and size installed.
3. Fuse Pullers: One set(s) compatible with each type and size installed.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

PART 2 PRODUCTS

2.1 APPLICATIONS

- A. Individual Motor Branch Circuits: Class RK1, time-delay.
- B. In-Line Protection for Pole-Mounted Luminaires: Class CC, time-delay.
- C. Primary Protection for Control Transformers: Class CC, time-delay.

2.2 FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, Class and ratings as indicated.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Class R Fuses: Comply with UL 248-12.
 1. Class RK1, Time-Delay, current limiting Fuses.
- H. Class CC Fuses: Comply with UL 248-4.
 1. Class CC, Time-Delay Fuses.
- I. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- J. Provide the following accessories where indicated or where required to complete installation:

1. Fuseholders: Compatible with indicated fuses.
2. Fuse Reducers: For adapting indicated fuses to permit installation in switch designed for fuses with larger ampere ratings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

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SECTION 26 2816.13 - ENCLOSED CIRCUIT BREAKERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed circuit breakers.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.3 REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service 2013e (Amended 2017).
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- E. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- H. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment Current Edition, Including All Revisions.
- J. UL 943 - Ground-Fault Circuit-Interrupters Current Edition, Including All Revisions.
- K. UL 1053 - Ground-Fault Sensing and Relaying Equipment Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

A. Coordination:

1. Coordinate work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.
5. **Do not order equipment until matching power system study reports and product submittals have both been evaluated by Architect/Engineer.**

1.5 SUBMITTALS

- A. Product Data: Provide manufacturer's standard catalog pages and data sheets for circuit breakers, enclosures, and other installed components and accessories.
- B. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of enclosed circuit breakers and adjacent equipment with all required clearances indicated.
 2. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
 3. Identify mounting conditions required for equipment seismic qualification.
- C. Manufacturer's equipment seismic qualification certification.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed circuit breaker internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between 23 degrees F and 104 degrees F during and after installation of enclosed circuit breakers.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish enclosed circuit breakers and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.2 ENCLOSED CIRCUIT BREAKERS

- A. Description: Units consisting of molded case circuit breakers individually mounted in enclosures.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Seismic Qualification: Provide enclosed circuit breakers and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between 23 degrees F and 104 degrees F.
- E. Short Circuit Current Rating:
 - 1. Provide enclosed circuit breakers with listed short circuit current rating not less than the available fault current at the installed location indicated on the drawings.
- F. Enclosed Circuit Breakers Used for Service Entrance: Listed and labeled as suitable for use as service equipment according to UL 869A.
- G. Conductor Terminations: Suitable for use with the conductors to be installed.

- H. Provide electronic trip circuit breakers for circuit breaker frame sizes 225 amperes and above.
- I. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- J. Provide solidly bonded equipment ground bus in each enclosed circuit breaker, with a suitable lug for terminating each equipment grounding conductor.
- K. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - c. Outdoor/Indoor Corrosive Environments or where subject to Hose Down: NEMA 4X.
 - d. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
 - 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
 - 3. Provide surface-mounted enclosures unless otherwise indicated.
- L. Provide externally operable handle with means for locking in the OFF position.
- M. Ground Fault Protection: Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
 - 2. Where accessory ground fault sensing and relaying equipment is used, equip companion circuit breakers with ground-fault shunt trips.
 - a. Use zero sequence ground fault detection method unless otherwise indicated.
 - b. Provide test panel and field-adjustable ground fault pick-up and delay settings.
 - c. Provide zone selective interlocking capability, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control ground fault delay functions for system coordination purposes.
- N. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

2.3 MOLDED CASE CIRCUIT BREAKERS

- A. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489 and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the drawings.
- B. Interrupting Capacity:
 - 1. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than:
 - a. 10,000 rms symmetrical amperes at 240 VAC or 208 VAC.
 - b. 14,000 rms symmetrical amperes at 480 VAC.
 - 2. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
- C. Conductor Terminations:
 - 1. Provide mechanical lugs unless otherwise indicated.
 - 2. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
- D. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - 2. Provide interchangeable trip units where indicated.
- E. Electronic Trip Circuit Breakers: Furnish solid state, microprocessor-based, true rms sensing trip units.
 - 1. Provide the following field-adjustable trip response settings:
 - a. Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - b. Long time delay.
 - c. Short time pickup and delay.
 - d. Instantaneous pickup.
 - e. Ground fault pickup and delay where ground fault protection is indicated.
 - 2. Provide zone selective interlocking capability, capable of communicating with other electronic trip circuit breakers and external ground fault sensing systems to control short time delay and ground fault delay functions for system coordination purposes.
- F. Multi-Pole Circuit Breakers: Furnish with common trip for all poles.

- G. Provide the following circuit breaker types where indicated:
 - 1. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers: Listed as complying with UL 943, class A for protection of personnel.
 - 2. Ground Fault Equipment Protection Circuit Breakers: Designed to trip at 30 mA for protection of equipment.
- H. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Shunt Trip: Provide coil voltage as required for connection to indicated trip actuator.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed circuit breakers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed circuit breakers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Provide required seismic controls in accordance with Section 26 0548.
- F. Install enclosed circuit breakers plumb.
- G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed circuit breakers such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 26 0573.

- K. Set field-adjustable ground fault protection pickup and time delay settings as directed.
- L. Identify enclosed circuit breakers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with manufacturer's instructions and NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers used for service entrance and for circuit breakers larger than 225 amperes. Tests listed as optional are not required.
- D. Ground Fault Protection Systems: Test in accordance with manufacturer's instructions as required by NFPA 70.
- E. Test GFCI circuit breakers to verify proper operation.
- F. Test shunt trips to verify proper operation.
- G. Correct deficiencies and replace damaged or defective enclosed circuit breakers.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from circuit breaker enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 2816.16 - ENCLOSED SWITCHES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed safety switches.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 2813 - Fuses.

1.3 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum) 2013.
- D. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- E. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations Current Edition, Including All Revisions.
- F. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations Current Edition, Including All Revisions.
- G. UL 98 - Enclosed and Dead-Front Switches Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.

3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. Shop Drawings: Indicate outline and support point dimensions, voltage and current ratings, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Identify mounting conditions required for equipment seismic qualification.
- B. Manufacturer's equipment seismic qualification certification.
- C. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- D. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 1. See ~~Section 01 6000—Product Requirements~~, for additional provisions.

McGill Section 017823.
 2. See Section 26 2813 for requirements for spare fuses.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F and 104 degrees F during and after installation of enclosed switches.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and

obtained from a single supplier.

2.2 ENCLOSED SAFETY SWITCHES

- A. Description: Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Seismic Qualification: Provide enclosed safety switches suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- D. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude: Less than 6,600 feet.
 - 2. Ambient Temperature: Between -22 degrees F and 104 degrees F.
- E. Horsepower Rating: Suitable for connected load.
- F. Voltage Rating: Suitable for circuit voltage.
- G. Short Circuit Current Rating:
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Minimum Ratings:
 - a. Heavy Duty Single Throw Switches Protected by Class R Fuses: 200,000 rms symmetrical amperes.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Fuse Clips for Fusible Switches: As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- J. Conductor Terminations: Suitable for use with the conductors to be installed.
- K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.
- L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- M. Enclosures: Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.

1. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - c. Outdoor/Indoor Corrosive Locations or where subject to Hose Down: Type 4X
 - d. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
 2. Finish for Painted Steel Enclosures: Manufacturer's standard, factory applied grey unless otherwise indicated.
- N. Provide safety interlock to prevent opening the cover with the switch in the ON position with capability of overriding interlock for testing purposes.
- O. Heavy Duty Switches:
1. Comply with NEMA KS 1.
 2. Conductor Terminations:
 - a. Provide mechanical lugs unless otherwise indicated.
 - b. Lug Material: Aluminum, suitable for terminating aluminum or copper conductors.
 3. Provide externally operable handle with means for locking in the OFF position, capable of accepting three padlocks.
- P. Provide the following features and accessories where indicated or where required to complete installation:
1. Hubs: As required for environment type; sized to accept conduits to be installed.
 2. Integral fuse pullers.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Provide required seismic controls in accordance with Section 26 0548.
- F. Install enclosed switches plumb.
- G. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches above the floor or working platform.
- H. Provide grounding and bonding in accordance with Section 26 0526.
- I. Provide fuses complying with Section 26 2813 for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- J. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- K. Identify enclosed switches in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 2913 - ENCLOSED CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Enclosed NEMA controllers for low-voltage (600 V and less) applications:
 - 1. Magnetic motor starters.
 - 2. Manual motor starters.
- B. Overcurrent protective devices for motor controllers, including overload relays.
- C. Control accessories:
 - 1. Pilot devices.
 - 2. Control power transformers.
 - 3. Control terminal blocks.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.
- E. Section 26 0573 - Power System Studies: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.

1.3 REFERENCE STANDARDS

- A. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers 2016.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- C. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- D. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2000, with Errata (2008).
- E. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices 2017.
- F. NEMA ICS 6 - Industrial Control and Systems: Enclosures 1993 (Reaffirmed 2016).

- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- H. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- I. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures Current Edition, Including All Revisions.
- J. UL 60947-1 - Low-Voltage Switchgear and Controlgear - Part 1: General Rules Current Edition, Including All Revisions.
- K. UL 60947-4-1 - Low-Voltage Switchgear and Controlgear - Part 4-1: Contactors and Motor-starters - Electromechanical Contactors and Motor-starters Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 2. Coordinate the work to provide motor controllers and associated overload relays suitable for use with the actual motors to be installed.
 - 3. Coordinate the work to provide controllers and associated wiring suitable for interface with control devices to be installed.
 - 4. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 5. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
 - 6. Notify Architect/Engineer of any conflicts with or deviations from Contract Documents. Obtain direction before proceeding with work.

1.5 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.

McGill Section 013300
- B. Product Data: Provide manufacturer's standard catalog pages and data sheets for motor controllers, enclosures, overcurrent protective devices, and other installed components and accessories.
- C. Shop Drawings: Indicate dimensions, voltage, controller sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.

1. Include dimensioned plan and elevation views of enclosed controllers and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.
- D. Manufacturer's Installation Instructions: Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- E. Maintenance Data: Include information on replacement parts and recommended maintenance procedures and intervals.
- F. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
1. See Section 01 6000 - Product Requirements, for additional provisions.
 2. Indicating Lights: Two of each different type.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to internal components, enclosure, and finish.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within required service conditions during and after installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish enclosed motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

1. Motor-starting switches without overload protection may be produced by the same manufacturer as the wiring devices used for this project.

2.2 ENCLOSED CONTROLLERS

- A. Provide enclosed controller assemblies consisting of all required components, control power transformers, instrumentation and control wiring, accessories, etc. as necessary for a complete operating system.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Description: Enclosed controllers complying with NEMA ICS 2, and listed and labeled as complying with UL 60947-1 and UL 60947-4-1; ratings, configurations and features as indicated on the drawings.
- D. Seismic Qualification: Provide panelboards and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- E. Service Conditions:
 1. Provide controllers and associated components suitable for operation under the following service conditions without derating:
 - a. Altitude:
 - 1) Class 1 Km Equipment (devices utilizing power semiconductors, e.g. variable frequency controllers): Less than 3,300 feet.
 - 2) Class 2 Km Equipment (electromagnetic and manual devices): Less than 6,600 feet.
 - b. Ambient Temperature: Between 32 degrees F and 104 degrees F.
 2. Provide controllers and associated components suitable for operation at indicated ratings under the service conditions at the installed location.
- F. Short Circuit Current Rating:
 1. Provide controllers with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
- G. Selectivity: Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.
- H. Conductor Terminations: Suitable for use with the conductors to be installed.
- I. Enclosures:
 1. Comply with NEMA ICS 6.

2. Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - a. Indoor Clean, Dry Locations: Type 1.
 - b. Outdoor Locations: Type 3R.
 - c. Outdoor/Indoor Corrosive Environment or where subject to Hose Down: NEMA 4X
 - d. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
 3. Finish: Manufacturer's standard unless otherwise indicated.
- J. Instrument Transformers:
1. Comply with IEEE C57.13.
 2. Select suitable ratio, burden, and accuracy as required for connected devices.
 3. Current Transformers: Connect secondaries to shorting terminal blocks.
 4. Potential Transformers: Include primary and secondary fuses with disconnecting means.
- K. Magnetic Motor Starters: Combination type unless otherwise indicated.
1. Combination Magnetic Motor Starters: NEMA ICS 2, Class A combination motor controllers with magnetic contactor(s), externally operable disconnect and overload relay(s).
 2. Noncombination Magnetic Motor Starters: NEMA ICS 2, Class A noncombination motor controllers with magnetic contactor(s) and overload relay(s).
 3. Configuration: Full-voltage non-reversing unless otherwise indicated.
 4. Minimum Starter Size: NEMA Size 0.
 5. Use of non-standard starter sizes smaller than specified standard NEMA sizes is not permitted.
 6. Disconnects: Circuit breaker type.
 - a. Circuit Breakers: Motor circuit protectors (magnetic-only) unless otherwise indicated or required.
 - b. Provide externally operable handle with means for locking in the OFF position. Provide safety interlock to prevent opening the cover with the disconnect in the ON position with capability of overriding interlock for testing purposes.
 - c. Provide auxiliary interlock for disconnection of external control power sources where applicable.

7. Overload Relays: Bimetallic thermal type unless otherwise indicated.
8. Pilot Devices Required:
 - a. Furnish local pilot devices for each unit as specified below unless otherwise indicated on drawings.
 - b. Single-Speed, Non-Reversing Starters:
 - 1) Pushbuttons: START-STOP.
 - 2) Selector Switches: HAND/OFF/AUTO.
 - 3) Indicating Lights: Red ON, Green OFF.

L. Manual Motor Starters:

1. Description: NEMA ICS 2, Class A manually-operated motor controllers with overload relay(s).
2. Configuration: Non-reversing unless otherwise indicated.
3. Fractional-Horsepower Manual Motor Starters:
 - a. Furnish with toggle operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type.
 - c. Provide means for locking operator in the OFF position.
 - d. Furnish Red ON indicating light where not within sight of equipment.
4. Integral-Horsepower Manual Motor Starters:
 - a. Furnish with toggle or pushbutton operator.
 - b. Overload Relays: Bimetallic or melting alloy thermal type.
 - c. Provide means for locking operator in the OFF position.
 - d. Furnish Red ON indicating light where not within sight of equipment.
 - e. Provide auxiliary contact where indicated; normally open (NO) or normally closed (NC) as indicated or as required.

M. Motor-Starting Switches: Horsepower-rated switches without overload protection; toggle operator.

2.3 OVERCURRENT PROTECTIVE DEVICES

A. Overload Relays:

1. Provide overload relays and, where applicable, associated current elements/heaters, selected according to actual installed motor nameplate data, in accordance with manufacturer's recommendations and NFPA 70; include consideration for motor service factor and ambient temperature correction, where applicable.
 2. Inverse-Time Trip Class Rating: Class 20 unless otherwise indicated or required.
 3. Trip-free operation.
 4. Visible trip indication.
 5. Resettable.
 - a. Employ manual reset unless otherwise indicated.
 - b. Do not employ automatic reset with two-wire control.
 6. Bimetallic Thermal Overload Relays:
 - a. Provide ambient temperature compensation.
 - b. Interchangeable current elements/heaters.
 - c. Adjustable trip; plus/minus 10 percent of nominal, minimum.
 - d. Trip test function.
 7. Melting Alloy Thermal Overload Relays:
 - a. Interchangeable current elements/heaters.
- B. Circuit Breakers:
1. Interrupting Capacity (not applicable to motor circuit protectors):
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating indicated, but not less than specified minimum requirements.
 - b. Fully Rated Systems: Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
 2. Motor Circuit Protectors:
 - a. Description: Instantaneous-trip circuit breakers furnished with magnetic instantaneous tripping elements for short circuit protection, but not with thermal inverse time tripping elements for overload protection; UL 489 recognized only for use as part of a listed combination motor controller with overload protection; ratings, configurations, and features as indicated on the drawings.
 - b. Provide field-adjustable magnetic instantaneous trip setting.

- c. Provide the following features and accessories where indicated or where required to complete installation:
 - 1) Pad-Lock Provision: For locking circuit breaker handle in OFF position.
- 3. Molded Case Circuit Breakers:
 - a. Description: Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers; listed and labeled as complying with UL 489; ratings, configurations, and features as indicated on the drawings.
 - 1) Provide thermal magnetic circuit breakers unless otherwise indicated.
 - b. Thermal Magnetic Circuit Breakers: For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - 1) Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
 - 2) Provide interchangeable trip units where indicated.

2.4 CONTROL ACCESSORIES

A. Auxiliary Contacts:

- 1. Comply with NEMA ICS 5.
- 2. Provide number and type of contacts indicated or required to perform necessary functions, including holding (seal-in) circuit and interlocking, plus one normally open (NO) and one normally closed (NC) spare contact for each magnetic motor starter, minimum.

B. Pilot Devices:

- 1. Comply with NEMA ICS 5; heavy-duty type.
- 2. Nominal Size: 30 mm.
- 3. Pushbuttons: Unless otherwise indicated, provide momentary, non-illuminated type with flush button operator; normally open or normally closed as indicated or as required.
- 4. Selector Switches: Unless otherwise indicated, provide maintained, non-illuminated type with knob operator; number of switch positions as indicated or as required.
- 5. Indicating Lights: Push-to-test type unless otherwise indicated.
- 6. Provide LED lamp source for indicating lights and illuminated devices.

C. Control and Timing Relays:

- 1. Comply with NEMA ICS 5.

2. Provide number and type of relays indicated or required to perform necessary functions.
- D. Control Power Transformers:
1. Size to accommodate burden of contactor coil(s) and all connected auxiliary devices, plus 25 VA spare capacity.
 2. Include primary and secondary fuses.
- E. Control Terminal Blocks: Include 25 percent spare terminals.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that ratings of enclosed controllers are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed controllers.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install controllers in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required support and attachment in accordance with Section 26 0529.
- E. Provide required seismic controls in accordance with Section 26 0548.
- F. Install enclosed controllers plumb and level.
- G. Provide grounding and bonding in accordance with Section 26 0526.
- H. Install all field-installed devices, components, and accessories.
- I. Where accessories are not self-powered, provide control power source as indicated or as required to complete installation.
- J. Set field-adjustable controllers and associated components according to installed motor requirements, in accordance with manufacturer's recommendations and NFPA 70.
- K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed in accordance with Section 26 0573.
- L. Identify enclosed controllers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Motor Starters: Perform inspections and tests listed in NETA ATS, Section 7.16.1.1. Tests listed as optional are not required.
- D. Molded Case Circuit Breakers: Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for circuit breakers larger than 225 amperes. Tests listed as optional are not required.
- E. Correct deficiencies and replace damaged or defective enclosed controllers or associated components.

3.4 ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.5 CLEANING

- A. Clean dirt and debris from controller enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

3.6 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of controllers to Owner, and correct deficiencies or make adjustments as directed.
- D. Training: Train Owner's personnel on operation, adjustment, and maintenance of enclosed controllers and associated devices.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of two hours of training.
 - 3. Instructor: Manufacturer's authorized representative.
 - 4. Location: At project site.

3.7 PROTECTION

- A. Protect installed enclosed controllers from subsequent construction operations.

END OF SECTION

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SECTION 26 2923 - VARIABLE-FREQUENCY MOTOR CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Variable frequency controllers.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Housekeeping pads.
- B. Section 26 0529 - Hangers and Supports for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
 - 1. Includes requirements for the seismic qualification of equipment specified in this section.
- D. Section 26 0553 - Identification for Electrical Systems: Identification products and requirements.

1.3 REFERENCE STANDARDS

- A. NEMA ICS 7.1 - Safety Standards for Construction and Guide for Selection, Installation, and Operation of Adjustable-Speed Drive Systems 2014.
- B. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- C. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.

1.4 SUBMITTALS

- A. Product Data: Provide catalog sheets showing voltage, controller size, ratings and size of switching and overcurrent protective devices, short circuit ratings, dimensions, and enclosure details.
- B. Shop Drawings: Indicate front and side views of enclosures with overall dimensions and weights shown; conduit entrance locations and requirements; and nameplate legends.
 - 1. Identify mounting conditions required for equipment seismic qualification.
- C. Operation Data: NEMA ICS 7.1. Include instructions for starting and operating controllers, and describe operating limits that may result in hazardous or unsafe conditions.
- D. Maintenance Data: NEMA ICS 7.1. Include routine preventive maintenance schedule.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See ~~Section 01 6000 - Product Requirements~~, for additional provisions.

McGill Section 017823.
 - 2. Extra Air Filters: Two of each type.

1.5 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience and with service facilities within 100 miles of Project.
- C. Products: Listed, classified, and labeled as suitable for the purpose intended.
- D. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to components, enclosure, and finish.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Source Limitations: Furnish variable frequency motor controllers and associated components produced by a single manufacturer and obtained from a single supplier.

2.2 DESCRIPTION

- A. Variable Frequency Controllers: Enclosed controllers suitable for operating the indicated loads, in conformance with requirements of NEMA ICS 7. Select unspecified features and options in accordance with NEMA ICS 3.1.
 - 1. Employ microprocessor-based inverter logic isolated from power circuits.
 - 2. Employ pulse-width-modulated inverter system.
 - 3. Design for ability to operate controller with motor disconnected from output.
 - 4. Design to attempt five automatic restarts following fault condition before locking out and requiring manual restart.
- B. Seismic Qualification: Provide variable frequency controllers and associated components suitable for application under the seismic design criteria specified in Section 26 0548 where required. Include certification of compliance with submittals.
- C. Enclosures:
 - 1. Indoor dry location: NEMA 1.

2. Outdoor or indoor wet location: NEMA 3R.
 3. Outdoor/Indoor Corrosive Environment or where subject to Hose Down: NEMA 4X.
 4. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
- D. Finish: Manufacturer's standard enamel.

2.3 OPERATING REQUIREMENTS

- A. Rated Input Voltage: as indicated on plans, three phase, 60 Hertz.
- B. Displacement Power Factor: Between 1.0 and 0.95, lagging, over entire range of operating speed and load.
- C. Operating Ambient: 0 degrees C to 40 degrees C.
- D. Volts Per Hertz Adjustment: Plus or minus 10 percent.
- E. Current Limit Adjustment: 60 to 110 percent of rated.
- F. Acceleration Rate Adjustment: 0.5 to 30 seconds.
- G. Deceleration Rate Adjustment: 1 to 30 seconds.
- H. Input Signal: 4 to 20 mA DC.

2.4 COMPONENTS

- A. Display: Provide integral digital display to indicate output voltage, output frequency, and output current.
- B. Status Indicators: Separate indicators for overcurrent, overvoltage, ground fault, overtemperature, and input power ON.
- C. Furnish HAND-OFF-AUTOMATIC selector switch and manual speed control.
- D. Include undervoltage release.
- E. Control Power Source: Separate circuit.
- F. Door Interlocks: Furnish mechanical means to prevent opening of equipment with power connected, or to disconnect power if door is opened; include means for defeating interlock by qualified persons.
- G. Safety Interlocks: Furnish terminals for remote contact to inhibit starting under both manual and automatic mode.
- H. Control Interlocks: Furnish terminals for remote contact to allow starting in automatic mode.

- I. Manual Bypass: Furnish contactor, motor running overload protection, and short circuit protection for full voltage, non-reversing operation of the motor. Include isolation switch to allow maintenance of inverter during bypass operation.
- J. Disconnecting Means: Include integral circuit breaker on the line side of each controller.
- K. Wiring Terminations: Match conductor materials and sizes indicated.

2.5 SOURCE QUALITY CONTROL

- A. Make completed controller available for inspection at manufacturer's factory prior to packaging for shipment. Notify Owner at least 7 days before inspection is allowed.
- B. Allow witnessing of factory inspections and tests at manufacturer's test facility. Notify Owner at least 7 days before inspections and tests are scheduled.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that surface is suitable for controller installation.
- B. Do not install controller until building environment can be maintained within the service conditions required by the manufacturer.
- C. Verify that field measurements are as indicated on shop drawings.

3.2 INSTALLATION

- A. Install in accordance with NEMA ICS 7.1 and manufacturer's instructions.
- B. Provide required support and attachment in accordance with Section 26 0529.
- C. Provide required seismic controls in accordance with Section 26 0548.
- D. Tighten accessible connections and mechanical fasteners after placing controller.
- E. Select and install overload heater elements in motor controllers to match installed motor characteristics.
- F. Identify variable frequency controllers in accordance with Section 26 0553.

3.3 FIELD QUALITY CONTROL

- A. Provide the service of the manufacturer's field representative to prepare and start controllers.
- B. Perform field inspection and testing in accordance with Section 01 4000.
- C. Inspect and test in accordance with NETA ATS, except Section 4.
- D. Perform inspections and tests listed in NETA ATS, Section 7.17. The insulation-resistance test on control wiring listed as optional is not required.

3.4 ADJUSTING

- A. Make final adjustments to installed controller to assure proper operation of load system. Obtain performance requirements from installer of driven loads.

3.5 CLOSEOUT ACTIVITIES

- A. Demonstrate operation of controllers in automatic and manual modes.

3.6 MAINTENANCE

- A. See Section 01 7000 - Execution Requirements, for additional requirements relating to maintenance service.
- B. Provide service and maintenance of controllers for one year from Date of Substantial Completion.

END OF SECTION

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SECTION 26 4300 - SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Surge protective devices for service entrance locations.
- B. Surge protective devices for distribution locations.
- C. Surge protective devices for branch panelboard locations.

1.2 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 2416 - Panelboards.

1.3 ABBREVIATIONS AND ACRONYMS

- A. EMI/RFI: Electromagnetic Interference/Radio Frequency Interference.
- B. SPD: Surge Protective Device.

1.4 REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems 2017.
- D. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- E. UL 1449 - Standard for Surge Protective Devices Current Edition, Including All Revisions.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Coordinate size and location of overcurrent device compatible with the actual surge protective device and location to be installed. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to ordering equipment.

1.6 SUBMITTALS

- A. Product Data: Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.

- B. Operation and Maintenance Data: Include information on status indicators and recommended maintenance procedures and intervals.
- C. Warranty: Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.8 DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in accordance with manufacturer's written instructions.

1.9 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.10 WARRANTY

- A. See ~~Section 01 7800—Closeout Submittals~~, for additional warranty requirements.

McGill Section 017700
- B. Manufacturer's Warranty: Provide minimum five-year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
- C. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Factory-installed, Internally Mounted Surge Protective Devices for new or replacement panels:
 - 1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.
- B. Field-installed, Externally Mounted Surge Protective Devices for existing panels:
 - 1. Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

- C. Source Limitations: Furnish surge protective devices produced by a single manufacturer and obtained from a single supplier.

2.2 SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description: Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the drawings.
- B. Unless otherwise indicated, provide field-installed, externally-mounted or factory-installed, internally-mounted SPDs.
- C. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
- D. Protected Modes:
 - 1. Wye Systems: L-N, L-G, N-G, L-L.
- E. UL 1449 Voltage Protection Ratings (VPRs):
 - 1. 208Y/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
 - 2. 240/120V System Voltage: Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
 - 3. 480Y/277V System Voltage: Not more than 1,500 V for L-N, L-G, and N-G modes and 2,000 V for L-L mode.
- F. UL 1449 Maximum Continuous Operating Voltage (MCOV): Not less than 115% of nominal system voltage.
- G. Enclosure Environment Type per NEMA 250: Unless otherwise indicated, as specified for the following installation locations:
 - 1. Indoor clean, dry locations: Type 1.
 - 2. Outdoor and indoor wet locations: Type 3R.
 - 3. Outdoor/Indoor Corrosive locations: Type 4X.
 - 4. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
- H. Equipment Containing Factory-installed, Internally Mounted SPDs: Listed and labeled as a complete assembly including SPD.
- I. Unless otherwise indicated, provide factory-installed, internally mounted SPDs.

1. List and label as complying with UL 1449, Type 1 when connected on line side of service disconnect overcurrent device and Type 1 or 2 when connected on load side of service disconnect overcurrent device.
2. Panelboards: See Section 26 2416.
3. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
4. Repetitive Surge Current Capacity: Not less than 5,000 impulses.
5. UL 1449 Nominal Discharge Current (I-n): 20 kA.
6. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
7. EMI/RFI Filtering: Provide EMI/RFI filter to attenuate electrical noise; listed as complying with UL 1283 for Type 2 SPDs (UL 1283 listing not available for Type 1 SPDs).

2.3 SURGE PROTECTIVE DEVICES FOR SERVICE ENTRANCE LOCATIONS

- A. Unless otherwise indicated, provide field-installed, externally mounted or factory-installed, internally mounted SPDs.
- B. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.
 1. Surge Protective Device:
 - a. Protection Circuits: Field-replaceable modular or non-modular.
 - b. Surge Current Rating: Not less than 120 kA per mode/240 kA per phase.
 - c. Repetitive Surge Current Capacity: Not less than 5,000 impulses.
 - d. UL 1449 Nominal Discharge Current (I-n): 20 kA.
 - e. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
 - f. Diagnostics:
 - 1) Protection Status Monitoring: Provide indicator lights to report the protection for each phase.
 - 2) Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
 - 3) Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six-digit LCD display that indicates quantity of surge events.

- g. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.4 SURGE PROTECTIVE DEVICES FOR DISTRIBUTION LOCATIONS

- A. Distribution locations include SPDs connected to distribution panelboards.
- B. Surge Protective Device:
 - 1. Protection Circuits: Field-replaceable modular or non-modular.
 - 2. Surge Current Rating: Not less than 80 kA per mode/160 kA per phase.
 - 3. Repetitive Surge Current Capacity: Not less than 3,500 impulses.
 - 4. UL 1449 Nominal Discharge Current (I-n): 20 kA.
 - 5. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
 - 6. Diagnostics:
 - a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
 - b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
 - c. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six-digit LCD display that indicates quantity of surge events.
 - 7. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

2.5 SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

- A. Surge Protective Device:
 - 1. Protection Circuits: Field-replaceable modular or non-modular.
 - 2. Surge Current Rating: Not less than 60 kA per mode/120 kA per phase.
 - 3. Repetitive Surge Current Capacity: Not less than 2,000 impulses.
 - 4. UL 1449 Nominal Discharge Current (I-n): 20 kA.
 - 5. UL 1449 Short Circuit Current Rating (SCCR): Not less than the available fault current at the installed location as indicated on the drawings.
 - 6. Diagnostics:

- a. Protection Status Monitoring: Provide indicator lights to report the protection status for each phase.
 - b. Alarm Notification: Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
 - c. Surge Counter: Provide surge event counter with manual reset button, surge count retention upon power loss, and six-digit LCD display that indicates quantity of surge events.
7. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 26 0526, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- E. Provide conductors with minimum ampacity as required by NFPA 70, as required by NFPA 70, and as required by NFPA 70.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.

- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 26 0526 where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.3 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS Section 7.19.1.
- D. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.

3.4 CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

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SECTION 26 5100 - INTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Accessories.

1.2 RELATED REQUIREMENTS

- A. Section 26 0529 - Hangers and Supports for Electrical Systems.
- B. Section 26 0533.16 - Boxes for Electrical Systems.
- C. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- D. Section 26 0923 - Lighting Control Devices: Automatic controls for lighting including occupancy sensors, time switches, and outdoor photo controls.
- E. Section 26 2726 - Wiring Devices: Manual wall switches.

1.3 REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules 2019.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- D. NECA/IESNA 500 - Standard for Installing Indoor Lighting Systems 2006.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems 2006.
- F. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices 2020.
- G. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012.
- H. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.
- I. NFPA 101 - Life Safety Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- J. UL 844 - Luminaires for Use in Hazardous (Classified) Locations Current Edition, Including All Revisions.
- K. UL 924 - Emergency Lighting and Power Equipment Current Edition, Including All Revisions.
- L. UL 1598 - Luminaires Current Edition, Including All Revisions.
- M. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
 - 2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
 - 3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
 - 4. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.

McGill Section 013300
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 - 2. Lamps: Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.

- D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See Section 01 6000 - Product Requirements, for additional provisions.
 - 2. Extra Lenses and Louvers: Two percent of total quantity installed for each type, but not less than one of each type.
 - 3. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
 - 4. Extra Driver: Two percent of total quantity installed for each type, but not less than one of each type.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications: Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND PROTECTION

- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.8 FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.9 WARRANTY

- A. See ~~Section 01 7800 - Closeout Submittals~~, for additional warranty requirements.

McGill Section 017000.
- B. Provide three-year manufacturer warranty for LED luminaires, including drivers.
- C. Provide five-year pro-rata warranty for batteries for emergency lighting units.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
- H. Hazardous (Classified) Location Luminaires: Listed and labeled as complying with UL 844 for the classification of the installed location. See plans for specific class and division rating.
- I. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 EMERGENCY LIGHTING UNITS

- A. Description: Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- B. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- C. Battery:

1. Sealed maintenance-free lead calcium unless otherwise indicated.
 2. Size battery to supply all connected lamps, including emergency remote heads where indicated.
- D. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- E. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- F. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- G. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.
- H. Accessories:
1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.4 EXIT SIGNS

- A. Description: Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
1. Number of Faces: Single or double as indicated or as required for the installed location.
 2. Directional Arrows: As indicated or as required for the installed location.
- B. Self-Powered Exit Signs:
1. Operation: Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
 2. Battery: Sealed maintenance-free nickel cadmium unless otherwise indicated.
 3. Diagnostics: Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
 4. Provide low-voltage disconnect to prevent battery damage from deep discharge.
 5. Self-Diagnostics: Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test

and diagnostic status.

2.5 DRIVERS

A. Ballasts/Drivers - General Requirements:

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
3. Electronic Ballasts/Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.

B. Dimmable LED Drivers:

1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility: Fully compatible with the dimming controls to be installed.
 - a. Wall Dimmers: See Section 26 2726.

2.6 ACCESSORIES

- A. Stems for Suspended Luminaires: Steel tubing, minimum 1/2" size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires: Zinc-plated steel, minimum 1/4" size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Suspended Ceiling Mounted Luminaires:
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- I. Recessed Luminaires:
 - 1. Install trims tight to mounting surface with no visible light leakage.
 - 2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
- J. Suspended Luminaires:
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.

2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet between supports.
 4. Install canopies tight to mounting surface.
 5. Unless otherwise indicated, support pendants from swivel hangers.
- K. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- L. Install accessories furnished with each luminaire.
- M. Bond products and metal accessories to branch circuit equipment grounding conductor.
- N. Emergency Lighting Units:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- O. Exit Signs:
1. Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- P. Install lamps in each luminaire.
- Q. Lamp Burn-In: Operate lamps at full output for prescribed period per manufacturer's recommendations prior to use with any dimming controls. Replace lamps that fail prematurely due to improper lamp burn-in.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.
- E. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Architect/Engineer or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows: Set as indicated or as required to properly designate egress path as directed by Architect/Engineer or authority having jurisdiction.

3.6 CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect/Engineer, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

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SECTION 26 5600 - EXTERIOR LIGHTING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Exterior luminaires.
- B. Driver.
- C. Lamps.
- D. Luminaire accessories.

1.2 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Materials and installation requirements for concrete bases for poles.
- B. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- C. Section 26 0529 - Hangers and Supports for Electrical Systems.
- D. Section 26 0533.16 - Boxes for Electrical Systems.
- E. Section 26 0548 - Vibration and Seismic Controls for Electrical Systems.
- F. Section 26 2813 - Fuses.

1.3 REFERENCE STANDARDS

- A. AASHTO LTS - Standard Specifications for Structural Supports for Highway Signs, Luminaires and Traffic Signals 2013 (Revised 2019).
- B. ANSI O5.1 - American National Standard for Wood Poles - Specifications and Dimensions 2017.
- C. IEEE C2 - National Electrical Safety Code 2017.
- D. IES LM-79 - Approved Method: Optical and Electrical Measurements of Solid-State Lighting Products 2019.
- E. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules 2019.
- F. NECA 1 - Standard for Good Workmanship in Electrical Construction 2015.
- G. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems 2006.
- H. NEMA 410 - Performance Testing for Lighting Controls and Switching Devices 2020.
- I. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility 2012.
- J. NFPA 70 - National Electric Code; National Fire Protection Association; 2014.

- K. UL 1598 - Luminaires Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products Current Edition, Including All Revisions.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination:
 - 1. Notify Architect/Engineer of any conflicts or deviations from Contract Documents to obtain direction prior to proceeding with work.

1.5 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures.

McGill Section 013300
- B. Shop Drawings:
 - 1. Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
 - 2. Provide photometric calculations where luminaires are proposed for substitution upon request.
- C. Product Data: Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires:
 - a. Include estimated useful life, calculated based on IES LM-80 test data.
 - b. Include IES LM-79 test report upon request.
 - 2. Lamps: Include rated life and initial and mean lumen output.
- D. Operation and Maintenance Data: Instructions for each product including information on replacement parts.
- E. Maintenance Materials: Furnish the following for Owner's use in maintenance of project.
 - 1. See ~~Section 01 6000 - Product Requirements~~, for additional provisions.

McGill Section 017823.
 - 2. Extra Lamps: Ten percent of total quantity installed for each type, but not less than two of each type.
 - 3. Extra Driver: Two percent of total quantity installed for each type, but not less than one of each type.

4. Extra Fuses: Five percent of total quantity installed for each type, but not less than two of each type.

1.6 QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications: An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.
- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- C. Receive, handle, and store wood poles in accordance with ANSI O5.1.

1.8 WARRANTY

- A. See ~~Section 01 7800—Closeout Submittals~~, for additional warranty requirements.

McGill Section 017700
- B. Provide three-year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.1 LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the drawings.

2.2 LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.

- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.
- H. Hazardous Areas: See plans for specific class and division rating. UL 1203 for the classification of the installed location.
- I. Recessed Luminaires:
 - 1. Ceiling Compatibility: Comply with NEMA LE 4.
 - 2. Luminaires Recessed in Insulated Ceilings: Listed and labeled as IC-rated, suitable for direct contact with insulation and combustible materials.
- J. LED Luminaires:
 - 1. Components: UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life: Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.3 DRIVERS

- A. Drivers - General Requirements:
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy: Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.
 - 3. Electronic Drivers: Inrush currents not exceeding peak currents specified in NEMA 410.
- B. Dimmable LED Drivers:
 - 1. Dimming Range: Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
 - 2. Control Compatibility: Fully compatible with the dimming controls to be installed.

2.4 LAMPS

- A. Manufacturers:
 - 1. Manufacturer Limitations: Where possible, provide lamps produced by a single manufacturer.
- B. Lamps - General Requirements:
 - 1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
 - 2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.

3. Minimum Efficiency: Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency: Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Architect/Engineer to be inconsistent in perceived color temperature.

2.5 ACCESSORIES

- A. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.2 PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.3 INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 26 0533.16 as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Provide required support and attachment in accordance with Section 26 0529.
- F. Provide required seismic controls in accordance with Section 26 0548.
- G. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- H. Recessed Luminaires:

1. Install trims tight to mounting surface with no visible light leakage.
2. Non-IC Rated Luminaires: Maintain required separation from insulation and combustible materials according to listing.
- I. Wall-Mounted Luminaires: Unless otherwise indicated, specified mounting heights are to center of luminaire.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. Install lamps in each luminaire.

3.4 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for additional requirements.
- B. Inspect each product for damage and defects.
- C. Operate each luminaire after installation and connection to verify proper operation.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Architect/Engineer.

3.5 ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Architect/Engineer. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics: Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Architect/Engineer.

3.6 CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.7 CLOSEOUT ACTIVITIES

- A. See Section 01 7800 - Closeout Submittals, for closeout submittals.
- B. See Section 01 7900 - Demonstration and Training, for additional requirements.
- C. Demonstration: Demonstrate proper operation of luminaires to Architect/Engineer, and correct deficiencies or make adjustments as directed.
- D. Just prior to Substantial Completion, replace all lamps that have failed.

3.8 PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

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SECTION 31 2316.13 - TRENCHING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Backfilling and compacting for utilities outside the building.

1.2 RELATED REQUIREMENTS

- ~~A. Appendix A Geotechnical Data: bore hole locations and findings of subsurface materials.~~
- ~~B. Section 31 2200 Grading: Site grading.~~
- ~~C. Section 31 2316 Excavation: Building and foundation excavating.~~
- ~~D. Section 31 2316.26 Rock Removal: Removal of rock during excavating.~~
- ~~E. Section 31 2323 Fill: Backfilling at building and foundations.~~

1.3 REFERENCES

- A. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop 2018.
- B. AASHTO T 99 - Standard Method of Test for Moisture-Density Relations of Soils Using a 2.5-kg (5.5-lb) Rammer and a 305-mm (12-in.) Drop 2015.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2019.
- D. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method 2015, with Editorial Revision (2016).
- E. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)) 2012 (Reapproved 2021).
- F. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method 2015.
- G. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) 2017a, with Editorial Revision.
- H. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision (2020).
- I. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)) 2012 (Reapproved 2021).
- J. VDOT Road and Bridge Standards - Virginia Department of Transportation Road and Bridge Standards 2016.

1.4 SUBMITTALS

- A. See ~~Section 01 3000 Administrative Requirements~~, for submittal procedures.

McGill Section 013300

- B. Compaction Density Test Reports.

1.5 FIELD MEASUREMENTS

- A. Unauthorized excavation consists of removal of materials beyond indicated subgrade elevations or side dimensions, without specific approval of Engineer. Unauthorized excavation shall be replaced at Contractor's expense.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When fill materials need to be stored on site, locate stockpiles where directed by the Engineer.
1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 2. Prevent contamination.
 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.1 FILL MATERIALS

- A. Aggregate fill shall meet VDOT requirements for No. 25 or No. 26 crusher run aggregate or No. 57 coarse aggregate.
- B. Clean earth fill shall be free of debris, roots, frozen materials, organic matter, rock or gravel larger than 1 inch in any dimension or other harmful matter.
- C. Native fill shall be 95 percent free of stones larger than 4 inches in any dimension or other harmful matter.
- D. Bedding Material: From trench bottom to 1/6 of outside pipe diameter.
1. Pipe: Clean earth fill or aggregate fill.
 2. PVC Pipe: Aggregate fill.
- E. Bedding for Structures: Aggregate fill.
- F. Initial Backfill: From 1/6 of outside pipe diameter to 12 inches minimum above pipe.
1. Pipe: Clean earth fill or aggregate fill.
 2. PVC Pipe: Aggregate fill.
- G. Final Backfill to Subgrade:
1. Under Traveled Rights-of-Way: Aggregate fill.

2. Under Landscape, Road Shoulders, and Existing or Future Paved Areas: Native fill or aggregate fill.

2.2 ACCESSORIES

- A. Concrete: Class A3 concrete conforming to VDOT Road and Bridge Standards.
 1. Compressive strength of 3,000 psi at 28 days.
 2. Air entrained, content of 6% (plus or minus 2%).
 3. Water cement ratio of 0.49.
 4. Slump of 1-5 inches.
 5. Minimum cement content of 588 lbs. per cubic yard.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey benchmarks and intended elevations for the work are as indicated.

3.2 PREPARATION

- A. Call Local Utility Line Information service at number shown on Drawings not less than three working days before performing Work.
 1. Request underground utilities to be located and marked within and surrounding construction areas.
- B. Identify required lines, levels, contours, and datum locations.
- C. ~~See Section 31-2200 for additional requirements.~~
- D. Locate, identify, and protect utilities that remain and protect from damage.
- E. Protect bench marks, survey control points, existing structures, fences, sidewalks, paving, and curbs from excavating equipment and vehicular traffic.
- F. Protect plants, lawns, rock outcroppings, and other features to remain.

3.3 TRENCHING

- A. Notify Architect/Engineer of unexpected subsurface conditions and discontinue affected Work in area until notified to resume work.
- B. Slope banks of excavations deeper than 4 feet to angle of repose or less until shored.
- C. Do not interfere with 45 degree bearing splay of foundations.
- D. Cut trenches wide enough to allow inspection of installed utilities.

- E. Hand trim excavations. Remove loose matter.
- F. Remove large stones and other hard matter that could damage piping or impede consistent backfilling or compaction.
- G. Remove lumped subsoil, boulders, and rock up to 1/3 cu yd measured by volume. See Section 31 2316.26 for removal of larger material.
- H. Remove excavated material that is unsuitable for re-use from site.
- I. Remove excess excavated material from site.
- J. Trench Width: Excavate bottom of trenches in accordance with the following schedule or as indicated on Drawings:
 - 1. 0 - 6' Trench Depth: Outside diameter of pipe bell, plus 12 inches.
 - 2. Greater than 6' Trench Depth: Outside diameter of pipe bell, plus 12 inches, plus 2 inches of width per foot for each foot of depth greater than 6 feet.
- K. Maintain vertical faces to an elevation equal to 12 inches above top of pipe.
 - 1. When Project conditions permit, side walls may be sloped or benched above this elevation.
 - 2. When side walls cannot be sloped, provide sheeting and shoring to protect excavation as specified in this Section.
- L. Support Utilities and Structures:
 - 1. Keep trench width at top of trench to practical minimum to protect adjacent or crossing utility lines.
 - 2. Support utilities crossing trench by means acceptable to utility company.
 - 3. Do not interfere with 45-degree bearing splay of foundations.
 - 4. Provide temporary support for structures above and below ground.
- M. When subsurface materials at bottom of trench are loose or soft, excavate to firm subgrade or to depth directed by Engineer.
 - 1. Cut out soft areas of subgrade not capable of compaction in place.
 - 2. Backfill with aggregate fill and compact to density equal to or greater than requirements of subsequent backfill material.
- N. When rock is encountered, excavate rock encountered 6 inches below the pipe for pipe bedding.
- O. Where rock is encountered so that a manhole, vault, or other structure will bear on rock, it shall be used to support the foundation. Where only a part of the foundation will bear on

rock, at least 8 inches of compacted granular material shall be provided below bottom of footings.

- P. Trim excavation. Hand trim for bell and spigot pipe joints where required. Shape trench bottom to afford circumferential support to the lower fourth of the pipe or excavate 6 inches below bottom of pipe for pipe bedding. Remove loose matter.
- Q. Excavate trench bottom for PVC pipe to a depth 3 inches below the pipe and backfill overdepth with aggregate fill.
- R. Correct over excavated areas with compacted backfill as specified for authorized excavation or replace with flowable fill as directed by Engineer.

3.4 SHEETING AND SHORING

- A. Sheet, shore, and brace excavations to prevent danger to persons, structures and adjacent properties and to prevent caving, erosion, and loss of surrounding subsoil.
- B. Support trenches more than 5 feet deep excavated through unstable, loose, or soft material. Provide sheeting, shoring, bracing, or other protection to maintain stability of excavation.
- C. Design sheeting and shoring to be removed at completion of excavation work.
- D. Repair damage caused by failure of the sheeting, shoring, or bracing and for settlement of filled excavations or adjacent soil.
- E. Repair damage to new and existing Work from settlement, water or earth pressure or other causes resulting from inadequate sheeting, shoring, or bracing.

3.5 SURFACE WATER CONTROL

- A. Control and remove unanticipated water seepage into excavation.
- B. Provide ditches, berms, and other devices to divert and drain surface water from excavation area.
- C. Divert surface water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

3.6 DEWATERING

- A. Design and provide dewatering system to permit Work to be completed on dry and stable subgrade.
- B. When dewatering system cannot control water within excavation, notify Engineer and stop excavation work.
- C. Modify dewatering systems when operation causes or threatens to cause damage to new construction, existing site improvements, adjacent property, or adjacent water wells.
- D. Discharge ground water and seepage water within excavation areas into sumps or settling basins prior to pumping water into drainage channels and storm drains.

- E. Remove dewatering and surface water control systems after dewatering operations are discontinued.

3.7 BEDDING, HAUNCHING, AND INITIAL BACKFILL

- A. Place bedding full width of trench to the depth indicated on Drawings and compact by tamping or rodding to prevent settlement. Perform in accordance with schedule at end of this Section.
- B. Install utility pipe and conduit in accordance with the respective utility section.
- C. Support pipe uniformly along entire length of pipe.
- D. Carefully place initial backfill to 12 inches above top of pipe or to depth indicated on Drawings. Compact in accordance with schedule at end of this Section.
- E. Backfill shall be placed by hand, uniformly on each side of the pipe and compacted in layers not exceeding 6 inches.

3.8 FINAL BACKFILLING TO SUBGRADE

- A. Backfill to contours and elevations indicated using unfrozen materials.
- B. Fill up to finish grade elevations unless otherwise indicated.
- C. Employ a placement method that does not disturb or damage other work.
- D. Systematically fill to allow maximum time for natural settlement. Do not fill over porous, wet, frozen or spongy subgrade surfaces.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Place fill material in continuous layers and compact in accordance with schedule at end of this section.
- G. Layers shall not exceed 12 inches. Under road shoulders and under existing or future paved areas, layers shall not exceed 8 inches.
- H. Employ compaction equipment suitable for materials to be compacted and work area locations. Use power driven hand tampers for compacting materials adjacent to structures.
- I. Replace topsoil to at least original depth in areas to be seeded.

3.9 DISPOSAL OF EXCESS OR UNSATISFACTORY MATERIALS

- A. Dispose of excess or unsatisfactory material offsite and legally.

3.10 TOLERANCES

- A. Top Surface of General Backfilling: Plus or minus 1 inch from required elevations.

3.11 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform laboratory material tests in accordance with ASTM D1557 or AASHTO T 180.
- C. Perform in place compaction tests in accordance with the following:
 - 1. Density Tests: ASTM D1556/D1556M, ASTM D2167, ASTM D6938, or ASTM D698 (AASHTO T 99).
 - 2. Moisture Tests: ASTM D6938.
- D. Frequency of Tests: One test per lift for every 1,000 feet of trench.
- E. Contractor shall employ an independent testing firm to assure compliance with these specifications for materials and compaction.
- F. If tests indicate Work does not meet specified requirements, remove Work, replace, compact, and retest.

3.12 PROTECTION OF FINISHED WORK

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Protecting finished Work.
- B. Reshape and re-compact fills subjected to vehicular traffic during construction.

3.13 CLEANING

- A. Leave unused materials in a neat, compact stockpile.
- B. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- C. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

3.14 SCHEDULE OF COMPACTION

- A. Compact each layer of fill or backfill to not less than the following percentages of the maximum density at optimum moisture content as determined by ASTM D698 (AASHTO T 99):
 - 1. 100 percent beneath and within 25 feet of buildings and structures, including those shown for future construction.
 - 2. 95 percent beneath pavements, walks, and road shoulders, including those shown for future construction.
 - 3. 90 percent in other unpaved areas.

END OF SECTION

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SECTION 32 1123 - AGGREGATE BASE COURSES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Aggregate base course.

1.2 RELATED REQUIREMENTS

- A. ~~Section 31 2200 - Grading: Preparation of site for base course.~~
- B. Section 31 2316.13 - Trenching: Compacted fill over utility trenches under base course.
- C. ~~Section 31 2323 - Fill: Topsoil fill at areas adjacent to aggregate base course; compacted fill under base course.~~

1.3 REFERENCE STANDARDS

- A. AASHTO M 147 - Standard Specification for Materials for Aggregate and Soil-Aggregate Subbase, Base, and Surface Courses 2017 (Reapproved 2021).
- B. AASHTO T 180 - Standard Specification for Moisture-Density Relations of Soils Using a 4.54-kg (10-lb) Rammer and a 457-mm (18 in.) Drop 2018.
- C. ASTM C136/C136M - Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates 2019.
- D. ASTM D2487 - Standard Practice for Classification of Soils for Engineering Purposes (Unified Soil Classification System) 2017, with Editorial Revision (2020).
- E. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft³ (600 kN-m/m³)) 2012 (Reapproved 2021).
- F. ASTM D1556/D1556M - Standard Test Method for Density and Unit Weight of Soil in Place by Sand-Cone Method 2015, with Editorial Revision (2016).
- G. ASTM D1557 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft³ (2,700 kN-m/m³)) 2012 (Reapproved 2021).
- H. ASTM D2167 - Standard Test Method for Density and Unit Weight of Soil in Place by the Rubber Balloon Method 2015.
- I. ASTM D4318 - Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils 2017, with Editorial Revision (2018).
- J. ASTM D6938 - Standard Test Methods for In-Place Density and Water Content of Soil and Soil-Aggregate by Nuclear Methods (Shallow Depth) 2017a, with Editorial Revision.
- K. VDOT Road and Bridge Specifications - Virginia Department of Transportation Road and Bridge Specifications 2016.

1.4 SUBMITTALS

- A. See ~~Section 01 3000 Administrative Requirements~~, for submittal procedures.

McGill Section 013300

1.5 DELIVERY, STORAGE, AND HANDLING

- A. When necessary, store materials on site in advance of need.
- B. When aggregate materials need to be stored on site, locate where directed by Owner.
- C. Aggregate Storage, General:
 - 1. Separate differing materials with dividers or stockpile separately to prevent intermixing.
 - 2. Prevent contamination.
 - 3. Protect stockpiles from erosion and deterioration of materials.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Subbase and Aggregate Base Material: Coarse aggregate type as indicated on Drawings conforming to Section 208 of the VDOT Road and Bridge Specifications.
- B. Coarse Aggregate: Coarse aggregate type as indicated on Drawings conforming to Section 203 of the VDOT Road and Bridge Specifications.
- C. Crusher Run Aggregate: Crusher run aggregate type as indicated on Drawings conforming to Section 205 of the VDOT Road and Bridge Specifications.
- D. Geotextile Fabric: Non-biodegradable, type as indicated on the Drawings conforming to Section 245 of the VDOT Road and Bridge Specifications.

2.2 SOURCE QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for testing and analysis of aggregate materials.
- B. Where aggregate materials are specified using ASTM D2487 classification, test and analyze samples for compliance before delivery to site.
- C. Use sources approved by VDOT.
- D. Perform Work in accordance with VDOT Road and Bridge Specifications; maintain one copy of document on site.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that survey bench marks and intended elevations for the work are as indicated.

- B. Verify substrate has been inspected, gradients and elevations are correct, and is dry.

3.2 PREPARATION

- A. Correct irregularities in substrate gradient and elevation by scarifying, reshaping, and re-compacting.
- B. Do not place aggregate on soft, muddy, or frozen surfaces.

3.3 INSTALLATION

- A. Place aggregate in minimum 3-inch and maximum 6-inch layers and roller compact to specified density. When total thickness is 6 inches or less, place in one layer. When total thickness is greater than 6 inches, place in two equal layers.
- B. Have each layer of material compacted and approved prior to placing succeeding layers.
- C. Level and contour surfaces to elevations and gradients indicated on Drawings.
- D. Add small quantities of fine aggregate to coarse aggregate when required to assist compaction.
- E. Maintain optimum moisture content of fill materials to attain required compaction density.
- F. Use mechanical tamping equipment in areas inaccessible to compaction equipment.

3.4 TOLERANCES

- A. Flatness: Maximum variation of 1/2-inch measured with 10 foot straight edge.
- B. Scheduled Compacted Thickness: Within 1/2-inch.
- C. Variation From Design Elevation: Within 1/2-inch.

3.5 FIELD QUALITY CONTROL

- A. See Section 01 4000 - Quality Requirements, for general requirements for field inspection and testing.
- B. Perform compaction density testing on compacted aggregate base course in accordance with ASTM D1556.
- C. Evaluate results in relation to compaction curve determined by testing uncompacted material in accordance with ASTM D698 ("Standard Proctor").
- D. If tests indicate work does not meet specified requirements, remove work, replace and retest.
- E. Frequency of Tests: Two tests per layer for every 5,000 square feet.
- F. Proof roll compacted aggregate at surfaces that will be under slabs-on-grade, pavers, and paving.

3.6 CLEANING

- A. Remove unused stockpiled materials, leave area in a clean and neat condition. Grade stockpile area to prevent standing surface water.
- B. Leave borrow areas in a clean and neat condition. Grade to prevent standing surface water.

END OF SECTION

SECTION 32 1216 - ASPHALT PAVING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Single course bituminous concrete paving.
- B. Double course bituminous concrete paving.
- C. Surface sealer.

1.2 RELATED REQUIREMENTS

- ~~A. Section 31 2200 - Grading: Preparation of site for paving and base.~~
- ~~B. Section 31 2323 - Fill: Compacted subgrade for paving.~~
- C. Section 32 1123 - Aggregate Base Courses: Aggregate base course.
- D. Section {CH#10013186}.13 - Painted Pavement Markings: Pavement markings.

1.3 REFERENCE STANDARDS

- A. AI MS-2 - Asphalt Mix Design Methods 2015.
- B. AI MS-19 - Basic Asphalt Emulsion Manual 2008.
- C. ASTM D946 - Standard Specification for Penetration-Graded Asphalt Cement for Use in Pavement Construction 2009a.
- D. Virginia Department of Transportation (VDOT): Road and Bridge Standards and Specifications; latest edition.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Submit product information for asphalt and aggregate materials.
 - 2. Submit mix design with laboratory test results supporting design.
- B. Manufacturer's Certification: Certify products are produced at a plant approved by VDOT and meet or exceed specified requirements.

1.5 QUALITY ASSURANCE

- A. Perform Work in accordance with Section 315 of the VDOT Road and Bridge Specifications.
- B. Maintain one copy of document on site.
- C. Obtain materials from the same source throughout.
- D. Use sources and mixing plant approved by VDOT.

1.6 FIELD CONDITIONS

- A. Do not place asphalt base course or intermediate course when ambient air or road surface temperature is less than 40 degrees F for Mix Designation A; 50 degrees F for Mix Designations D, E, M, and S; or if surface is wet or frozen.
- B. Do not place asphalt surface course when ambient air or base surface temperature is less than 40 degrees F for Mix Designation A; 50 degrees F for Mix Designations D, E, M, and S; or if surface is wet or frozen.
- C. Place bitumen mixture when temperature is not more than 15 degrees F less than initial mixing temperature and not more than maximum specified temperature.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Asphalt Concrete Materials: Conform to Section 211 of VDOT Road and Bridge Specifications.
- B. Prime Coat and Tack Coat: Conform to Sections 310 and 311 of VDOT Road and Bridge Specifications.
- C. Sand: Fine aggregate, natural sand or stone sand conforming to Section 202 of VDOT Road and Bridge Specifications.
- D. Mineral Filler: Finely ground particles of limestone, hydrated lime or other mineral dust, free of foreign matter.

2.2 ASPHALT PAVING MIXES AND MIX DESIGN

- A. Use dry material to avoid foaming. Mix uniformly.
- B. General: Use Superpave mix design conforming to Section 211 of the VDOT Road and Bridge Specifications.
- C. Wedging or Leveling Mix: Conform to intermediate course.
- D. Submit proposed mix design of each class of mix for review prior to beginning of Work.

2.3 PAVEMENT SEALCOAT

- A. Pavement sealcoat meeting the requirements of ASTM D5727, RP-355E, ASTM D490 and ASTM D3320-74T shall be SealMaster Coal Tar Concrete Pavement Sealer or approved equal.

2.4 SOURCE QUALITY CONTROL

- A. Obtain materials from plant approved by VDOT.
- B. Test plant samples and mix design in accordance with Section 211 of the VDOT Road and Bridge Specifications.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify utilities indicated under paving are installed with excavations and trenches backfilled and compacted.
- B. Verify compacted subgrade and aggregate base is dry and ready to support paving and imposed loads.
- C. Verify gradients and elevations of base are correct.
- D. Verify utility structure frames and lids are installed in correct position and elevation.

3.2 BASE COURSE

- A. Place and compact base course.

3.3 PREPARATION - PRIMER

- A. Apply primer in accordance with Section 311 of the VDOT Road and Bridge Specifications.
- B. Apply primer to contact surfaces of curbs and gutters.
- C. Use clean sand to blot excess primer.

3.4 PREPARATION - TACK COAT

- A. Apply tack coat in accordance with Section 310 of the VDOT Road and Bridge Specifications.
- B. Apply tack coat on asphalt or concrete surfaces over subgrade surface at uniform rate of 0.05 to 0.10 gallon/sq. yd. (undiluted) and 0.10 to 0.15 gallon/sq. yd. (diluted).
- C. Apply tack coat to contact surfaces of curbs and gutters.
- D. Coat surfaces of manhole, catch basin, and utility structure frames with oil to prevent bond with asphalt pavement. Do not tack coat these surfaces.

3.5 PLACING ASPHALT PAVEMENT - SINGLE COURSE

- A. Install Work in accordance with Section 315 of the VDOT Road and Bridge Specifications.
- B. Place asphalt within 24 hours of applying primer or tack coat.
- C. Place to thickness identified on the Drawings.
- D. Install manhole frames and covers in correct position and elevation.
- E. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- F. Perform rolling with consecutive passes to achieve even and smooth finish without roller marks.

3.6 PLACING ASPHALT PAVEMENT - DOUBLE COURSE

- A. Place asphalt binder course within 24 hours of applying primer or tack coat.
- B. Place wearing course within two hours of placing and compacting binder course.
- C. Install gutter drainage grilles and frames, manhole frames, and covers in correct position and elevation.
- D. Compact pavement by rolling to specified density. Do not displace or extrude pavement from position. Hand compact in areas inaccessible to rolling equipment.
- E. Perform rolling with consecutive passes to achieve even and smooth finish, without roller marks.

3.7 JOINTS

- A. Transverse Joints
 - 1. When Work is suspended long enough to allow mixture to chill, construct transverse joint.
 - 2. Use butt joint when traffic will not pass over pavement.
 - 3. Use sloped wedge ahead of the end of pavement when traffic will pass over pavement. Place paper parting strip to removal of wedge.
 - 4. Tack coat edge of pavement prior to placing adjoining pavement.
- B. Longitudinal Joints
 - 1. Pinch joint by rolling immediately behind the paver.
 - 2. Offset longitudinal joints in each layer by approximately 6 inches.

3.8 PAVEMENT SEALCOAT

- A. Mixing procedures shall be in accordance with the manufacturer's mix design.
- B. Apply properly mixed Coal Tar Sealer at a rate of 0.11 to 0.13 gallon/square yard per coat. Two (2) coats shall be applied of properly mixed SealMaster Coal Tar and three (3) coats in high traffic areas such as entrances, exits, and drive lines.

3.9 TOLERANCES

- A. Flatness: Maximum variation of 1/4 inch measured with 10 foot straight edge.
- B. Variation from True Elevation: Within 1/2 inch.

3.10 FIELD QUALITY CONTROL

- A. Perform Contractor Quality Control Program in accordance with Section 315 of VDOT Road and Bridge Specifications.

- B. When tests indicate Work does not meet specified requirements, remove Work, replace, and retest.

3.11 PROTECTION

- A. Immediately after placement, protect pavement from mechanical injury for 7 days or until surface temperature is less than 140 degrees F.

END OF SECTION

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SECTION 33 0519 - PRESSURE PIPING TIED JOINT RESTRAINT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Tied joint restraint system.

1.2 RELATED REQUIREMENTS

- A. Section 31 2316.13 Trenching.
- ~~B. Section 33 3400 - Sanitary Utility Sewerage Force Mains.~~

1.3 REFERENCES

- A. American National Standards Institute (ANSI):
 - 1. ANSI B1.1 - Unified Inch Screw Threads.
- B. ASTM International (ASTM):
 - 1. ASTM A36/A36M - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 3. ASTM A143 - Practice for Safeguarding Against Embrittlement of Hot-Dip Galvanized Structural Steel Products and Procedure for Detecting Embrittlement.
 - 4. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60 000 PSI Tensile Strength.
 - 6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 7. ASTM A563 - Standard Specification for Carbon and Alloy Steel Nuts.
 - 8. ASTM A588/A588M - Specification for High Strength Low-Alloy Structural Steel with 50 ksi (345 MPa) Minimum Yield Point to 4 in. (100 mm) Thick.
 - 9. ASTM B633 - Specification for Electrodeposited Coating of Zinc on Iron and Steel.
 - 10. ASTM F436 - Specification for Hardened Steel Washers.
- C. American Water Work Association (AWWA):
 - 1. AWWA C600 - Installation of Ductile-Iron Water Mains and Their Appurtenances.

2. AWWA C605 - Underground Installation of Polyvinyl Chloride (PVC) Pressure Pipe and Fittings for Water.

1.4 DESIGN REQUIREMENTS

- A. Provide pressure pipeline with restrained joints at each bends, tees, and changes in direction.
- B. Provide additional restraints as indicated on Drawings.

1.5 SUBMITTALS

- A. ~~Section 01 3000 – Administrative Requirements:~~ Requirements for submittals.

McGill Section 013300
- B. Shop Drawings: Indicate restrained joint details and materials being utilized. Submit layout drawings showing piece numbers and locations. Also, indicate restrained joint locations.
- C. Product Data: Submit catalog data for restrained joint details and installation instructions.
- D. Design Data: Submit design calculations showing determination of restrained lengths and submit joint restraint details. Use joint restraint devices specifically designed for applications described in manufacturer's data.
- E. Manufacturer's Installation Instructions: Submit installation instructions.
- F. Manufacturer's Certificate: Certify products meet or exceed specified requirements.

1.6 CLOSEOUT SUBMITTALS

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Requirements for submittals.

McGill Section 017700

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years experience.
- B. Installer: Company specializing in performing Work of this Section with minimum 3 years documented experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. ~~Section 01 6000 – Product Requirements:~~ Requirements for transporting, handling, storing, and protecting products.

McGill Section 011200

PART 2 PRODUCTS

2.1 TIED JOINT RESTRAINT SYSTEM

- A. Manufacturers:
 1. Dresser Piping Specialties.
 2. Ebaa Iron Sales, Inc.

3. Star Pipe Products, Inc.
4. Substitutions: Equal per Section 01 6000 - Product Requirements.

2.2 MATERIALS

A. Steel Types:

1. High Strength Low-Alloy Steel, ASTM A588, heat-treated.
2. High Strength Low-Alloy Steel, ASTM A588.
3. Carbon Steel ASTM A36.

2.3 COMPONENTS

A. Tie Bolts:

1. 5/8-inch for 2-inch and 3-inch mechanical joints, 3/4 inch for 4 inch to 12 inch mechanical joints and flanged joints, ASTM A588, Grade B; ASTM A325, Type 3, except increase tensile strength of full-body threaded section to 40,000 pounds minimum for 5/8 inch and 60,000 pounds minimum for 3/4 inch by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.
2. 3/4-inch for 14-inch to 24-inch mechanical joints, ASTM A588, Grade B; ASTM A325, Type 3.
3. 1 inch for 30-inch and larger mechanical joints and flanged joints, ASTM A588, Grade B; ASTM A325, Type 3; except increase tensile strength of full-body thread section to 100,000 pounds minimum by heat-treating (quenching and tempering) to manufacturer's reheat and hardness specifications.

B. Tie Nut: Hex nut for each tie bolt and tie rods.

1. ASTM A563, Grade C3; plain, zinc plated, or galvanized.

C. Tiepin: 3/4-inch round bar stock for use on bends and hydrants.

1. 6 inch hairpin shape, ASTM A588; ANSI B1.1; plain, zinc plated, or galvanized.

D. Tie Coupling: Used to extend continuous threaded rods and provided with center stop to aid installation.

1. ASTM A588; plain, zinc plated, or galvanized.

E. Tie Clamp: Retainer clamp for ductile iron, asbestos cement and polyvinyl chloride, push-on pipe in front of bell.

1. ASTM A36; ASTM A307 Grade A; ASTM A563, Grade A; plain, zinc plated, or galvanized.

F. Tie Rod: Continuous threaded rod for cutting to desired lengths.

1. ASTM A588, Grade B; ASTM A325, Type 3; ANSI B1.1; plain zinc plated, or galvanized.
- G. Tie Bar: Steel bar used to restrain push-in plugs.
 1. ASTM A36; plain, zinc plated, or galvanized.
- H. Tie Washer: Round flat washers.
 1. ASTM A588, ASTM F436, Type 3; plain, zinc plated, or galvanized.

2.4 FACTORY APPLIED FINISHES - STEEL

- A. Items to be zinc plated or galvanized to meet the following requirements:
 1. ASTM B633 for electrodeposited coating of zinc on steel.
 2. ASTM A153 for galvanizing iron and steel hardware.
 3. Galvanizing for rolled, pressed, and forged steel shapes: ASTM A123; minimum 2.0 ounces per square foot coating thickness; galvanize after fabrication.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify pipe and fittings are ready to receive Work.
- B. Field measure and verify conditions.

3.2 PREPARATION

- A. Clean surfaces of pipe and fittings to receive tied joint restraint system.

3.3 INSTALLATION

- A. Excavate and backfill in accordance with Section 31 2317 - Trenching.
- B. Install pipe and fittings in accordance with 33 1116 - Water Utility Distribution Piping.
- C. Install joint restraint system so joints are mechanically locked together to prevent joint separation.

3.4 ERECTION TOLERANCES

- A. Section 01 4000 - Quality Requirements: Tolerances.
- B. Torque nuts on mating threaded fasteners to 45 foot pounds to 60 foot pounds for 5/8-inch nut or per manufacturer's recommendations.
- C. Torque nuts on mating threaded fasteners to 75 foot pounds to 90 foot pounds for 3/4-inch nut or per manufacturer's recommendations.

- D. Torque 1 inch nuts to 100 foot pounds to 120 foot pounds or per manufacturer's recommendations.

END OF SECTION

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SECTION 33 3210 - SEWAGE BYPASS PUMPING

PART 1 GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish all labor, materials, equipment, and incidentals to construct, maintain, and operate inflatable plugs, hoses, piping, and pumps to bypass sewage flow as necessary to perform the Work. The flow shall be diverted by pumping around the construction location to a downstream manhole or treatment unit. Bypass pumping shall be provided when necessary to prevent backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways, without diverting sewage outside of the sewer system or treatment plant.

1.2 QUALITY ASSURANCE

- A. The bypass system shall meet the requirements of all codes and regulatory agencies having jurisdiction. The Contractor shall be responsible for damage due to sewer backup or overflow onto streets, yards and unpaved areas or into buildings, adjacent ditches, storm sewers, and waterways.

1.3 SUBMITTALS

- A. ~~Section 01 3000 - Administrative Requirements:~~ Requirements for submittals.
McGill Section 013300
- B. The Contractor shall submit, prior to installation, a detailed sewage bypass pumping plan and description outlining all details and provisions of the temporary sewage bypass pumping system. The plan shall be specific and complete, including such items as schedules, locations, elevations, capacities of equipment, materials and all other incidental items necessary and/or required to assure proper operation of the bypass pumping system, including protection of the access and bypass pumping locations from damage due to the discharge flows, and compliance with the requirements and permit conditions specified in the contract documents. No bypass pumping shall begin until all provisions and requirements have been reviewed and approved by the Engineer.
- C. The sewage bypass pumping plan shall include but not be limited to the following:
 - 1. Staging areas for pumps.
 - 2. Flow stoppage system, including pipe and channel plugging method and types of plugs.
 - 3. Number, size, material, location, and method of installation of pump suction piping.
 - 4. Number, size, materials, method of installation, and location of installation of discharge piping.
 - 5. Bypass pump sizes, capacities, number quantities, and power requirements.
 - 6. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted)

7. Size and location of standby power generator, if required.
8. Downstream discharge plan.
9. Any thrust and restraint block sizes and locations.
10. Any temporary pipe supports and anchoring required.
11. Calculations for selection of bypass pumping pipe size.
12. Schedule for and installation of and maintenance of bypass pumping lines.
13. Plan indicating location of bypass pumping lines.
14. Wet weather operations.
15. Lateral service control/bypass method.
16. Backup equipment.

PART 2 PRODUCTS

2.1 MATERIALS

- A. Flow conditions are variable and will fluctuate throughout the day and vary by season, the sanitary sewer system is also susceptible to peaking factors up to 3 times in response to wet weather conditions, average daily flow (dry weather) is anticipated to be 1,000,000 gallons per day into to the wastewater plant.
- B. For all pumping operations using eight-inch or larger pumps, design piping, joints, and accessories to withstand at least twice the maximum system pressure or fifty pounds per square inch (psi), whichever is greater.
- C. Pumps shall be self-priming type or submersible electric, in good working order, with a working pressure gauge and a flow meter on the discharge. The contractor must supply all power. All pumps used must be constructed to allow dry running to accommodate for extended periods of time to accommodate the cyclical nature of sewer flows. Pump and pump generators intended for use beyond normal working hours shall be fitted with day tanks sufficiently sized to allow for 24 hours of uninterrupted operation at full throttle, and autodialer capable of notifying contractor whenever high sump level conditions or low fuel conditions are experienced. All pumps must be constructed with acoustical enclosures that shall reduce pump and engine noise to 69 dBa or less at a distance of 30 feet.
- D. Contractor shall provide stand-by pumps of adequate capacity.
- E. Use of sand bags is not permitted.

PART 3 EXECUTION

3.1 FIELD QUALITY CONTROL AND MAINTENANCE

- A. Any time the bypass pumping system is operating, an experienced operator shall be available to monitor the operation, adjust pump speed, valves, etc., and make minor repairs to the system and report problems. Contractor shall provide owner with names and numbers of contacts included in the autodialer. The bypass pumping operator shall be the primary contact for the system autodialer. Outside of normal working hours, Contractor shall be able to respond onsite to an autodial alert within 60 minutes of alert.
- B. During bypass pumping, do not allow sewage to be leaked, dumped, or spilled in or onto any area outside of the existing sewer system including but not limited to trenches and excavations. Leakage of sewage from pumps or hoses are cause for immediate stoppage of the Work.
- C. In the event of accidental spill or overflow, immediately stop the discharge and take action to clean up, disinfect the spill, and promptly notify the Owner and Engineer.
- D. Prevent backup of sewage in sewer laterals.
- E. In the event of rain, the contractor shall coordinate the operation of bypassing with the Engineer.
- F. Spare parts for each type of pump and piping shall be kept on site as required.

3.2 INSTALLATION AND REMOVAL

- A. Contractor shall locate bypass pipelines to minimize any disturbance to existing utilities and shall obtain approval of the pipeline locations from the Engineer.
- B. During all bypass pumping operations, the contractor shall protect existing structures and equipment from damage inflicted by any equipment. The contractor shall be responsible for all physical damage to the existing structures and equipment caused by human or mechanical failure.
- C. When working inside existing structures, the contractor shall exercise caution and comply with OSHA when working in the presence of gases, combustible or oxygen-deficient atmospheres, and confined spaces.
- D. The bypass pipeline must be located off streets and sidewalks and on shoulders of the roads. When the bypass pipeline crosses streets and driveways, the Contractor must place the bypass pipelines in Engineer-approved bump ramps.
- E. When bypass pumping operations are complete, piping shall be drained into the sewer prior to disassembly. Contractor shall take precautions, including flushing line, to prevent the spill of wastewater onto ground surface.

3.3 HYDROSTATIC TESTING

- A. Contractor shall perform hydrostatic testing of all bypass piping on bypass systems using 8-inch or larger pumps.
- B. Test Procedure:

1. Fill pipeline slowly to minimize air entrapment and surge pressures.
 2. Examine exposed joints and valves, and correct visible leakage.
 3. Pressurize line to 50 psi or filled, whichever is greater.
 4. Hold test pressure for a minimum of 15 minutes.
- C. Test Criteria: Pipeline shall hold test pressure for specified time period with zero drop in pressure.

END OF SECTION

SECTION 40 0552 - PROCESS VALVES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Ball valves - metal body.
- B. Butterfly valves - metal body.
- C. Gate valves - metal body.
- D. Pinch valves.
- E. Plug valves.
- F. Valve operators.
- G. Electric valve operators.
- H. Pneumatic valve operators.

1.2 RELATED REQUIREMENTS

- A. Section 40 2340 - Sanitary Wastewater Process Piping.
- B. Section 46 0106 - Operation and Maintenance Manual: Operating and maintenance data.
- C. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Valve finish colors.

1.3 REFERENCE STANDARDS

- A. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
- B. ASME B16.34 - Valves — Flanged, Threaded, and Welding End 2020.
- C. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service 2021.
- D. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings 2012.
- E. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings 2017.
- F. AWWA C504 - Rubber-Seated Butterfly Valves 2015.
- G. AWWA C509 - Resilient-Seated Gate Valves for Water Supply Service 2015.
- H. AWWA C541 - Hydraulic and Pneumatic Cylinder and Vane-Type Actuators for Valves and Slide Gates 2016.
- I. AWWA C542 - Electric Motor Actuators for Valves and Slide Gates 2016.

- J. AWWA C550 - Protective Interior Coatings for Valves and Hydrants 2017.
- K. MSS SP-25 - Standard Marking System for Valves, Fittings, Flanges and Unions 2018.
- L. MSS SP-80 - Bronze Gate, Globe, Angle, and Check Valves 2019.
- M. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum) 2020.

1.4 SUBMITTALS

- A. See ~~Section 01 3000 – Administrative Requirements~~ for submittal procedures.

McGill Section 013300
- B. Product Data: Manufacturer's data sheets for each valve and accessory, showing compliance with requirements; include materials, pressure ratings, valve operators, seats and seals, clearances for operation and maintenance, and other characteristics.
 - 1. Identify data sheets using the valve identification scheme used on drawings.
 - 2. For electric actuators, show electrical characteristics.
 - 3. For pneumatic actuators, show air supply pressure.
 - 4. AWWA C504 Butterfly Valves: Submit certified statement by manufacturer that proof-of-design performance, leakage, and hydrostatic tests as described in AWWA C504 were successfully met.
- C. Shop Drawings: Custom-prepared piping diagrams showing location of each valve and drain, whether or not indicated in Contract Documents; this shop drawing may be combined with other piping shop drawings.
- D. Valve Schedule: Custom-prepared schedule of valves, showing:
 - 1. Valve identifying number; cross-reference to product data sheets and to process and instrumentation diagrams (P&ID).
 - 2. Manufacturer and model name/number.
 - 3. Valve type using specification terminology (e.g. gate, metal body, over 2 inch).
 - 4. Application (direct-buried or exposed).
 - 5. Piping Service (e.g. return activated sludge).
 - 6. Installation orientation (horizontal or vertical pipe, stem vertical or horizontal).
 - 7. Size and dimensions.
 - 8. Flow coefficient Kv.
 - 9. Pressure rating and pressure drop at specified flow rate.
 - 10. Spring range.

11. Valve end type (e.g. flanged, threaded, socket-welded).
 12. Manual operator type.
 13. Automatic operator type, where applicable, and identifying number.
 14. Accessories (e.g. extension stem, floor stand, extension bonnet).
 15. Access and clearance requirements.
- E. Automatic Operator Schedule: Custom-prepared schedule of automatic valve operators, showing:
1. Valve and operator identifying numbers.
 2. Operator manufacturer and model number.
 3. Positive positioner range.
 4. Close-off pressure to torque.
 5. Actuator type (electric or pneumatic).
 6. Electric Actuators: Input and output contacts.
 7. Pneumatic Actuators: Input air pressure.
 8. Access and clearance requirements.
- F. Automatic Valve Operator Calculations: For each remote-controlled valve, submit calculations supporting selection of actuator, including calculations of the force required to move and seal the valve.
- G. Operating and Maintenance Data: See Section 46 0106.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with not less than 10 years documented experience.

PART 2 PRODUCTS

2.1 VALVE APPLICATIONS

- A. Do not direct-bury flanged valves; provide valve pit or manhole.
- B. In-Line Electrical Devices: Provide a line size ball valve and union upstream of each solenoid valve, in-line flow switch, or other in-line electrical device, excluding magnetic flowmeters, for isolation during maintenance.

2.2 REQUIREMENTS APPLICABLE TO ALL VALVES

- A. See drawings for valve sizes, valve ratings, operator types, and piping types and sizes.

- B. Provide valves suitable for the service indicated and coordinated to piping system.
 - 1. Provide valves that will withstand working pressure indicated or working pressure of pipe to which valve is connected, whichever is greater.
 - 2. Provide valves of sizes indicated or of port diameter/area equal to that of pipe to which valve is connected, whichever is larger.
 - 3. Provide valves that open by turning counterclockwise, with direction of opening integrally marked on operating nut or operator.
 - 4. Valve End Connections: As indicated; if not indicated, provide end connections of the same type as indicated for joints in pipe to which valve is connected.
 - 5. Factory install operators and accessories.
- C. Identification and Tagging: In addition to the information required by Section 46 0500, mark valves in accordance with MSS SP-25 using identification tags securely attached; on tags show the service, valve identification number from drawings, manufacturer's name and model number.
 - 1. Identification Tags: 1.375 inches diameter, minimum; engraved laminated plastic with black lettering.
 - 2. Attachment: No. 12 AWG copper wire.

2.3 REQUIREMENTS APPLICABLE TO METAL-BODY VALVES

- A. Valve End Connections:
 - 1. Flanged Ends: In accordance with ASME B16.5; Class 125 pound unless otherwise indicated.
 - 2. Mechanical Joint Ends: Styrene butadiene rubber (SBR) or vulcanized SBR gasketed type, in accordance with AWWA C111/A21.11 and AWWA C110/A21.10.
- B. Valve Exterior Finish: Factory-applied epoxy coating complying with AWWA C550; either two-part liquid material or heat-activated material.
 - 1. Where valve is indicated to have fusion bonded epoxy finish, provide only heat-activated material.
 - 2. Coating Thickness: 7 mils, minimum, dry film thickness.
 - 3. Colors: As specified in Section 46 0500; use "safety yellow" for isolation valves and lockout valves with handles, hand wheels, or chain wheels.
- C. Valve Lining: Factory-applied factory-applied lining; use epoxy lining unless other material is indicated.
 - 1. Epoxy Lining: AWWA C550; either two-part liquid material or heat-activated material except provide only heat-activated material when lining is indicated as fusion bonded.

2. Epoxy Lining Thickness: 7 mils, minimum, dry film thickness, except where thickness is limited by valve operating tolerances.

2.4 BALL VALVES - METAL-BODY

- A. Ball Valves - Sizes 2 inch and Smaller: End entry one-piece body type.
 1. Rating: 400 psig at 150 degrees F.
 2. Body: Bronze, with full bore ports.
 3. Seat: Polytetrafluoroethylene (PTFE) seats and packing.
 4. Ball: Chrome plated steel.
- B. Ball Valves - Sizes 2.5 inch and larger: End entry one-piece body type.
 1. Rating: 400 psig at 150 degrees F.
 2. Body: Bronze, with full bore ports.
 3. Seat: Polytetrafluoroethylene (PTFE) seats and packing.
 4. Ball: Chrome plated steel.
- C. Ball Valves - Sizes 1.5 inches to 6 inch: Multi-piece body type with stainless steel ball.
 1. Rating: 1000 psig.
 2. ASME Class: [] in accordance with ASME B16.34.
 3. Body: Three piece; ASTM A216/A216M stainless steel, with full bore ports.
 4. Trim: TP316 stainless steel ball, reinforced polytetrafluoroethylene (PTFE) seats and stem packing.

2.5 BUTTERFLY VALVES - METAL BODY

- A. Butterfly Valves: Lugged style.
 1. AWWA Class: 125 in accordance with AWWA C504.
 2. Body: ASTM A126 cast iron.
 3. Disc: Contoured ASTM A436 Type 1 Ni-resist cast iron with maximum lead content of 0.003 percent.
 4. Valve Shafts: Carbon steel with self-lubricating, corrosion-resistant sleeve type bearings.
 5. Seats for Valves 24 inch and Smaller: Attached to either valve body or disc; chloroprene.
 6. Seats for Valves Larger Than 30 inch: Field replaceable.

2.6 GATE VALVES - METAL BODY

- A. Gate Valves - Sizes 2 inch and Smaller: Solid wedge type with clear waterway equal to full diameter of valve.
 - 1. Rating: 175 psig.
 - 2. Body: , Type 1, Class 150; bronze body and stem.
 - 3. Bonnet: Bronze; screwed.
 - 4. Disc: Bronze; with rising stem.
- B. Gate Valves - Sizes 2-1/2 inches and Larger: Solid wedge type with clear waterway equal to full diameter of valve.
 - 1. Rating: 200 psig.
 - 2. Body: AWWA C509, resilient-seated; Ni-resistant.
 - 3. Trim: Iron.
 - 4. Bonnet: OS&Y, bolted type.
 - 5. Disc: Iron; with non rising stems with backseats.

2.7 PINCH VALVES

- A. Manufacturers:
 - 1. Flowrox: www.flowrox.com/#sle.
 - 2. Onyx Valve Company: www.onyxvalve.com/#sle.
 - 3. RF Valves, Inc: www.rfvalve.com/#sle.
- B. Pinch Valves:
 - 1. Rating: 200 psig.
 - 2. Body: Aluminum; full port sleeves and upper and lower pinch bars.
 - 3. Seats: Natural rubber.

2.8 PLUG VALVES

- A. Manufacturers:
 - 1. Milliken Valve: www.millikenvalve.com/#sle.
 - 2. Henry Pratt Company: www.henrypratt.com/#sle.
 - 3. Val-Matic Valve & Manufacturing Corporation: www.valmatic.com/#sle.

4. Weir Power Industrial; The Weir Group PLC: www.weirpowerindustrial.com/#sle.
- B. Plug Valves - Sizes 3 inch and Smaller: Eccentric type.
1. Rating: 175 psig at 140 degrees F.
 2. Body: Nonlubricated type; cast iron; drip-tight shutoff with pressure from either direction.
 3. Plugs: Same material as body, with round ports.
 4. Ports: Regular, with open area minimum 80 percent of connecting pipe area.
 5. Seats: Stainless steel.
 6. Stem Bearings: Self-lubricating stainless steel.
 7. Seals: Butadiene acrylonitrile U-cup type.
- C. Plug Valves - Sizes 3 inches through 54 inch: Eccentric type.
1. Rating: 175 psig at 140 degrees F.
 2. Body: Nonlubricated type; cast iron; drip-tight shutoff with pressure from either direction.
 3. Plugs: Cast iron, with round ports.
 4. Ports: Regular, with open area minimum 80 percent of connecting pipe area.
 5. Seats: Stainless steel.
 6. Stem Bearings: Self-lubricating stainless steel.
 7. Manual Operator for Valves 6 inches and Smaller: Wrench lever.
 8. Manual Operator for Valves 8 inches and Larger: Totally enclosed, geared; with hand wheel, 2-inch nut, or chain wheel.

2.9 VALVE OPERATORS

- A. Operator Types:
1. For each valve controlled by process control system, provide remote-controlled automatic operator, electric type.
 2. For each valve not controlled by process control system, provide a manual operator, except for self-actuated valves.
- B. Operators: Sized to operate valve for full range of pressures and velocities and of the type specified for application:

1. Maximum Force to Operate: Not more than 39.3 pounds-force under any operating condition including initial breakaway; provide gear reduction where necessary to reduce force to operate.
 2. Locking: Self-locking or equipped with self-locking device; padlock eyes on valve handles; wheels lockable with chain and padlock.
 3. Quarter Turn Valves: Provide position indicator.
 4. Direct-Buried Quarter-Turn Valves: Operator designed to withstand input torque of 450 foot-pounds at fully open or fully closed positions; grease packed and gasketed to withstand submersion in water to 10.2 psig.
- C. Automatic Operators: Actuator, valve stem coupling, gearing if required, size and configuration to suit full range of valve operation, and additional requirements as indicated.
1. Totally enclosed valve actuating mechanism with adjustable travel stops and valve position indicator.
 2. For Quarter Turn Valves: Reversing, bi-directional operation.
 3. Provide manual override mechanism unless specifically indicated as "no manual override"; with lockable motor de-clutch mechanism.
 4. On loss of control signal, maintain valve in last position, unless otherwise indicated.
 5. Housing: NEMA 250 Type 4X enclosure.
- D. Manual Operators:
1. Direct-Buried Valves Larger Than 2-1/2 inches: 2 inch operating nut.
 2. Direct-Buried Valves 2 inches and Smaller: Cross handle for operation by forked key.
 3. Exposed Valves: Hand wheel type operator except where other type is permitted or required.
 4. Hand Wheels: Galvanized and painted.
 5. Lever handles are allowed on quarter-turn valves 8 inches and smaller.

2.10 ELECTRIC VALVE OPERATORS

- A. Manufacturers:
1. Rotork: www.rotork.com/#sle.
- B. Electric Operators: Motor-operated.
1. Gearing: Two-stage, planetary, permanently lubricated self-locking gear train with self-lubricating bearings; connections via male output shaft.

2. Start-up Torque: 120 foot-pound.
 3. Stall Torque: 150 foot-pound.
 4. Duty Cycle: 75 percent.
 5. Equipped with AC thermal overload protector with automatic reset or non-overloading under normal operating conditions.
- C. Positioners: For modulating actuators provide positioner controlling the valve position as function of input signals; direct acting; with corrosion-resistant, splash- and moisture-proof enclosure with gasketed cover.

2.11 PNEUMATIC VALVE OPERATORS

- A. Pneumatic Operators: Cylinder and diaphragm actuators as indicated; pressure regulator, gearing, exhaust muffler, safety vented lockout isolation valve, and accessories.
1. Provide pressure gauges in piping as indicated, easily readable and accessible.
 2. Air Supply Pressure: 80 psig.
- B. Cylinder Actuators: Comply with AWWA C541 and AWWA C542.
1. Non Swivel Type: Totally enclosed; position indicator; factory lubricated and sealed, requiring no additional lubrication.
 2. Double Acting Type: Nonmetallic, for operation on non lubricated air; manual override independent of cylinder.
- C. Diaphragm Actuators: Spring return with steel or aluminum diaphragm case and spring barrel, steel spring and actuator stem, and fabric-reinforced chloroprene diaphragm; factory lubricated and sealed.
- D. Pressure Regulator: Adjustable reduced pressure range as required by valve actuator; gauge range 1.33 to 2 times maximum operating pressure; with internal relief, filter, outlet pressure gauge, aluminum body and hand wheel.
- E. Positioners: Pneumatic force balance instruments to control valve position as function of input signal, suitable for either double acting or spring return actuator, with zero and span adjustment and field reversible for direct or reverse action.
1. Accomplish positive positioning of valve by mechanical feedback connection from valve actuating mechanism, consisting of a characterized linear cam allowing adjustment of valve positioning and input signal.
 2. Provide gauges for supply and output pressure and for input signal pressure.
 3. Input: Pneumatic or DC electric, unless otherwise indicated.
 4. Pneumatic Input: 3 to 15 psig.

5. DC Electric Input: 4 to 20 mA; provide transducer to convert electrical signal to appropriate pneumatic signal; transducer to be integral with positioner or separate component.
 - a. Separate transducers factory mounted on actuator.
 - b. Transducer must operate without line electric power.
6. Enclosures: Corrosion-resistant, splash- and moisture-proof with gasketed cover.

2.12 VALVE ACCESSORIES

- A. Extension Bonnets: Provide as necessary, with stem and accessories applicable to specific valve and operator.
- B. Direct-Buried Valves: Provide extension stem enclosed in cast iron, concrete, or polyethylene valve box housing to prevent contact with soil.
 1. Length: Sufficient to bring operating nut to a point 6 inches or less below grade.
 2. Diameter: Sufficient to completely cover valve.
 3. Cast Iron Valve Boxes: Extension type with slide or screw vertical adjustment and flared base; minimum metal thickness of 3/16 inch.
 4. Concrete Valve Boxes: Standard product of a manufacturer of precast concrete equipment; cast iron cover and cover ring.
- C. Manual Valves Below Operating Personnel Floor Level: Where depth of valve centerline is more than 36 inches below floor level, provide extension stem and floor stand.
 1. Floor Stands: Non rising, indicating type; with extension stem, coupling, hand wheel, and yoke attachment.
 2. Stem Guide Brackets: Spaced such that stem L/R ratio does not exceed 200; provide anchors as required.
 3. Quarter Turn Valves: Provide torque tube, properly sized for maximum torque capacity of valve.
- D. Access Doors: Where valves are to be installed inside walls or above ceilings in finished spaces, provide access doors for valve access.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. Install valves as nearly as possible in position indicated on drawings, located and oriented to provide easy access to valve operator and to avoid interference with other equipment.

- C. Install valves without exerting distortion or strain on appurtenances.
- D. Flanged Connections:
 - 1. Install flanged valve bolt holes so as to straddle vertical centerline of pipe.
 - 2. Clean flanged faces prior to inserting gasket and bolts.
 - 3. Tighten nuts progressively and uniformly.
- E. Threaded Connections: Clean threads by wire brushing or swabbing prior to installation.
- F. Manual Valve Orientation in Horizontal Runs of Pipe:
 - 1. Where pipe centerline elevation is 54 inches or less above finished floor, install valve with operating stem of in vertical position, unless otherwise indicated.
 - 2. Where pipe centerline elevation is between 54 inches and 81 inches above finish floor, install valve with stem in horizontal position, unless otherwise indicated.
- G. Automatic Valves: Install in accordance with manufacturer's instructions.
- H. Butterfly Valves: Orient valve shafts so that unbalanced flows caused by pipe direction changes or other disturbances are equally divided to each half of disc.
- I. Plug Valves: If seat position is not indicated, locate seat position as follows:
 - 1. For horizontal flow, orient seat so that flow produces an "unseating" pressure, with plug opening into top half of valve.
 - 2. For vertical flow, locate seat in highest portion of valve.
- J. Insulation: Where piping is indicated to be insulated, insulate valves in same manner using same materials.

3.2 FIELD QUALITY CONTROL - PRIOR TO STARTUP

- A. Demonstrate proper valve operation while testing pipelines or as a separate step.
 - 1. Show that valves open and close smoothly with operating pressure on one side and atmospheric pressure on the other, and in both directions for two-way valve applications.
 - 2. Count and record the number of turns required to open and close each valve, and account for any discrepancies from manufacturer's data.
- B. Isolation Valve Leak Check:
 - 1. With full pressure in the system, command valve closed.
 - 2. Use an ultra-sonic flow meter to detect flow or leakage.
- C. Actuator Range Check: Verify proper operation of actuators and positioners.

1. Verify that actuator extreme positions are correct.
 2. Apply a signal to actuator through its controller.
 3. Record the signal levels for the extreme positions.
 4. Vary the signal over its full range and verify that actuators travel in the correct direction and from one extreme position to the other.
- D. Valve Stroke Setup and Check:
1. Verify the actual positions against the control system readout.
 2. Set pump to normal operating mode.
 3. Command valve closed; visually verify that valve is closed and adjust output zero signal as required.
 4. Command valve to open; verify position is full open and adjust output signal as required.
 5. Command valve to a few intermediate positions.
 6. If actual valve position does not reasonably correspond, replace actuator or add pilot positioner (for pneumatics).

3.3 OWNER PERSONNEL TRAINING

- A. Content: For each valve include actuator and transmitter, cover control sequences, actuating sensors, manual operation, maintenance, and testing.
- B. Operating Personnel Training:
1. Sessions: One.
 2. Trainees: Two.
 3. Training Hours: 2, minimum, for each valve.

END OF SECTION

SECTION 40 0559 - HYDRAULIC GATES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Upward sliding gates, for opening and closing channels.
- B. Weir gates, downward sliding, for liquid level adjustment.

1.2 RELATED REQUIREMENTS

- A. Section 46 0106 - Operation and Maintenance Manual: Operating and Maintenance Data.
- B. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Requirements applicable to all equipment.

1.3 REFERENCE STANDARDS

- A. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2020a.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- C. ASTM A572/A572M - Standard Specification for High-Strength Low-Alloy Columbium-Vanadium Structural Steel 2021, with Editorial Revision.
- D. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).
- E. ASTM D395 - Standard Test Methods for Rubber Property—Compression Set 2018.
- F. ASTM D412 - Standard Test Methods for Vulcanized Rubber and Thermoplastic Elastomers--Tension 2016 (Reapproved 2021).
- G. ASTM D471 - Standard Test Method for Rubber Property--Effect of Liquids 2016a (Reapproved 2021).
- H. ASTM D572 - Standard Test Method for Rubber—Deterioration by Heat and Oxygen 2004 (Reapproved 2019).
- I. AWWA C561 - Fabricated Stainless-Steel Slide Gates 2014.
- J. AWWA C562 - Fabricated Aluminum Slide Gates 2014.

1.4 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000 - Administrative Requirements~~, and Section 46 0500 - Common Work Results For Water and Wastewater Equipment for submittal procedures.
- B. Product Data: Manufacturer's data on products, showing composition, dimensions, accessories, and anchorage.

- C. Shop Drawings: Detailed fabrication and installation drawings showing materials, fabrication, tolerances, connections, seals, and anchorages.
- D. Operating and Maintenance Data: See Section 46 0106 - Operation and Maintenance Manual.
- E. Field Quality Control Test Reports.

1.5 WARRANTY

McGill Section 017700

- A. See ~~Section 01 7800 - Closeout Submittals~~, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Golden Harvest, Inc: www.goldenharvestinc.com/#sle.
- B. Hydro Gate, a brand of Henry Pratt Company: www.hydrogate.com/#sle.
- C. Waterman Industries, LLC: watermanusa.com/#sle.

2.2 GATES - GENERAL

- A. Aluminum Gates: Comply with AWWA C562.
- B. Stainless Steel Gates: Comply with AWWA C561.
- C. Design and fabricate gates to withstand the design head.
- D. Metals:
- E. Structural Steel:
 - 1. Structural Steel: Comply with ASTM A36/A36M.
 - 2. Structural Steel Plates: Comply with ASTM A572/A572M Grade 50.
- F. Stainless Steel Bars and Shapes
- G. Stainless Steel Plate, Sheet, and Strip:
 - 1. Stainless Steel Plate, Sheet, and Strip: Comply with ASTM A240/A240M, UNS S 41008.
 - 2. Plate finish: Hot-rolled, annealed or heat-treated, and blast-cleaned or pickled.
 - 3. Sheet and strip finish: No.1.
- H. Rubber Seals:
 - 1. Rubber seals: EPDM.
- I. Physical Characteristics of Seals:
 - 1. Tensile Strength 2500 psi (min.); based on ASTM D412.

2. Elongation at Break: 450 percent (min.); based on ASTM D412.
3. 300 percent: 900 psi (min.); based on .
4. Durometer Hardness (Shore Type A): 60 to 70; based on .
5. Water Absorption: 5 percent by weight (max.); based on ASTM D471.
6. Compression Set: 30 percent (max.); based on ASTM D395.
7. Tensile Strength (after aging 48 hrs.): 80 percent of tensile strength (min.); based on ASTM D572.

J. Leakage Rate:

1. Leakage: Not to exceed 0.05 U.S. gallon per minute per foot of seal periphery under the design seating head and 0.1 U.S. gallon per minute per foot of seal periphery for the unseating design head.

K. Slide Gate Leaf:

1. Single-component structural fabrication, shop fabricated and provided complete with gate stem, stem guides, leaf nut, leaf nut spanner wrench, bar seals, seal collars, lock assembly, and other appurtenant items as required for installation.
2. Surfaces of leaf framing elements for welding to skin plates: Not to vary from a true plane by more than 1/16 inch to provide uniform bearing.
3. The outside surfaces of skin plates welded to framing elements: Not to vary from a true plane by more than 1/16 inch.
4. Splices in skin plates: Locate only where shown on drawings.
5. The overall width and height of the fabricated gate leaf: Not to vary from the respective dimensions as indicated on drawings by more than 1/16 inch.
6. Stress-relieve gate leaf prior to the attachment of bar seals.
7. Accurately machine surfaces where bar seals attach to provide uniform bearing for the full contact dimensions.
8. Firmly butt top and side bar seals together at the corners.
9. Provide flush condition at bottom seating surface of gate leaf with ends of side bar seals.
10. Perform final machining of bar seals after attachment to the gate leaf.
11. Machine bottom seat of gate leaf for tight fit with gate frame sill.

L. Slide Gate Frame and Bonnet:

1. Shop fabricate slide gate frame and bonnet.

2. Machine finish guiding and seal surfaces of slide gate frame and bonnet to true vertical plane.
3. Machine bottom seat of gate leaf for tight fit with gate frame sill.
4. Stress-relieve gate frame and bonnet prior to the attachment of bar seals.
5. Accurately machine surfaces where bar seals attach to provide uniform bearing for the full contact dimensions.
6. Firmly butt top, side and invert bar seals together at the corners.
7. Perform final machining of bar seals after attachment to gate frame and bonnet.

M. Slide Gate Bonnet Cover, Pedestal and Base Plate:

1. Accurately machine flanges of the bonnet cover, pedestal and base plate for the supporting the operating machinery for the slide gate; drill to match mating flanges and provide required true alignment.
2. Base plate dimensions may be altered to fit the operating machinery furnished, provided the basic configuration, plate thickness, and number and sizes of fasteners are equal to that indicated on drawings and the altered dimensions are approved.
3. Operators:
 - a. Size Operators to start moving gate under design maximum head pressure with a pull not to exceed 40 lbs.
 - b. Provide manual hand wheel or crank compatible with lift. Indicate direction of operation clearly and permanently on lift: Provide arrow and the word "OPEN" cast in raised letters to indicate the direction of opening.
 - c. Provide two operators connected by a tandem shaft for gates having width equal to or greater than two times their height.

N. Controls:

1. Provide manual controls as indicated.
2. Provide control devices of type and characteristics required to connect to process control system.

O. Instrumentation:

1. Control Panel: Mount instrumentation and control devices in enclosure as specified in Section 46 0500, mounted near equipment. Provide the following, at minimum, mounted on or in panel door:
 - a. Motor starter push-button station.
2. Power Components:

- a. Motor starter.
- b. Branch circuit breaker for each drive motor and control circuit.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Thoroughly clean bearing surfaces requiring lubrication; lubricate with an manufacturer's approved lubricant before assembly and installation.
- B. Align field welded components to correct positions prior to commencing welding.
- C. Install anchors as indicated on drawings.
- D. Prime coat embedded metals with required paint on all surfaces prior to installation in concrete forms.
- E. Gate Frame and Guides:
 - 1. Test gate frame and guides for proper alignment and clearances prior to embedding in concrete, by lowering and raising the gate leaf through the full operating range.
- F. Concrete and Concrete Grout Placement:
 - 1. Embed gate frame and other components in concrete in an approved manner to fill all voids, secure anchorage, prevent seepage, and provide uniform finish surfaces.
 - 2. Inspect embedment concrete after curing for at least 7 days; fill any voids around embedded components by pumping concrete grout to full embedment.
 - 3. Inspect pumped grout after curing for at least 7 days, and use hammer blows to the components to detect any remaining voids.
 - 4. Where remaining voids are located, drill 1 inch diameter grout holes in the components and the voids and fill by pressure grouting through the grout holes.
 - 5. Plug grout holes by welding openings in the components and grinding welds flush.
- G. Fabricate, assemble and install gate assembly so the gate leaf forms a watertight barrier in compliance with the specified leakage rate when lowered to the seated position.
- H. Fabricate, assemble and install gate assembly so the gate leaf forms a watertight barrier in compliance with the specified leakage rate when raised to the fully closed position.

3.2 ACCEPTANCE TRIAL OPERATION AND TEST

- A. After the gate assembly has been installed, including operating machinery, the Owner and Architect/Engineer will examine the complete system for final acceptance.
- B. Operate the gate throughout its full operating range a sufficient number of times to demonstrate proper operation.

- C. Conduct initial operation of the gate assembly in the dry.
- D. Conduct operation of the gate assembly in actual operating conditions.

END OF SECTION

SECTION 40 2340 - SANITARY WASTEWATER PROCESS PIPING

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Flanged ductile iron pipe and fittings.
- B. Non-flanged ductile iron pipe and fittings.
- C. Stainless steel pipe and fittings.
- D. Plastic (PVC/CPVC) pipe and fittings.
- E. Pipe expansion joints.

1.2 RELATED REQUIREMENTS

- A. See drawings for normal service conditions, pipe sizes, pressure ratings, nominal wall thicknesses, and insulation requirements.
- B. Section 13 4713 - Cathodic Protection: Cathodic protection for buried steel, ductile iron, gray iron, and stainless steel piping.
- C. Section 46 0106 - Operation and Maintenance Manual.
- D. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Requirements applicable to all piping and equipment.

1.3 REFERENCE STANDARDS

- A. ASME B1.20.1 - Pipe Threads, General Purpose (Inch) 2013 (Reaffirmed 2018).
- B. ASME B1.20.2M - Pipe Threads, 60 Deg, General Purpose 2006 (Reaffirmed 2011).
- C. ASME B16.1 - Gray Iron Pipe Flanges and Flanged Fittings: Classes 25, 125, and 250 2020.
- D. ASME B16.3 - Malleable Iron Threaded Fittings: Classes 150 and 300 2016.
- E. ASME B16.5 - Pipe Flanges and Flanged Fittings: NPS 1/2 through NPS 24 Metric/Inch Standard 2020.
- F. ASME B16.9 - Factory-Made Wrought Buttwelding Fittings 2018.
- G. ASME B16.11 - Forged Fittings, Socket-Welding and Threaded 2016, with Errata (2017).
- H. ASME B16.21 - Nonmetallic Flat Gaskets for Pipe Flanges 2016.
- I. ASME B31.3 - Process Piping 2020.
- J. ASME B36.19M - Stainless Steel Pipe 2018.

- K. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2018).
- L. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- M. ASTM A105/A105M - Standard Specification for Carbon Steel Forgings for Piping Applications 2021.
- N. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- O. ASTM A193/A193M - Standard Specification for Alloy-Steel and Stainless Steel Bolting for High Temperature or High Pressure Service and Other Special Purpose Applications 2020.
- P. ASTM A194/A194M - Standard Specification for Carbon Steel, Alloy Steel, and Stainless Steel Nuts for Bolts for High Pressure or High Temperature Service, or Both 2020a.
- Q. ASTM A216/A216M - Standard Specification for Steel Castings, Carbon, Suitable for Fusion Welding, for High-Temperature Service 2021.
- R. ASTM A240/A240M - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications 2020a.
- S. ASTM A307 - Standard Specification for Carbon Steel Bolts, Studs, and Threaded Rod 60 000 PSI Tensile Strength 2021.
- T. ASTM A403/A403M - Standard Specification for Wrought Austenitic Stainless Steel Piping Fittings 2020.
- U. ASTM A727/A727M - Standard Specification for Carbon Steel Forgings for Piping Components with Inherent Notch Toughness 2014 (Reapproved 2019).
- V. ASTM A858/A858M - Standard Specification for Heat-Treated Carbon Steel Fittings for Low-Temperature and Corrosive Service 2019.
- W. ASTM A865/A865M - Standard Specification for Threaded Couplings, Steel, Black or Zinc-Coated (Galvanized) Welded or Seamless, for Use in Steel Pipe Joints 2006 (Reapproved 2017).
- X. ASTM D1784 - Standard Classification System and Basis for Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds 2020.
- Y. ASTM D1785 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120 2021a.
- Z. ASTM D2240 - Standard Test Method for Rubber Property--Durometer Hardness 2015 (Reapproved 2021).
- AA. ASTM D2466 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40 2021.

- BB. ASTM D2467 - Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80 2020.
- CC. ASTM D2564 - Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems 2020.
- DD. ASTM D2657 - Standard Practice for Heat Fusion Joining of Polyolefin Pipe and Fittings 2007 (Reapproved 2015).
- EE. ASTM D2855 - Standard Practice for the Two-Step (Primer and Solvent Cement) Method of Joining Poly (Vinyl Chloride) (PVC) or Chlorinated Poly (Vinyl Chloride) (CPVC) Pipe and Piping Components with Tapered Sockets 2020.
- FF. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings 2018.
- GG. ASTM F656 - Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings 2021.
- HH. ASTM F1290 - Standard Practice for Electrofusion Joining Polyolefin Pipe and Fittings 2019.
- II. AWWA C104/A21.4 - Cement-Mortar Lining for Ductile-Iron Pipe and Fittings 2016.
- JJ. AWWA C110/A21.10 - Ductile-Iron and Gray-Iron Fittings 2012.
- KK. AWWA C111/A21.11 - Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings 2017.
- LL. AWWA C115/A21.15 - Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges 2020.
- MM. AWWA C150/A21.50 - Thickness Design of Ductile-Iron Pipe 2014.
- NN. AWWA C151/A21.51 - Ductile-Iron Pipe, Centrifugally Cast 2017, with Errata (2018).
- OO. NACE No. 3 - Joint Surface Preparation Standard Commercial Blast Cleaning 1994 (Reaffirmed 2006).
- PP. PPI (PE) - Handbook of Polyethylene Pipe 2008, Second Edition.
- QQ. SSPC-SP 6 - Commercial Blast Cleaning 2007.

1.4 ADMINISTRATIVE REQUIREMENTS

- A. Coordination: Furnish piping, sleeves, and appurtenances to be cast into concrete to concrete form installer in time for placement in forms.

1.5 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000 - Administrative Requirements~~, and Section 46 0500 for submittal procedures.

- B. Product Data: Manufacturer's descriptive and technical literature for each material and component, showing compliance with requirements and installation instructions.
- C. Shop Drawings:
 - 1. List of piping systems, indicating application, material, size, and pressure rating.
 - 2. Detailed drawings of piping systems, showing locations of valves, expansion joints, specialties, and instrument connections.
- D. Waste Water Disposal: Before starting operations that require a temporary water supply submit the method proposed for disposal of waste water; for information; where regulatory permits are required, submit evidence that permits have been obtained.
- E. Pipe Testing Plan.
- F. Field Quality Control Reports.
- G. Operation and Maintenance Data: See Section 46 0106.
- H. Project Record Documents: Record actual locations of pipe anchors and guides and layout of piping systems relative to other parts of the work including clearances for maintenance and operation.

1.6 FIELD CONDITIONS

- A. Existing Conditions:
 - 1. Verify existing piping and penetrations.
 - 2. Prior to ordering materials, expose all existing pipes which are to be connected to new pipelines.
 - 3. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipes.
 - 4. Inspect size and location of structure penetrations to verify adequacy of wall sleeves and other openings before installing connecting pipes.

PART 2 PRODUCTS

2.1 PIPING APPLICATIONS

- A. All Pipe Applications, Unless Otherwise Indicated:
 - 1. Submerged, All Sizes: PVC plastic.
 - 2. Below Grade, All Sizes: Ductile iron, non-flanged.
 - 3. Above Grade, All Sizes: Ductile iron, flanged.
- B. Raw Sewage:

1. Below Grade, All Sizes: Ductile iron, non-flanged.
- C. Sludge:
1. Below Grade, All Sizes: Ductile iron, non-flanged.
 2. Above Grade, All Sizes: Galvanized carbon steel.
- D. Effluent Downstream of Primary Clarifiers:
1. Below Grade, All Sizes: Ductile iron, non-flanged.
 2. Above Grade, All Sizes: Ductile iron, flanged.
- E. Aeration Air:
1. Submerged, All Sizes: PVC plastic.
 2. Below Grade, All Sizes: Ductile iron, non-flanged.
 3. Air Main, Above Grade, Not Submerged, All Sizes: Stainless steel pipe.
 4. Air Distribution Headers and Branches, All Sizes: PVC plastic.
- F. Liquid Chemical Feed:
1. Smaller Than 1-1/2 inch Diameter: PVC plastic.
 2. 1-1/2 inch Diameter and Larger: Rubber-lined carbon steel.

2.2 PERFORMANCE REQUIREMENTS

- A. Provide piping systems suitable for the design conditions and applications intended, coordinated to function as a system, and considering the piping both with and without internal pressure, installation factors, and supports.
- B. The pressure ratings and materials specified represent minimum acceptable performance; provide fittings, flanges, valves, and appurtenances with pressure ratings no less than that required for the system in which they are installed.
- C. Provide cathodic protection for buried ferrous piping in accordance with Section 13 4713.
- D. Provide all work and equipment required to accommodate expansion and contraction of piping under varying temperature conditions; verify that anchors, guides, and expansion joints provided, adequately protect the piping systems.
- E. Provide flexible connections:
 1. Between piping and equipment mounted on vibration isolators.
 2. Between floor mounted equipment and suspended piping.

3. Between unbraced piping and restrained suspended items.
 4. At building separations and seismic joints.
- F. Aeration Air: Provide an air distribution system, including piping, valves, and supports to distribute air from blowers to air diffusers, of adequate capacity and adjustable for balancing of air distribution.

2.3 PIPE AND FITTINGS - GENERAL REQUIREMENTS

- A. Piping and Fittings: New and unused material.
1. Pressure Ratings: As indicated on drawings.
 2. Nominal Sizes: As indicated on drawings.
 3. Fittings: Same pressure rating as pipe, or greater, unless higher rating is specified; same material as pipe unless otherwise indicated.
 4. Sizes: Use standardized nominal sizes for compatibility with future work.
 5. Material Identification: Permanently mark each piece of pipe and fitting with its AWWA or ASTM designation and other markings required for that designation.
- B. Joints: Completed joints are to have working pressure rating for liquids equal to pressure rating of the pipe.
- C. Flanged Joints and Fittings (Metal and Plastic): Internal diameter bores of flanges and flanged fittings same as that of pipe.
1. Bolting: Hex head bolts of alloy-steel complying with ASTM A193/A193M Grade B5, hex head nuts of ASTM A194/A194M, and washers of same material as bolts; except when mating with cast iron flanges use Grade B8 Class 1 bolts and Grade 8 heavy hex head nuts.
 2. Provide with washers of same material as bolts.
 3. Non-Metallic Gaskets: Chloroprene rubber, unless otherwise indicated; and .
 - a. Thickness: 1/8 inch, maximum.
 - b. Hardness: 80 Shore A durometer, in accordance with .
 - c. Tensile Strength: 1,500 psi, minimum.
 - d. Elongation: 125 percent, minimum.
 - e. For Raised Face Flanges: Flat ring type.
 - f. For Flat Face Flanges: Full face type.
 4. Metallic Gaskets: Ring joint gaskets; ASME B16.5.

- 5. Mating To Existing Flanges: Field verify bolt hole configurations and design of existing flanges for accurate fit.
- D. Threaded Fittings: Threaded in accordance with ASME B1.20.1 (ASME B1.20.2M).
- E. Aeration Air Main: Provide eccentric reducers at each change in air main diameter; maintain crown of air main at the same elevation for full length of applicable tank.
- F. Bolts and Nuts:
 - 1. Non-Submerged: Zinc-plated; on cast iron and ductile iron couplings high-strength, low-alloy steel complying with .
 - 2. Buried and Submerged: Stainless steel, TP304.
- G. Isolation Devices for Dissimilar Metals: Where dissimilar metallic piping, fittings, or valves must be connected, use isolation devices as indicated and as required to separate the different materials to avoid galvanic action.
 - 1. For flanged connections use flange isolation gaskets; gas-tight where underground.
 - 2. For threaded and welded connections, use dielectric fittings.
 - 3. For mechanical joints, use joint devices that accomplish separation.
- H. Pipe Closure Pieces: ASME B16.9 or ASME B16.11; provide wherever pipe runs end.
- I. External Coatings: Unless otherwise indicated; finish fittings with same coating as pipe.
- J. Silicone Coating: Factory- or field-applied.
 - 1. Preparation: As recommended by paint manufacturer.
 - 2. Primer: Alkyd primer, 2.5 mils dry film thickness.
 - 3. Top Coats: Alkyd modified silicone, two coats.
 - 4. Inspect finished coating for holidays, pinholes, and other defects; repair and/or recoat as required to produce a corrosion resistant finish.

2.4 FLANGED DUCTILE IRON PIPE FOR PRESSURE SERVICE

- A. Ductile-Iron Pipe: AWWA C115/A21.15, all pipe sizes, with ASME B16.1, Class 125 flanges.
 - 1. Cement-Mortar-Lining: AWWA C104/A21.4 standard thickness cement lining with tolerance of plus 1/8 inch permitted.
 - 2. External Coating: Coated on outside with manufacturer's standard asphaltic coating, minimum one mil thick.
 - 3. Nominal Size: As indicated on drawings.

4. Joints: Comply with AWWA C110/A21.10.
 - a. Provide gaskets, glands, bolts and nuts as required to completely assemble joints.
 - b. Gaskets: Vulcanized synthetic rubber; reclaimed rubber is not acceptable.
- B. Fittings: Ductile iron or gray iron, cement mortar lined same as pipe.
 1. Pipe Diameters Up To 12 inches Inclusive: Use fittings rated 250 psig.
 2. Bolts and Nuts: Carbon steel complying with ASTM A307, Grade B, with washers of same material.
 3. Gaskets: Ring.

2.5 NON-FLANGED DUCTILE IRON PIPE FOR PRESSURE SERVICE

- A. Ductile-Iron Pipe: AWWA C151/A21.51 and AWWA C150/A21.50, all pipe sizes.
 1. Cement-Mortar-Lining: with tolerance of plus 1/8 inch permitted.
 2. External Coating: Coated on outside with manufacturer's standard asphaltic coating, minimum one mil thick.
 3. Nominal Size: As indicated on drawings.
 4. Joints - Below Grade: Mechanical gland and gasket joints, unrestrained.
- B. Restrained Joints: Comply with ; field-made cuts supplied with lock ring complete with retainer, retainer lock and roll-pin, as required by manufacturer's recommendations, procedures and/or installation instructions; attach with socket clamps.
- C. Mechanical Gland and Gasket Joints: AWWA C110/A21.10 and AWWA C111/A21.11.
 1. Glands: Ductile or gray iron.
 2. Gaskets: Styrene butadiene rubber (SBR) or vulcanized SBR; reclaimed rubber is not acceptable.
 3. Orient bolt holes straddling vertical centerline of valves and fittings.
- D. Fittings: Ductile iron or gray iron, cement mortar lined same as pipe.
 1. Pipe Diameters Up To 12 inches Inclusive: Use fittings rated 250 psig.
- E. Pipe Sleeves and Wall Castings: , with sizes and joints as indicated.

2.6 RUBBER-LINED STEEL PIPE

2.7 CARBON STEEL PIPE

- A. Steel Pipe: ASTM A53/A53Mseamless, Grade A, galvanized where indicated.

1. Galvanized Finish: Hot-dipped galvanized in accordance with ASTM A153/A153M; electroplated zinc or cadmium plating not permitted.
 2. External Coating: Silicone coating as specified.
 3. Joints - Buried: Welded.
 4. Joints - Above Grade: Welded.
- B. Threaded Fittings: Class 150.
1. Material: One of the following:
 - a. Malleable iron, ASTM A47/A47M, complying with ASME B16.3, black, banded.
 - b. Forged carbon steel ASTM A105/A105M, complying with ASME B16.11.
 - c. Low carbon steel, ASTM A858/A858M, complying with ASME B16.11.
 2. Couplings: welded, black.
- C. Welding Fittings: ASME B16.9 butt-welding or ASME B16.11 socket-welding type.
1. Material: One of the following:
 - a. Forged steel, Class 150.
 - b. Forged low-carbon steel, ASTM A858/A858M seamless or welded.
- D. Flanged Fittings: Faced and drilled to ASME B16.5, Class 150, welding neck type.
1. Material: One of the following:
 - a. Forged steel, ASTM A105/A105M.
 - b. Forged steel, ASTM A727/A727M.
 2. Flange Faces: Raised, 0.0625 inch thick.
 3. Backing Flanges: Cast steel, ASTM A216/A216M Grade WCA, Van Stone type, drilled in compliance with ASME B16.5 Class 150.

2.8 STAINLESS STEEL PIPE/TUBE AND FITTINGS

- A. Stainless Steel Pipe:
1. Grade: TP304.
 2. Nominal Size: As indicated on drawings.
 3. Wall Thickness: Schedule 10S, with dimensions complying with ASME B36.19M.
 4. Joints - Buried: Butt- or socket-welded.

5. Joints - Above Grade: Butt- or socket-welded.
- B. Welding Fittings: Forged austenitic stainless steel.
1. Material: ASTM A403/A403M Grade TP304.
 2. Butt-Welding Fittings: ASME B16.9 Class CR.
 3. Socket-Welding Fittings: Class WP-S.

2.9 JOINING DEVICES FOR METAL PIPE

- A. Dielectric Fittings: Material, shape, and design as required to prevent metal-to-metal contact of dissimilar metallic piping elements; suitable for required working pressure, temperature and corrosion environment.
- B. Flange Isolation Gaskets: Dielectric isolation gasket, isolation washers and full length isolation sleeves for flange bolts; size and type to fit piping flanges.
1. Gaskets: Full faced with outside diameter equal to flange outside diameter.
 2. Shape and design as required to prevent metal-to-metal contact of dissimilar metallic piping elements.

2.10 PLASTIC PIPE, FITTINGS, AND JOINING DEVICES

- A. Plastic Pipe: Polyvinyl chloride (PVC).
1. Ultraviolet Resistance: Provide UV resistant or protected piping where installed above grade and outdoors.
- B. PVC Pipe: Schedule-based; , minimum cell classification 12545-C.
1. Nominal Size: As indicated on drawings.
 2. Wall Thickness: In accordance with .
- C. Joints and Fittings: Fittings of same composition as pipe.
1. Joints Requiring Future Disassembly: Use back-welded threaded joints; such joints include but are not limited to unions, valves, and equipment.
 2. Chemical Feed Piping: Flanged or threaded.
 3. Other Joints: Socket-welded, flanged, or mechanical joints, unless a specific joint type is indicated.
- D. Socket-Welding Fittings: for Schedule 80; for Schedule 40; joined with PVC solvent cement complying with and of manufacture and viscosity as recommended by pipe and fitting manufacturer; primed prior to assembly with primer.

- E. Flanged Fittings: One piece molded hub type, flat faced, with molded stub ends; dimensions as specified in {\rs\#1}.
 - 1. Pressure Rating: Class 125.
 - 2. Backing Flanges: Stainless steel, {\rs\#1}, Type 304 with {\rs\#1} drilling.
 - 3. Gaskets: Non-metallic, full-faced.
 - 4. Where mating flange has raised face, use flat ring gasket and a filler gasket between outer edge of raised face and flange outer edge.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Verify that size and location of piping, sleeves, and appurtenances embedded in concrete are correct.
- B. Before installing, examine piping having factory-applied linings for damage to linings; replace pipe with damaged lining.

3.2 PREPARATION

- A. Keep Interior of Pipes Clean:
 - 1. Prevent accumulation of weld rod, weld spatter, pipe cuttings and filings, gravel, cleaning rags, and other foreign material inside piping sections during fabrication.
 - 2. Close pipe openings with caps or plugs before, during, and after installation.
 - 3. Remove foreign objects and dirt prior to assembly and installation.
- B. Protect pipe coatings from chemical and mechanical damage; do not install damaged products.
- C. Repair damaged zinc, organic, and paint coatings with material equal to original coating, as specified in Section 46 0500.
- D. Before field fabrication of pipe or fittings, notify Architect/Engineer at least 2 weeks prior to date of starting fabrication.

3.3 INSTALLATION - GENERAL

- A. Install piping and appurtenances in compliance with ASME B31.3, reviewed shop drawings, if any, and manufacturer's instructions, with all joints tight and no undue marring of finishes.
 - 1. Install piping to accurate lines and grades.
 - 2. Run piping as straight as practical in alignment shown with minimum of joints.
 - 3. Maintain required upstream and downstream clearances.

4. At flow measuring devices, provide straight runs of piping upstream and downstream as indicated.
 5. Install piping without springing or forcing pipe to fit.
 6. Pitch piping toward low points and provide a valved drain at each low point.
 7. Provide a sufficient number of unions or flanges to allow for dismantling of pipe, valves, and equipment.
 8. Where temporary supports are used, make them sufficiently rigid to prevent shifting or distortion of pipe.
 9. Make installed piping, valves, and fittings free from strain and excessive stresses caused by weight or misalignment.
- B. Provide isolation valves and miscellaneous devices as required for an operable installation.
- C. Pipe Jointing: Clean the ends of pipes thoroughly, remove foreign matter and dirt from inside of pipes, and keep piping clean during and after installation.
- D. Thermal Expansion and Contraction: Install piping to allow for thermal expansion and contraction resulting from difference between temperature during installation and during operation.
1. Anchors: Locate as indicated on drawings and reviewed shop drawings, if any, to withstand expansion thrust loads and to direct and control thermal expansion.
 2. Intermediate Pipe Alignment Guides:
 - a. Install adjacent to pipe expansion joints and within four pipe diameters each side.
 - b. At pipe mounted on metal channel framing, install intermediate pipe guide at each metal channel framing support not carrying an anchor or alignment guide.
- E. Pipe Tap Connections: Taps direct to pipe barrels are prohibited; make taps as follows:
- F. Metallic Piping Embedded In Concrete: Coat piping with specified underground pipe coating to prevent direct metal-to-metal contact with reinforcement bars and wires.

3.4 METALLIC PIPE JOINTING

- A. Connecting Dissimilar Metallic Pipe and Appurtenances: Use isolation devices as specified and as required to separate different materials to avoid galvanic action; install in accordance with manufacturer's instructions.

3.5 PLASTIC PIPE INSTALLATION

- A. Cut, fabricate, and install plastic pipe in accordance with pipe manufacturer's instructions and recommendations.

- B. Install pipe only when ambient temperature is above 40 degrees F and below 90 degrees F and not exposed to direct sunlight.
- C. Plastic Pipe Jointing: Follow manufacturer's instructions.
 - 1. Heat Jointing: Comply with .
 - 2. Electrofusion Jointing: Comply with ASTM F1290.
 - 3. Solvent-Cemented Jointing: Comply with .
 - 4. Push-On Joints: Lubricate gaskets to prevent displacement; take care to ensure that gasket remains in proper position in bell or coupling.
 - 5. Do not thread Schedule 40 pipe; where connecting pipe to threaded valves or fittings, use Schedule 80 threaded nipples.
 - 6. Use strap wrenches for tightening threaded plastic joints, taking care not to over-tighten fittings.
 - 7. Shield pipe ends from direct sunlight prior to and during installation.
 - 8. Provide adequate ventilation when working with pipe joint solvent cement; comply with for handling of solvent cements, primers and cleaners.
- D. Use expansion joints and offset piping arrangements to accommodate thermal expansion and contraction.
 - 1. Make offset loops from pipe centerline as recommended by manufacturer based on maximum temperature difference between pipe temperature at time of jointing and operating temperature.
 - 2. For pipe exposed to outside air or in which the temperature variation of the contents is substantial, make provisions for movement due to thermal expansion and contraction in accordance with ; Material Properties; Coefficient of Expansion/Contraction.

3.6 FIELD QUALITY CONTROL - GENERAL

- A. Test all parts of piping systems using clean water and hydrostatic pressure tests, unless otherwise indicated.
- B. Water: Provide clean test water of such quality to avoid corrosion of piping system materials.

3.7 FIELD QUALITY CONTROL - HYDROSTATIC PRESSURE TESTING

- A. Perform hydrostatic testing in accordance with under normal service conditions.
- B. Maximum Velocity During Filling: 0.25 fps applied over full area of pipe or as recommended by pipe manufacturer, whichever is lesser.

- C. Venting Air While Filling: Purge all air in system; open air release vents to purge air pockets; venting may also be provided by loosening minimum of four bolts of flanges or by use of equipment vents.
- D. Valves: Include each valve in at least one piping section tested; open and close valves several times during test.
- E. Rigid Piping Test Procedure:
 - 1. Maintain test pressure continuously for minimum of 30 minutes and during examinations for leakage.
 - 2. Leave piping system full of water after leaks are repaired, unless otherwise directed by Owner.
- F. Non-Rigid, Non-Metallic Piping and Metallic Piping With Non-Metallic Liner Test Procedure:
 - 1. Raise pressure to 50 percent of normal service pressure.
 - 2. Inspect pipe, fittings, joints and connections, and valves for visible leakage; correct leaks and continue test.
 - 3. Raise pressure to test pressure and add small amounts of test liquid as required hourly for maximum of 3 hours as required to maintain test pressure.
 - 4. After 4 hours, lower test pressure by 10.2 psi.
 - 5. If pressure remains steady for one (1) hour, no leakage is indicated.
 - 6. Before retesting, allow piping system to relax for 8 hours.
- G. Inspect pipe, fittings, joints and connections, and valves for visible leakage; correct leaks and re-test until results are satisfactory.

3.8 CLEANING PIPING - PRIOR TO STARTUP

- A. After testing, flush piping with water to remove accumulated construction debris and other foreign matter; continue flushing until no foreign matter exits the pipe.
- B. Install cone strainers in connections of attached equipment and leave in place until flushing is completed. Remove accumulated debris through drains or by removing spools or valves.
- C. Minimum Flushing Velocity: 2.5 feet per second.
- D. For large diameter pipe impractical to flush at minimum flushing velocity, clean pipe in place from inside by brushing and sweeping, then flush at a lower velocity.

END OF SECTION

SECTION 40 7000 - INSTRUMENTATION

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Field and panel mounted process instrumentation, auxiliary equipment, accessories, and supplies.
- B. Flow meters.
- C. Level transmitters.
- D. Float switches.
- E. Pressure gauges.

1.2 REFERENCES

- A. ANSI - American National Standards Institute.
- B. IEEE - Institute of Electrical and Electronics Engineers.
- C. NEMA - National Electrical Manufacturers Association.
- D. ISA - The Instrumentation, Systems and Automation Society (formerly the Instrumentation Society of America).
 - 1. S20 - Specification Forms for Process Measurement and Control Instruments, Primary Elements, and Control Valves.
- E. NIST - National Institute of Standards and Technology.

1.3 SUBMITTALS

- A. Equipment Specification Data Sheets (ESDS), including:
 - 1. Separate ESDS for each item or type of equipment.
 - 2. Use ESDS as cover sheet for related item submittal information.
 - 3. All information required to reorder an exact duplicate of the original item from the manufacturer.
 - 4. The assigned tag number. More than one tag numbered item may be included on a sheet.
 - 5. Calibration information.
 - 6. Manufacturer's part number (this shall not be considered as a substitute for any of the required statement of specifications).
 - 7. Panel and breaker from which item receives power.

8. Provide ISA S20 sheets or in format similar to same.
- B. Manufacturer's Product Data
 1. Provide complete legible manufacturer's product data for each item of equipment.
 2. Clearly identify options being provided.
 3. Neatly strike out options not being provided.
- C. Parameter Configuration Data Sheets
 1. Provide for each item of equipment that requires parameters (software settings, dip switches, jumpers, and the like) to be configured for proper operation.
 2. Provide blank sheets with initial submittal.
 3. Complete sheets during installation, calibration, and start-up.
 4. Include As-Built sheets with Operations and Maintenance Manuals.
- D. Manufacturer's Installation Instructions.
- E. Manufacturer's, User's, Programming, and other related manuals.
- F. Shop Drawings:
 1. Provide Shop Drawings showing assembly of equipment and related accessories.
- G. Certificates of Compliance.
- H. Certified Test Reports.
- I. Installation Details, showing:
 1. Proposed mounting methods.
 2. Sample, and process connection tubing routing, valving, and supports.
 3. Proposed installation materials and hardware.
- J. Proposed wording for identification nameplates and tags.
- K. Instrument Calibration Reports.
- L. List of and Specifications for Calibration Equipment.
- M. Operations and Maintenance Manual Data.

1.4 QUALITY ASSURANCE

- A. Manufacturer

1. Monitoring and control devices shall be manufactured by a firm regularly, and currently engaged in the design and manufacture of similar equipment.
 2. Equipment furnished shall be new and of current design and technology.
- B. Maintainability
1. Equipment shall be designed and installed for ease of maintenance and repair, and access to critical parts shall not require a major disassembly.
 2. Internal field adjustments where permitted or required herein shall be easily accessible upon removal of a panel or cover.
- C. Minimum Quality
1. Materials and installation shall comply with the requirements of related electrical codes and standards.
 2. Capacities of equipment shall not be less than that indicated, specified, or required for the associated apparatus.
- D. Similar Items.
1. Equipment of the same type shall be products of the same manufacturer (and model number when applicable).
- E. Electronic Equipment.
1. Select components of construction for their suitability and reliability.
 2. Employ adequate component derating to preclude failures because of transients and momentary overloads reasonably expected in normal operation in an industrial facility.
 3. Design units for operation without forced cooling, unless such cooling is an integral part of the device.

PART 2 PRODUCTS

2.1 MAGNETIC FLOW METERS

- A. Provide magnetic flow meters to measure liquid flow as follows:
1. Materials of construction:
 - a. Metering Tube: Lined 304 Stainless Steel.
 - b. Body: Epoxy coated cast aluminum, cast iron, or steel.
 - c. Flanges: Carbon Steel.
 - d. Electrodes: Hastelloy C OR 316 SST.
 - e. Liner: Ultra Liner, Polypropylene, hard rubber, or Polyurethane.

2. Process connection: ANSI Class 150 flanges.
 3. Output signal: 4-20 mAdc capable of transmission into at least a 750 ohm load at 24 vdc, linear with flow, automatic zero and adjustable low flow cutoff.
 4. Operating temperatures:
 - a. Process fluid: Up to 170°F.
 - b. Ambient: -4 to + 140°F.
 5. Accuracy: 1.0-percent of flow rate, or better above 1 fps, .01 percent of scale below IFPS.
 6. Repeatability: 0.05-percent of full scale, or better or -/+ .0008 ft./s whichever is greater.
 7. Rangeability: 100 to 1, or better. Process signal to be set to zero when flowrate is less than 1-percent of full scale.
 8. Integral dampening: Yes.
 9. Meter Body Enclosure rating:
 - a. NEMA 4 with integral and remote converter.
 - b. NEMA 6 with remote converter.
 - c. Suitable for Class I, Division 1 or Division 2 areas (with remote converter) when indicated or specified.
 10. Power supply: 120 VAC.
 11. Signal converter:
 - a. Remote.
 - b. With LCD indicator, programming buttons, and conduit entries.
 - c. Explosion proof enclosure.
 12. Cables: Provide cables between metering tube and converter as required.
 13. Coil excitation: DC.
 14. Grounding rings: Provide grounding rings for each magnetic flow meter.
 15. Installation clearance for specified accuracy: 5 pipe diameters upstream, 2 pipe diameters downstream.
- B. Manufacturers and model numbers:
1. Magnetic flow meters:
 - a. Endress Hauser, 53W.

- b. Siemens, 5100W.
 - c. ABB Instrumentation, WaterMaster.
- 2. Remote converters:
 - a. Endress Hauser.
 - b. Siemens.
 - c. ABB Instrumentation.
- 3. Grounding rings: By same manufacturer.

2.2 PRESSURE GAUGES

- A. Pressure gauges shall have bronze bourdon tube connected to a rotary gear movement. Dial shall be white-coated with black numerals, minimum diameter of 4-1/2 inches, graduated to meet system design requirements with normal operating pressure being indicated mid-range of dial.
- B. Manufacturers:
 - 1. Ashcroft 1010.
 - 2. March P Series.
 - 3. Trerice 500XB.
 - 4. Or Equal.
- C. Provide ball valve in connecting line to pressure gauge.
- D. Provide diaphragm on all sewage and sludge applications.
- E. Provide one of the following pulsation control devices furnished by the gauge manufacturer:
 - 1. 1106 B Brass pulsation Damper by Ashcroft.
 - 2. 52 Snubber by Marsh.
 - 3. No. 870 impulse dampener by Trerice.
 - 4. Weksler Type RS or MS.

2.3 ULTRASONIC FLOW & LEVEL TRANSMITTERS:

- A. Ultrasonic transmitter shall be a microprocessor-based electronic unit consisting of a sensor assembly, a signal converter/transmitter, and an interconnecting cable. The sensor shall be encapsulated in a chemical and corrosion-resistant material such as kynar or CPVC, and shall be suitable for operation over a temperature range of -20 to +150 degrees Fahrenheit, with a relative humidity of 10 to 100 percent. The sensor shall be compatible with the process media being measured. The sensor shall be mounted in an unclassified area suitable for outside use.

Sensors which are mounted in areas where freezing condensation is likely to occur shall be provided with special transducers or a heater designed to prevent sensor icing.

- B. The supplier shall coordinate the sensor mounting requirements and shall furnish drawings, complete with dimensions and elevations, to ensure a proper and satisfactory installation.
- C. The ultrasonic transmitter shall have automatic compensation for changes in air temperature at the sensor location. If separate temperature sensing probes are provided, they shall be mounted with or adjacent to the ultrasonic sensor, as recommended by the manufacturer. The transmitter shall have a multi-digit display scaled to read in engineering units. The transmitter shall be designed to ignore momentary level spikes or momentary loss-of-echo. A loss-of-echo condition shall be indicated on the transmitter unit and shall be available as an alarm contact output. The transmitter output shall be an isolated 4-20 mA dc signal linearly proportionalized to the measured level range. The output shall be characterized to be proportional to the flume flow. Calibration parameters shall be entered through a keypad on the unit and shall be stored in nonvolatile EEPROM memory. Accuracy of the transmitted signal shall be plus or minus 0.5 percent of the level range.
- D. An appropriate length of sensor-to-transmitter signal cable shall be furnished with the instrument. The sensor shall be capable of being located from 25 to 200 feet away from the signal converter. The signal converter electronics shall be housed in a NEMA Type 4X non-metallic enclosure suitable for wall or pipestand mounting and for operating temperatures of +30 to +120 Fahrenheit, with relative humidity of 10 to 100 percent. A thermostatically controlled strip heater shall be provided in the signal converter enclosure. The signal converter shall be powered from 120 volts AC, 60 Hz. The ultrasonic transmitter output shall be proportional to the flow or level as per the parameter requirement for each location.
- E. Provide and install a sunshield for all exterior mounted transmitters.
- F. Transmitter shall be Siemens, LUT , ISCO, Endress-Hauser, or equal.

2.4 FLOAT SWITCHES

- A. Float-Tilt Type Level Switches:
 - 1. Manufacturers:
 - a. Anchor Scientific, Inc.
 - b. Contegra, Inc.
 - c. Flygt.
 - d. SJE-Rhombus, Inc.
 - e. Or equal.
 - 2. Materials:
 - a. Float material: Polypropylene or Teflon coated type 316 stainless steel.
 - b. Cable jacket: PVC, neoprene or equal.

- c. Cable clamp: Polypropylene or 316 stainless steel.
- d. Design and fabrication:
 - 1) Sealed mercury switch in float or snap switch.
 - 2) Provide switch complete with flexible electrical cables.
 - 3) SPDT contact rated at 4.5 A at 120 V AC.
 - 4) Direct acting float switch:
 - (a) Switch actuates on rising level.
 - (b) Switch deactuates when liquid falls 1 IN below actuation level.
 - 5) Terminate cables in junction box.
 - 6) Process temperature: 32-100 degrees Fahrenheit.
 - 7) Install floats per Drawing details.

2.5 IDENTIFICATION

- A. All monitoring and control devices shall be identified by nameplates, when panel mounted, or identification tags when field mounted.
- B. Nameplates shall be as specified in Specification Section 26 0553 - Identification for Electrical Systems.
- C. Identification tags shall be as follows:
 - 1. Information shall be printed on polyester labels which shall be mounted on a hi-density polyethylene carrier.
 - 2. The labels shall be yellow with black lettering and shall include the device tag number as listed on the Drawings or in the schedules.
 - 3. Tags shall be attached to a normally non-removable part on the device with stainless steel jack chain and shall be plainly visible to a standing observer.

2.6 PROCESS CONNECTIONS

- A. Provide the following basic materials for process connections:
 - 1. Process connections shall include, as close as practical to the point of connection, a tight closing block valve suitable for the maximum process pressure, temperature, and process fluid involved.
 - 2. Process connections shall include a union or flanged connection located to facilitate disassembly of the connection and removal of the instrument without interrupting process operation.

3. Impulse tubing shall be 316 stainless steel tubing (straight lengths) unless other materials are required to be compatible with the process fluid.
 4. Tubing fittings for impulse lines shall be 316 stainless steel (unless other materials are required to be compatible with the process fluid). Tubing fittings shall be the compression type as manufactured by Swagelok, or approved equal.
 5. All tubing bends shall be tool made.
 6. Impulse tubing connected to moving or vibrating equipment shall be connected using flexible hose. The flexible hose shall be TFE lined flexible stainless steel hose (unless other materials are required to be compatible with the process fluid) as manufactured by Cajon, or approved equal.
- B. The above establishes the minimum basic quality for process connections. Provide additional materials that are required but not specifically listed.

2.7 SIGNAL ISOLATORS, CONVERTERS AND CONDITIONERS

- A. Provide signal isolators, converters, and conditioners.

2.8 SPECIAL TOOLS AND ACCESSORIES

- A. Furnish special tools, instruments, and accessories required to maintain the monitoring and control devices.
- B. Furnish special lifting, handling, and storage devices for the monitoring and control devices when required.

PART 3 EXECUTION

3.1 PRE-INSTALLATION

- A. Ensure that installation areas are clean and that concrete or masonry operations are completed prior to installing monitoring and control devices.
- B. Maintain the areas in a broom clean condition during installation operations.

3.2 INSTALLATION

- A. Field mounted monitoring and control devices shall be installed, calibrated, and started up in strict compliance with the manufacturer's requirements and recommendations.
- B. Conflicts between the manufacturer's requirements and recommendations and these specifications or Drawings shall be presented to the Engineer for resolution before any affected work is started.
- C. Furnish the services of authorized factory personnel especially trained and experienced in the installation of the monitoring and control devices to perform the following:
1. Provide advice during installation to ensure the monitoring and control devices are

- a. installed in accordance with the approved instruction manual.
- 2. Be present when the monitoring and control devices are first put into operation.
- 3. Inspect, check, adjust as necessary, and approve the installation.
- 4. Calibrate the monitoring and control devices, in accordance with the Specifications herein, until all trouble or defects are corrected and the installation and operation are acceptable.
- 5. Prepare and submit the specified Manufacturer's Certified Report.
- D. Unless specifically shown on an applicable monitoring and control device installation detail, process connections shall be as follows:
 - 1. Using standard practices for the installation of industrial instrumentation, and as follows.
 - 2. Process connections for pressure or differential pressure instruments shall be as short as practical and shall be installed with a minimum slope of 1-inch per foot (1:12) downward toward the instrument in liquid systems and upward toward the instrument in gaseous systems.
 - 3. If this preferred direction of slope cannot be maintained, submit for approval an installation configuration utilizing traps, drains, and/or vents at high and low points which will ensure freedom from mixed phase offset effects and provide ease of purging or draining.
 - 4. Provide fill tee fittings and sediment collection legs with blow-down valves where applicable.
 - 5. Conflicts shall be presented to and resolved by the Engineer.

3.3 MOUNTINGS

- A. Where not shown, mount according to standard practices for the installation of industrial instrumentation using floor or wall mounted pipe stands in accordance with manufacturer's recommendation.
- B. When mounted in control panels, mount according to requirements of that section.
- C. Equipment specified for field mounting shall be suitable for direct pipe stand mounting.
- D. Non in-line indicators, and equipment with calibration adjustments or requiring periodic inspection, shall be mounted not lower than 3 feet nor higher than 5 feet above walkways, platforms, and catwalks.
- E. When mounted in a designated hazardous area, the equipment shall meet the explosion proof ratings required by the hazardous area, whether specified herein or not.
- F. When several related instruments are to be mounted in the same vicinity, mount on fabricated racks fastened to main instrument pipe stand. Overall assembly to be logically laid

out and assembled leaving room for maintenance, calibration, and electrical connections.

3.4 FACTORY TESTS AND CALIBRATION

- A. All field mounted monitoring and control devices shall be factory tested by the manufacturer to assure satisfactory performance prior to shipment to the job site.
- B. Whenever possible, this shall include calibration to the actual range and conditions of use.

3.5 INSTRUMENT CALIBRATION

- A. Provide the services of factory trained instrumentation technicians with the proper tools and equipment to field calibrate each instrument to its specified accuracy in accordance with the manufacturer's specifications and instructions for calibration.
- B. Each instrument shall be calibrated at 10 percent, 50 percent, and 90 percent of span using test instruments to simulate inputs and read outputs that are rated to an accuracy of at least 5 times greater than the specified accuracy of the instrument being calibrated.
- C. Test instruments shall have accuracy's traceable to the National Institute of Standards and Technology (NIST), as applicable. Provide a list and basic specifications for calibration instruments used.
- D. The Engineer shall be given 48 hours notice and the opportunity to witness the calibration.
- E. Coordinate the instrument calibration schedule with the requirements of Section 40 9000.
- F. Instrument Calibration Report
 - 1. Submit a written report to the Engineer on each instrument certifying that it has been calibrated to its published specified accuracy.
 - 2. Record data on prepared forms.
 - 3. This report shall include the following for each instrument:
 - a. Facility identification (Name, location, etc.)
 - b. Loop identification (Name and function)
 - c. Instrument tag and serial numbers.
 - d. Zero and full scale calibration limits in the proper engineering units.
 - e. Test mode or type of test.
 - f. Input values or settings.
 - g. Expected outputs and tolerances.
 - h. Actual readings.
 - i. Defects noted, corrective action required, and corrections made.

- j. Explanations or special notes as applicable.
- k. Date of actual calibration.
- l. Tester's certification with name and signature.

END OF SECTION

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SECTION 40 9000 - PROCESS INSTRUMENTATION, CONTROL AND MONITORING GENERAL REQUIREMENTS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. The general requirements for the Instrumentation, Control, and Monitoring System (ICMS) described in Division 33 and shown on the Drawings.

1.2 RELATED REQUIREMENTS

- A. Section 40 7000 - Instrumentation
- B. Section 40 9200 - Process Control Descriptions.
- C. Section 40 9443 - Programmable Logic Process Controllers.
- D. Section 40 9513 - Control Panels.
- E. Section 40 9816 - Supervisory Control and Data Acquisition System.

1.3 REFERENCES

- A. ANSI - American National Standards Institute.
- B. IEEE - Institute of Electrical and Electronics Engineers.
- C. NEMA - National Electrical Manufacturers Association.
- D. ISA - The Instrumentation Systems and Automation Society, (formerly the Instrument Society of America).
- E. NIST - National Institute of Standards and Technology.

1.4 DEFINITIONS

- A. The following words will have the defined meanings when used throughout the Drawings and Specifications.
 - 1. Control Systems Integrator (CSI) or (ISS) - The person, firm or corporation with whom the CONTRACTOR intends on having perform all Work related to the ICMS. Also, referred to as an (ISS) instrumentation and integrated equipment supplier.
 - 2. Applications software - Custom written software developed by the CSI or other firm specifically for this project. Examples include programmable logic controller (PLC) ladder logic and OW graphic displays.
 - 3. Programming software - A standard off-the-shelf software package used to develop applications software.

- a. Programmable Logic Controller: A ruggedized industrial type computer which requires applications software and is typically used to monitor and control process equipment and related instrumentation.
- b. Enclosure - A cabinet, box, or control panel of standard or custom manufacture used to house controls, instruments, and or ICMS components.
- c. Input/Output (I/O): The real world interface between the PLC and the process equipment and instrumentation. Examples include analog inputs, analog outputs, discrete inputs, and discrete outputs.
- d. Operator Workstation (OW) - A personal computer (PC) or other graphic display device used as the man machine interface between the ICMS and the operating personnel.
- e. Local Control Panel (HMI) - A panel, as described in Section 40 9513 or shown on the Drawings, containing selector switches, pilot lights, and or other operator interface devices, controls, and equipment. May contain PLC and I/O hardware.
- f. PC HAND - An operational control mode that requires the operator to initiate a desired action.
- g. PC AUTO - An operational control mode that allows automatic operation based on equipment status, alarm, process variable, or other preprogrammed or configured condition.
- h. Drive - Variable frequency drive (VFD), including inverter, controls, bypasses, and all applicable and required devices and components assembled into enclosure to provide variable speed control of motors and equipment.
- i. ICMS - Instrumentation, control and monitoring system.

1.5 GENERAL REQUIREMENTS

- A. Provide an ICMS complete in every detail to perform the intended process monitoring and control functions as shown on the Drawings and described in the specifications, including:
 - 1. Labor, materials, plant facilities and equipment, and performance of all Work necessary to manufacture, assemble, install, program, calibrate, test, start-up, and demonstrate a complete and operable ICMS.
 - 2. The ICMS is shown on the Drawings and specified in the level of detail necessary to convey to the CSI the intended functions.
 - 3. The CSI shall thoroughly design the ICMS to the detailed level necessary to obtain approval through submittals and shall then manufacture, assemble, program, install, test, start-up, and demonstrate a complete and operable system.
 - 4. The ICMS, as specified, shall be a complete, thoroughly designed, and integrated system.

5. The components of the ICMS, including primary measuring, indicating, transmitting, receiving, recording, integrating, controlling, and alarming devices and appurtenances, shall be completely compatible and shall function as required.
 6. Provide any such additional equipment and accessories as required to meet the intended requirements of the ICMS at no cost to Owner.
- B. ICMS Design:
1. In general, the ICMS design, sequence of operations, Process Flow Diagrams, and related electrical requirements are based on one of the specified process equipment or process system manufacturers.
 2. Coordinate and provide the exact requirements of the selected process equipment or process system manufacturer.
 3. Additional devices, I/O, control logic, and Work may be required (beyond what is shown on the Drawings or specified herein) to achieve the functional results required by the system descriptions. Provide at no additional cost.
 4. Any and all Work required to incorporate products other than those specified in Specifications shall be provided at no additional cost.
 5. Products provided other than those specified, shall provide the same (or better) level of performance as those specified. Level of performance shall be based solely on the opinion or evaluation of the Engineer or Owner. Unsatisfactory equipment shall be removed and replaced at no additional cost.
 6. Provide replacement products and related replacement Work at no additional cost.
- C. Provide control logic as required to satisfy the requirement of the sequence of operation, the process equipment and systems, and as required by the Drawings.
- D. Provide drives, integration, configuration, calibration, and related Work as required by Section 26 2923 - Variable Frequency Drive.
- E. Provide the instruments, devices, accessories, and related Work as required by Section 40 9612 - Primary Elements and Transmitters.
- F. Provide computers, software, configuration, and related Work as required by Section 40 9443 - Programmable Logic Controllers.
- G. Provide enclosures, devices, and assembly, and related Work as required by Section 40 9513 - Control Panels.
- H. Develop, install and troubleshoot Applications Software for PLCs and OW.
- I. Provide project start-up and check-out assistance and training.

- J. Coordinate interface requirements with equipment and systems provided in other Divisions.

1.6 SUBMITTALS

- A. Provide as-built information for Division 40 in electronic format as follows:
 - 1. Provide on CD.
 - 2. Provide the following in AutoCAD, latest release:
 - a. Panel arrangement and layout drawings.
 - b. Panel wiring drawings and schematics.
 - c. Panel I/O point wiring and connection, and tabulation of points.
 - d. Loop drawings.
 - e. Control schematics.
 - f. Other similar information.
 - 3. Provide the following in Microsoft Word, latest release:
 - a. Equipment Specification Data Sheets.
 - b. Parameter Configuration Data Sheets.
 - c. Instrument calibration reports.
 - d. Other similar information.
- B. The following general guidelines shall be used in preparing submittals:
 - 1. Submittals shall be made in complete bound sets indexed by specification number.
 - 2. Provide a written description of the items being submitted.
 - 3. Manufacturer's specification or data sheets shall be clearly marked to delineate the options or styles to be furnished. Options or equipment not being provided shall be neatly crossed-out.
 - 4. Submit only complete systems, not pieces of equipment from various systems.
 - 5. Submittals shall reference assigned equipment and device tag numbers.
 - 6. Submittals not following these and related requirements will be returned without review.
- C. The following submittals shall be provided for the ICMS:

1. Prepare and submit process and instrumentation diagrams (P&IDs) for systems and equipment not shown on the Drawings.
2. Prepare P&ID's in accordance with ISA Standard ANSIISA-S5.5 (1985).
3. Loop Diagrams:
 - a. Prepare loop diagrams in accordance with ISA Standard ANSIISA-S5.4 (1991).
 - b. Obtain required information from electrical subcontractor for completion of loop diagrams.
4. Schedule of values for the ICMS Work - Submit a schedule of values within 10 days of Contract award. The Schedule of Values shall be modified, as required, to be approved by the Engineer. No payments, inspections, submittal reviews, validation, start-up, or other similar activities shall occur until the schedule of values is approved.
5. Training submittals as required by System Demonstration and Training.
6. Evidence of experience, training, and certification.
7. Record Drawings - Drawings shall be a record of work as actually constructed and shall be labeled as "Record".
8. Validation and Start-up certificates.
9. Operation and Maintenance Manuals as required by Division 01 - The manuals shall include the following in addition to requirements listed elsewhere:
 - a. The following identification shall be on the cover: the words "ICMS Operation and Maintenance Manual," the name and location of the Facility, the CSI's name, and the contract number.
 - b. Names, addresses, and telephone numbers of each subcontractor installing equipment and the local representatives for each provided item of equipment and each system.
 - c. A table of contents with the manual assembled accordingly. Tab sheets shall be placed before each section.
 - d. Large sheets of drawings shall be folded in or placed in pockets.
 - e. As-built drawings of control panels, PLC and I/O cabinets. All interconnecting wiring, cables, power sources, modules, terminal numbers, I/O points, and relays shall be shown. Corresponding terminals from within other vendors equipment shall be shown.
 - f. As-built sequence of operation with descriptions addressing the OW graphic displays, operator selections, functions, alarm list, and alarm set points.

- g. Copies of the OW graphic displays which shall be referenced from within the sequence of operations text.
- h. Equipment specification data sheets for each instrument and item of equipment.
- i. Manufacturers product data sheets, installation instructions, operations and maintenance manuals, and complete users, programming, and other manuals for each item of equipment.
- j. Recommended spare parts list with specific model numbers.
- k. After installation is complete, update the manuals to reflect any changes which occurred during installation and deliver balance of manuals to Owner.
- l. Process and instrumentation diagrams and instrumentation loop diagrams.
- m. As-built versions of all submittals provided for Division 33.

1.7 QUALITY ASSURANCES

A. General Qualifications:

- 1. The entire ICMS installation including panel building, calibration, validation, start-up, operational testing, and training shall be performed by qualified personnel, possessing necessary equipment and experience in performing similar installations.
- 2. The system shall be integrated using the latest, most modern proven design and shall, as far as practical, be of one manufacturer.
- 3. The equipment, level of detail, and overall quality of the ICMS shall be consistent a typical industrial type control system.
- 4. Overall system performance shall be guaranteed.
- 5. Software packages shall be latest versions available.
- 6. Pre-Submittal Conference:
 - a. Hold a pre-submittal conference with the Owner and Engineer within 45 calendar days after Contract award (but after acceptance of evidence of experience) for the purpose of discussing in detail the overall control system engineering methods and equipment and to generally provide a framework for communication and coordination.
 - b. Provide pre-submittal conference materials for review at least 14 days before the scheduled conference.
 - c. As a minimum, the pre-submittal conference materials shall include:
 - d. A listing of major items and instruments for this Division.

- e. Identify each by tag number, description, function, manufacturer, and model number.
- f. Provide descriptive literature and statement as to whether item is as specified or a proposed equal. Items identified as equals shall be accompanied by a comparative listing of the published specifications for the specified item and the proposed item.
- g. ICMS block diagram.
- h. List of personal assigned to this project.
- i. Overall schedule for project completion.
- j. A representative sample of each type of submittal required in Division 13.
- k. A sample portion of documented PLC and OW program.

1.8 COORDINATION

- A. Obtain manufacturer's technical information for items of equipment not provided with, but directly connected to, the ICMS. Provide the necessary coordination and components necessary to allow correct signal interfaces between this equipment and the ICMS.
- B. Equipment shall be designed and installed in full conformance with the drawings, specifications, and the recommendations of the equipment manufacturer and the related process equipment manufacturers. Conflicts shall be presented to the Engineer for resolution before proceeding. Conflicts shall be resolved without additional cost to the Owner.
- C. Coordination with other subcontractor's and equipment suppliers, as well as supervision of installation, shall be provided for the duration of the project.

1.9 ENVIRONMENTAL CONSIDERATIONS

- A. All ICMS equipment shall be rated for normal operating performance with varying operating conditions over the following minimum environmental conditions.
- B. Unless specifically intended for such service, instruments and equipment shall be protected and isolated from vibration, temperature extremes, radiant heat, rain or falling water, and similar adverse conditions. Provide enclosures; sunshields; thermostatically controlled fans, heaters, and or air conditioners; as required by the equipment manufacturer.
- C. Project Conditions:
 - 1. Outdoor Areas:
 - a. Ambient Temperature: 0 to 104 degrees F.
 - b. Weather: Rain, sleet, snow, ice, condensing fog, wind, and sun.
 - 2. Indoor Unheated Areas:

- a. Ambient Temperature: 0 to 104 degrees F.
 - b. Ambient Relative Humidity: 5 to 100 percent.
- 3. Indoor Environmentally Controlled Areas:
 - a. Ambient Temperature: 35 to 104 degrees F.
 - b. Ambient Relative Humidity: 5 to 100 percent.

PART 2 PRODUCTS

2.1 MAINTENANCE MATERIALS AND SPARE PARTS

- A. Provide in manufacturer's original containers labeled to completely describe contents and equipment for which it is furnished. Spare parts shall consist of the following basic items:
- B. Five percent but not less than 1 minimum of each type of plug-in unit, etched or printed circuit board assembly.
- C. One spare Input/Output card for every 20 units or portion thereof.
- D. One spare PLC processor, memory, and communication card for every 20 units or Portion thereof.
- E. One spare PLC and loop power supply for every 20 units or portion thereof.
- F. One spare PLC back plane or chassis for every 20 units or portion thereof
- G. Ten percent but not less than 2 of each type switch, push-button, potentiometer, etc. used.
- H. Ten percent but not less than 10 of each type light bulb and fuse used.
- I. One year supply of expendable items.
- J. One spare of each type of special termination and interconnecting cable used.
- K. Others as described in Division 16.
- L. Tools, computers, software, and calibration equipment as specified in Division 26.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Inspect each instrument and piece of equipment for damage, defects, completeness, and correct operation before installing.
- B. Inspect previously installed related work and verify that it is ready for installation of instruments and equipment.

- C. If devices furnished by other suppliers or under other contracts, such as valve operators, motor controls, chemical feeders, and instruments, do not perform properly, the field technician shall use suitable test equipment to introduce simulated signals to and/or measure signals from those devices as may be required to locate the source of trouble or malfunction. A written report regarding the results of such tests shall be furnished as necessary to resolve a question of responsibility for corrective measures.

3.2 PREPARATION

- A. Ensure that installation areas are clean and that concrete and masonry operations and other major construction are completed prior to installing instruments and equipment. Maintain the areas in a broom clean condition during installation operations.
- B. Protect instrumentation, enclosures, and other ICMS equipment from damage until Substantial Completion occurs.

3.3 ICMS VALIDATION AND START-UP

- A. Validate and start-up the ICMS in coordination with the requirements of Facilities Startup and the following and other pump station requirements. The same CSI's personnel shall be present for the duration of the ICMS validation and start-up as described below.
- B. Schedule the ICMS validation and start-up with the availability and start-up schedule for the various process systems.
- C. Initially the ICMS shall be treated as a component, as such the ICMS shall undergo a Pre operational Component Inspection and a Component Validation. In general, the Pre operational Component Inspection and Component Validation shall include:
 - 1. Pre-operational Component Inspection:
 - a. The ICMS shall be operated and thoroughly checked-out by the CSI prior to the Pre-operational Component Inspection.
 - b. A visual inspection of all equipment, instruments, control panels, graphic displays, and other installations made under Division 33.
 - c. A demonstration of the proper calibration and operation of all field instruments and control panels.
 - 2. Component Validation: their limits (simulated or process) to verify all alarms, failure interlocks, and operational interlocks between systems and mechanical equipment.
 - 3. Demonstrate all control sequences for the various subsystems with process fluids. During this portion of the validation, perform final tuning and calibration of all instruments, controls, and control loops to allow the Reliability Demonstration Testing to proceed without upsets.

4. Make adjustments to set points and alarms, tune controllers, and make adjustments and changes to the control logic as required for proper system operation and as directed by the Engineer.
 5. Demonstration of all modes of operation including successful switch-overs and switch-backs to and from the back-up equipment and systems. Submit certification that the System Validation was successfully performed
- D. After a successful System Validation, the ICMS shall be demonstrated as part of the Reliability Demonstration Testing. During the Reliability Demonstration Test:
1. The CSI's personnel shall be on-site as required by the Contractor or Engineer.
 2. The Reliability Demonstration Test shall be at least one week in duration.
 3. No modifications or changes shall be initiated without strict permission of the Engineer or Owner.
 4. Demonstration of all modes of operation.
 5. Make adjustments to set points and alarms, tune controllers, and make adjustments and changes to the control logic as required for proper system operation (as directed by the Engineer).
 6. Make a reasonable amount of preferential type software changes as directed by the Engineer or Owner.

3.4 INSTRUCTION OF OWNER'S PERSONNEL

- A. Provide the services of a factory trained and field experienced instrumentation engineer to conduct group training for the control system. The training for the instrumentation and control systems shall be divided into two categories.
- B. Field instrument training - Field instrument training shall include a total of two (2) 1-day training, two (2) trips, to instruct the Owner's representatives on the following:
- C. Location, maintenance and calibration of field devices.
- D. An ICMS overview addressing I/O cabinet locations, points monitored and controlled, communications, and programming techniques.
 1. Systems training - Systems training shall include a total of two (2) working days. The purpose of the systems training is to instruct the Owner's operating and maintenance personnel on the operation of the ICMS. The training shall include the following:
 - a. An explanation and demonstration of the functions available at the OW and in the field for each process systems.

- b. The systems training shall be conducted in two segments. The first segment shall include one working days of pre-operational start-up training and the second shall include one working days of hands on training. The hands on training shall occur after building start-up.

END OF SECTION

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SECTION 40 9200 - PROCESS CONTROL DESCRIPTIONS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Control descriptions for wastewater treatment process.

1.2 RELATED WORK SPECIFIED ELSEWHERE INCLUDES THE FOLLOWING:

- A. Section 43 1133 - Rotary Lobe Blower Packages
- B. Section 46 1010 - Wastewater Pumps
- C. Section 46 2020 – Mechanically Cleaned Bar Screen
- D. Section 46 2025 – Screenings Washer/Compactor
- E. Section 46 2300 – Grit Removal and Handling Equipment
- F. Section 46 4140 – Linear Motion Sludge Mixers
- G. Section 46 4321 - Circular Clarifier and Thickener Equipment
- H. Section 46 6656 – Ultraviolet Disinfection Equipment
- I. Section 46 7621 – Belt Filter Presses
- J. Division 26 - Electrical

1.3 SUBMITTALS

- A. A written control narrative shall be submitted with each shop drawing for mechanical equipment covered in this Section.

1.4 UNLESS SPECIFICALLY NOTED OTHERWISE, ALL CONTROLS SHALL BE PROTECTED BY LOCAL TRANSIENT SURGE SUPPRESSION AT EACH INDIVIDUAL PANEL.

PART 2 PRODUCTS

2.1 ROTARY LOBE BLOWER PACKAGES (GRIT CHAMBER B10, B20; POST AERATION B30, B40)

- A. Equipment: Blower Units shall include complete blower package with variable frequency drive with inverter duty rated motor, run time meter, control panel, and accessories as required for operation. These items, as well as H-O-A switch, maintained contact START-STOP pushbuttons, and local disconnect, shall be provided where not supplied with the equipment. Provide all control panel for each blower set, connections, devices, relays, hardware, enclosures, etc. as necessary to yield the specified operation.
- B. Sequence of Operation: In the manual mode with the H-O-A switch set to hand, the operator shall be able to turn each blower on or off locally with a maintained contact switch; this will permit the blower to restart after momentary power outage. Speed for each blower shall be available for adjustment at the control panel or at the variable frequency drive for each

blower. With the H-O-A switch set to automatic, on/off and speed control for each blower shall be available at the SCADA system. All resets to failure modes shall remain manual.

- C. SCADA: In addition to the features specified above, status signals of START/STOP/FAIL for the system shall be transmitted to the PLC and SCADA system. At activation of any failure device, PLC shall sound an alarm and signal the SCADA to the condition and deactivate the motor unit.
- D. Safety Features: Each blower motor shall be equipped with motor overloads and loss-of-phase protection for all three phases. Each blower motor shall also be equipped with motor overheat switches and a discharge pressure switch. Overheating or loss of pressure conditions shall cause the motor to fail and a fault signal transmitted to the local PLC and the SCADA system. Manual reset of the fail condition will be required.

2.2 PUMP SETS FOR MAINTAINING WETWELL LEVELS (INFLUENT PUMPS P10, P20, P30; EFFLUENT PUMPS P100, P110; RAVEN DORAN LIFT STATION PUMPS P300, P310, P320)

- A. Equipment: VFD-driven pumps, rated for inverter duty, with lag-lead-high operation and level controls via pressure transducer with float switch back-up in the wet well. Pressure transducer shall provide analog level data to the local PLC and the plant SCADA system. Provide interlocks to prevent operation of three pumps simultaneously; only two maximum shall operate at the same time. For the Effluent Pumps, only one maximum shall operate. Provide pump control panel for each pump set, H-O-As, VFDs (one per pump) and all necessary accessories, features, and programming as required to meet the specified operation.
- B. Sequence of Operation: When the H-O-A switch is in manual, the start/stop function shall be enabled directly at the pump control panel. When in Automatic, sequence is as follows.
 - 1. Sequence begins with wetwell at low level, with "ALL PUMPS OFF". As water level rises to the "LEAD PUMP ON" elevation, the lead pump shall slowly accelerate to a pre-determined user-set minimum speed less than 100 percent. As the wetwell level rises, the pump shall gradually increase in speed, up to a pre-determined user-set maximum speed, to attempt to maintain a constant wetwell level. If the wetwell level falls to the "ALL PUMPS OFF" elevation with one pump running, the lead pump shall slowly decelerate and stop, and the PLC shall index to make the next pump the lead pump. However, if the wetwell level continues to rise after the lead pump has accelerated to maximum speed, and the level reaches the "LAG PUMP ON" elevation, the lag pump shall slowly accelerate to a pre-determined user-set speed less than 100 percent and the lead pump speed shall be reduced to match the lag pump. As the wetwell level continues to rise, the pump set shall gradually increase in speed simultaneously to attempt to maintain a constant wetwell level. If the wetwell level falls to the "ALL PUMPS OFF" elevation with both pumps running, both pumps shall slowly decelerate to stop and the PLC shall index to make the third pump the lead pump. It shall be impossible for all three pumps (or two pumps in the case of the Effluent Pumps) to run simultaneously. With both the lead pump and lag pump running, if the wetwell level continues to rise to the "HIGH WATER ALARM" level, the pump set shall continue to run and a high water alarm condition shall be sent to the SCADA system at the treatment plant via the PLC. If any pump fails due to any safety interlocks, the PLC shall skip over the failed pump in sequence until the fail condition is corrected and reset manually; failure of pump shall be

indicated as an alarm locally and at the SCADA system. Operator shall have the capability of changing set points for all levels, and minimum and maximum speed settings for each pump, from a local “user-friendly” control panel and from the SCADA.

- C. SCADA: Status START/STOP/FAIL signals for each pump shall be sent to the PLC and SCADA system. At activation of any failure device, PLC shall sound an alarm and signal the SCADA to the condition and deactivate the motor unit. Wetwell level, with zero level referenced to the bottom of the wetwell, shall be provided from the pressure transducer to the local PLC and SCADA system. Float switch status (open/closed) shall be provided to the local PLC and to the SCADA system.
- D. Safety Features: Failure/safety interlocks, in addition to those specified elsewhere as standard for motors, shall include seal cavity moisture sensors, embedded motor overheating elements, motor overload and loss-of-phase protection.

2.3 PUMP SETS FOR MAINTAINING OPERATOR SET-POINT FOR FLOW RATE, OPERATOR INITIATED START/STOP (GRIT PUMPS P40, P50; PRIMARY SLUDGE PUMPS P60, P70; SECONDARY SLUDGE PUMPS P80, P90; SLUDGE TRANSFER PUMPS P120, P130; SLUDGE RECIRCULATION PUMPS P140, P150; PROCESSED SLUDGE PUMPS P160, P170; SECONDARY SLUDGE WASTE PUMPS P210, P220, LIME PUMPS P270, P280)

- A. Equipment: VFD-driven pumps, rated for inverter duty. Provide interlocks to prevent operation of two pumps simultaneously; only one maximum shall operate at the same time. Pump control panel for each pump set, H-O-As, VFDs (one per pump), speed controller, and all specified accessories, features, and programming as required to meet the specified operation.
- B. Sequence of Operation: Only one pump shall operate at any time. When the H-O-A switch is in manual, the start/stop/speed control functions shall be enabled directly at the pump control panel. When in the automatic mode, the start/stop/speed control features shall be available at the SCADA system.
- C. SCADA: Status signals of START/STOP/FAIL for the system shall be transmitted to the PLC and SCADA system. At activation of any failure device, PLC shall sound an alarm and signal the SCADA to the condition and deactivate the motor unit.
- D. Safety Features: Failure/safety interlocks, in addition to those specified elsewhere as standard for motors, shall include seal cavity moisture sensors, embedded motor overheating elements, motor overload and loss-of-phase protection. At activation of any failure device, PLC shall sound an alarm and signal the SCADA to the condition and deactivate the motor unit.
- E. Grit pumps: Grit pump controls shall be provided in the grit system control panel.

2.4 PUMP SETS FOR MAINTAINING PRESSURE SET-POINT, AUTOMATED START/STOP (NONPOTABLE WATER PUMPS P190, P200)

- A. Equipment: VFD-driven pumps, rated for inverter duty. Provide interlocks to prevent operation of two pumps simultaneously; only one maximum shall operate at the same time. pump control panel for each pump set, H-O-As, VFDs (one per pump), speed controller, and all specified accessories, features, and programming as required to meet the specified

operation.

- B. Sequence of Operation: Only one pump shall operate at any time. When the H-O-A switch is in manual, the start/stop/speed control functions shall be enabled directly at the pump control panel. When in the automatic mode, the pump set shall operate to maintain a discharge pressure as set by user set point in the SCADA system.
- C. SCADA: Status signals of START/STOP/FAIL for the system shall be transmitted to the PLC and SCADA system. At activation of any failure device, PLC shall sound an alarm and signal the SCADA to the condition and deactivate the motor unit.
- D. Safety Features: Failure/safety interlocks, in addition to those specified elsewhere as standard for motors, shall include seal cavity moisture sensors, embedded motor overheating elements, motor overload and loss-of-phase protection. At activation of any failure device, PLC shall sound an alarm and signal the SCADA to the condition and deactivate the motor unit.

2.5 MECHANICALLY CLEANED BAR SCREEN

- A. Equipment: See Section 46 2020 - Mechanically Cleaned Bar Screen.
- B. Sequence of Operation: See Section 46 2020 - Mechanically Cleaned Bar Screen.
- C. SCADA: Provide outputs from screen control system as specified in Section 46 2020 - Mechanically Cleaned Bar Screen to local SCADA PLC as shown in drawings.
- D. Safety Features: The screen controls shall be equipped with motor overloads and loss-of-phase protection.

2.6 SCREENINGS WASHER/COMPACTOR

- A. Equipment: See Section 46 2025 – Screenings Washer/Compactor.
- B. Sequence of Operation: When the H-O-A switch is in manual, the start/stop/speed control functions shall be enabled directly at the pump control panel. When in the automatic mode, the start/stop/speed control features shall be available at the SCADA system.
- C. SCADA: Provide outputs from screenings washer/compactor control system as specified in Section 46 2020 - Mechanically Cleaned Bar Screen to local SCADA PLC as shown in drawings. Outputs shall be provided either directly to the SCADA PLC or via the screen control panel.
- D. Safety Features: The screen controls shall be equipped with motor overloads and loss-of-phase protection.

2.7 GRIT SYSTEM

- A. Equipment: See Section 46 2300 – Grit Removal and Handling Equipment.
- B. Sequence of Operation: Operator shall be able to set timed interval operation over a 24-hour resetting period of the grit pumps and the grit classifier either locally at the control panel when set in Hand mode or remotely via SCADA when set in automatic mode.

- C. SCADA: Display and control functions as indicated in Section 46 300 Grit Removal and Handling equipment shall be provided to the SCADA HMI.
- D. Safety Features: Controls shall be equipped with motor overload and loss-of-phase protection.

2.8 LINEAR MOTION SLUDGE MIXERS

- A. Equipment: See Section 46 2300 – Grit Removal and Handling Equipment.
- B. Sequence of Operation: Sequence shall be per manufacturer's standard controls, see Section 46 4140 Linear Motion Sludge Mixers.
- C. SCADA: All functions and indicators available at the local control panel shall also be available through the SCADA system.
- D. Safety Features: Controls shall be equipped with motor overload and loss-of-phase protection.

2.9 AERATION BASIN (AERATOR NOS 1 THROUGH 9)

- A. Equipment: VFD-driven aerators with motors rated for inverter duty, run time meter, control panel, and accessories as required for operation. Process instruments and controls including nine ORP and DO probes with transmitters two analytical transmitters, control panel with PLC, touch screen HMI. H-O-A switch, maintained contact START-STOP pushbuttons, and local disconnect shall be provided where not supplied with the equipment. Provide all connections, devices, programming, hardware, enclosures, etc. as necessary to yield the specified operation.
 - 1. Heat tracing tape, where utilized, shall be installed per manufacturer's instructions to prevent pipe freezing. ON signal from heat tape shall be sent to the PLC.
- B. Sequence of Operation: PLC setpoint control of the aerators with override via touch screen HMI or SCADA input. HMI input to SCADA shall allow for DO target level with hysteresis for control of aerator speed to maintain set point via VFD control. HMI override shall allow for aerator speed setting without PLC control to maintain DO setpoint.
- C. SCADA: Status signals of "START/STOP/FAIL" for the system shall be transmitted to the PLC and SCADA system. ORP probe data, DO probe data, aerator speed status and input shall be available at the SCADA. All resets to failure modes shall remain manual. Refer to the drawings for addition information and requirements.
- D. Safety Features: Controls shall be equipped with motor overload and loss-of-phase protection.

2.10 CLARIFIERS AND SLUDGE THICKENER

- A. Equipment: drive units shall include motor, run time meter, control panel, overtorque switches (two per drive), and accessories as required for operation. These items, as well as motor starter, H-O-A switch, maintained contact START-STOP pushbuttons, and local disconnect, shall be provided where not supplied with the equipment. Provide all connections, devices, relays, hardware, enclosures, etc. as necessary to yield the specified operation.

- B. Sequence of Operation: Each drive unit shall be started and stopped manually; PLC control of the drives shall be wired and programmed into the system, but not accessible without special password or coding; PLC-based control shall be only a secondary method of operation. All resets to failure modes shall remain manual.
- C. SCADA: Status signals of START/STOP/FAIL for the system shall be transmitted to the PLC and SCADA system.
- D. Safety Features: Failure/safety interlocks in addition to those specified as standard for motors, shall include overtorque cutouts: At 100% torque, the first overtorque switch shall sound an alarm and signal the SCADA to the condition; at 125% torque, the second overtorque switch shall sound an alarm and signal the SCADA to the condition, and deactivate the drive unit.

2.11 ULTRAVIOLET DISINFECTION SYSTEM

- A. Equipment: Two-bank channel mounted system as shown in the drawings and per Section 46 6656 – Ultraviolet Disinfection Equipment.
- B. Sequence of Operation: A flow switch shall be mounted on the pipe before each inline disinfection module. The flow switch shall send a signal to the manufacturer supplied control panel to initiate energizing of the inline disinfection module. Unless overridden manually, the power setting of the inline disinfection modules shall be controlled by the system to provide effective intensity for disinfection.
- C. SCADA: The ultraviolet disinfection system shall be equipped with ultraviolet meter(s) to gauge the intensity of the light and sound an alarm if it is too low for effective disinfection. Low intensity alarm signals shall be routed to the local PLC and SCADA systems. Additionally, inputs to the system to allow remote on/off and intensity settings from the SCADA shall be provided. An analog output from the system which corresponds to the output of the UV intensity monitor shall be relayed to the PLC and SCADA systems. Ground fault and wiper failures shall also be relayed to the PLC and SCADA systems. Provide any additional output or inputs from SCADA as specified in Section 46 5556 -Ultraviolet Disinfection Equipment.
- D. Safety Features: The system shall de-energize the lamp group in an overtemperature situation to prevent damage to the UV chamber or cabinet. An overtemperature alarm shall be sent to the PLC and SCADA system.

2.12 SLUDGE DEWATERING EQUIPMENT

- A. Equipment: A packaged skid-mounted belt press system shall be provided as specified in Section 46 7621 Belt Filter Presses.
- B. Sequence of Operation: The sludge dewatering equipment shall operate semi-automatically through a manufacturer supplied control panel or manually through the use of the same panel. The operator shall be able to control press operation at the local control panel as specified in Section 46 7621 - Belt Filter Presses.
- C. SCADA: Belt press control panel shall be connected to SCADA via ethernet connection. Provide all status/speed/flow indicators and alarms which are available at the belt press control panel

to the SCADA system for indication on SCADA HMI. SCADA control of belt press shall not be provided.

1. The system shall have an electromagnetic meter in the sludge feed and output for this flow rate shall be connected to the PLC and SCADA systems.
- D. Safety Features: Each motor shall be equipped with motor overload and loss-of-phase protection for all three phases. Manual reset of the fail condition is required. Local fault indication shall be as indicated in Section 46 7621 - Belt Filter Presses. Tripping of any of these faults shall send a corresponding fault signal to the SCADA.

PART 3 EXECUTION

3.1 NOT USED.

END OF SECTION

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SECTION 40 9443 - PROGRAMMABLE LOGIC PROCESS CONTROLLERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Programmable logic process controllers and accessories.

1.2 SYSTEM DESCRIPTION

- A. Configuration: Standalone and network interfaced programmable controller incorporated into system control panel for controlling pump station system.

1.3 RELATED REQUIREMENTS

- A. Section 26 0526 - Grounding and Bonding for Electrical Systems.
- B. Section 26 0553 - Identification for Electrical Systems.

1.4 REFERENCES

- A. National Electrical Manufacturers Association:
 - 1. NEMA IA 2.2 - Programmable Controllers - Equipment Requirements and Tests.
 - 2. NEMA IA 2.3 - Programmable Controllers - Programming Languages.
 - 3. NEMA ICS 3 - Industrial Control and Systems: Factory Built Assemblies.
 - 4. NEMA ICS 6 - Industrial Control and Systems: Enclosures.

1.5 SUBMITTALS

- A. ~~Section 01 3000 - Administrative Requirements: Submittal Procedures.~~

McGill Section 013300
- B. Shop Drawings: Indicate electrical characteristics and connection requirements, including layout of completed assemblies, interconnecting cabling, dimensions, weights, and external power requirements.
 - 1. Master drawing index.
 - 2. Dimensioned outline drawing.
 - 3. Logic diagrams.
 - 4. Schematic diagram.
 - 5. Component list.
 - 6. Terminal locations.
 - 7. Terminal and input/output ratings including:

- a. Voltage.
 - b. Continuous current.
 - c. Central processing unit memory size.
- C. Product Data: Submit catalog data for each component specified showing electrical characteristics and connection requirements.
 - D. Test Reports: Indicate procedures and results for specified factory and field testing and inspection.
 - E. Manufacturer's Field Reports: Indicate activities on site, adverse findings, and recommendations.

1.6 CLOSEOUT SUBMITTALS

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Closeout procedures.

McGill Section 017700
- B. Project Record Documents: Record actual locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information, and terminal block layouts in controller cabinets. Include copy of manufacturer's certified drawings, PLC programming integration, and ladder diagram of process logic.
- C. Operation and Maintenance Data: Submit bound copies of operating and programming instructions, and include card replacement, adjustments, and preventive maintenance procedures and materials.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this section with minimum three years documented experience, and with service facilities within 100 miles of project.
- B. Supplier: Authorized distributor of specified manufacturer with minimum three years documented experience.
- C. Source Limitations:
 - 1. All PLCs shall be by Allen-Bradley, no exceptions. If the PLC manufacturer has authorized third party vendors to provide modules that are compatible with their platforms, then products manufactured by these authorized third party vendors will be acceptable.

1.8 ENVIRONMENTAL REQUIREMENTS

- A. ~~Section 01 6000 – Product Requirements:~~

McGill Division 01
- B. Conform to specified service conditions during and after installation of programmable controllers. Maintain area free of dirt and dust during and after installation of products.

1.9 MAINTENANCE SERVICE

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Maintenance service.
McGill Section 017823.
- B. Furnish service and maintenance of programmable controllers for one (1) year from Date of Substantial Completion.

1.10 MAINTENANCE MATERIALS

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Spare parts and maintenance products.
McGill Section 017823.
- B. Furnish spare parts as described below for each type of PLC. Material shall be packaged for long term storage and identified with labels describing contents.
 - 1. I/O Cards: Provide as a minimum a spare of each type of card identified. Provide an additional spare for every ten cards of a specific type installed.
 - 2. Processors: Provide as a minimum a spare for each type of CPU identified.
 - 3. PLC-Oriented Power Supplies: Provide as a minimum a spare of each type of power supply identified. Provide an additional spare for every ten (10) power supplies of a specific type installed.
 - 4. Memory Cards: Provide as a minimum a spare of each type of card identified. Provide an additional spare for every ten (10) cards of a specific type installed.
 - 5. Specialty Modules: Provide as a minimum a spare of each type of module identified. Provide an additional spare for every ten (10) modules of a specific type installed.

PART 2 PRODUCTS

2.1 PROGRAMMABLE CONTROLLER

- A. Manufacturers:
 - 1. Allen-Bradley - Control Micrologics Compact Logix.
- B. Product Description: Controller conforming to NEMA IA 2.2, and with required memory and functional capacity to perform specified sequence of operation with scheduled input and output points.
 - 1. Collect data, perform process control functions, communicate with other PLCs, and distribute process information along the local area network.
 - 2. Be able to have its program downloaded from a remote workstation over a network, or locally programmed from a portable laptop computer.
 - 3. Allow for the expansion of the system by addition and configuration of hardware.
 - 4. Executive firmware shall be stored in Flash memory and can be updated in the field using standard programming tools. Executive firmware files shall be readily available via a public web site.

- C. Service Conditions: Conform to NEMA ICS 3 and the following:
 - 1. Temperature: 32-131 deg F.
 - 2. Humidity: 30-95% (noncondensing).
- D. Programming Language: Conform to NEMA IA 2.3.
- E. Programming Software: CompactLogix, FT View SE Runtime (25 displays)
- F. Networking Connections: Ethernet.
- G. Spare Input/Output Capacity: 50 percent.
- H. Input Voltage: 120 volts, 60 Hz.
- I. Enclosure: NEMA ICS 6; Type 1 for indoor installation, Type 3R for outdoor installation.

2.2 SOURCE QUALITY CONTROL

- A. Test programmable controller in accordance with NEMA IA 2.2.

PART 3 EXECUTION

3.1 EXISTING WORK

- A. Connect and interface to existing Owner's system.
- B. Coordinate all IP addresses with Owner prior to completion of programming.

3.2 INSTALLATION

- A. Do not install products until major construction is complete and building interior is enclosed and heated.
- B. Coordinate all IP addresses with Owner prior to completion of programming.
- C. Connect input and output devices as indicated on Drawings.
- D. Install engraved plastic nameplates in accordance with Section 26 0553.
- E. Ground and bond programmable controllers in accordance with Section 26 0526.

3.3 FIELD QUALITY CONTROL

- A. Section 01 4000 - Quality Requirements and ~~01 7000 - Execution and Closeout Requirements:~~ Field inspecting, testing, adjusting, and balancing.
- B. Perform operational testing on control systems to verify proper operation and field wiring connections.

3.4 MANUFACTURER'S FIELD SERVICES

- A. Section 01 4000 - Quality Requirements: Manufacturer's field services.
- B. Prepare and start up programmable controller.

3.5 DEMONSTRATION AND TRAINING

- A. Furnish four (4) hours of instruction each for two (2) persons, to be conducted at project site with manufacturer's representative.

END OF SECTION

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SECTION 40 9513 - CONTROL PANELS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. This Section specifies the requirements for furnishing, installing, connecting, and testing the control panels applied for instrumentation and equipment systems to interface process equipment.
- B. The control panels or field panels will contain the PLC, CPU, UPS, media converter, and necessary surge protection, operator field panel interface devices, switches, relays, and wire management systems to protect the control equipment environment.

1.2 RELATED REQUIREMENTS

- A. Section 26 4300 - Surge Protective Devices.

1.3 REFERENCES

- A. ANSI – American National Standards Institute.
- B. IEEE – Institute of Electrical and Electronics Engineers.
- C. NEMA – National Electrical Manufacturers Association.
- D. ISA – The Instrumentation Systems and Automation Society, (formerly the Instrument Society of America).
- E. NIST – National Institute of Standards and Technology.
- F. UL 508A - for Industrial Control Panels.

1.4 SUBMITTALS

- A. Product Data:
 - 1. Bill of Materials including part number, item description, and manufacturer to identify all project-specific equipment.
 - 2. Spare parts list for spare parts required by this section, identified as per Bill of Materials, but listed separately.
 - 3. A manufacturer's catalog sheet for each item in the bill of materials, with all part numbers and project-specific options clearly identified. Show electrical characteristics and connection requirements.
- B. Shop Drawings:
 - 1. Interior and exterior elevation drawings showing the layout of all components, dimensions, support points, and required clearances.

2. Wiring diagrams, electrical schematics, and/or control diagrams showing all internal components and method of connection and control for all external devices connected to panel. Provide legend for all symbols used in the diagrams.

PART 2 PRODUCTS

2.1 GENERAL

- A. The control panels shall be NEMA Type 4x, wall mounted enclosures with all instruments, switches and gauges flush mounted on the front of the panel. Suppliers shall size panels to accommodate devices and equipment installed for a fully integrated operational process control system, with space for 10 percent future items. Dimensions on the drawings are for general reference only. All control panel assemblies shall be UL listed and labeled.
- B. Construction shall consist of a steel frame with 11 gage minimum top, end panels, and front panel. The front of the panel shall consist of a 1/8-inch thick minimum sheet steel door having concealed hinges and 3 point latch with locking handle for accessibility to all wiring on the inside of the panel. Surface mounted subpanels shall be mounted on the interior of the panel, behind each access door for mounting auxiliary devices, accessories. These devices shall not be mounted on the interior side panels of the control panel.
- C. Panel finish shall be the manufacturer's standard ANSI 39-grey Color for machine tool panels and electrical enclosures.
- D. The large double door panels shall have a 15 watt (minimum) interior LED light with diffuser, and switch. A duplex NEMA 5-20R, 120 volt single phase receptacle shall be provided and wired inside the panel for maintenance use. The panels shall have all instrument and control wiring installed at the manufacturer's plant. The location of the electrical terminals within the panel shall be coordinated with the Electrical Contractor's layout. Wiring shall be numbered at all connections to permit easy identification. The panel manufacturer shall provide an overall coordinated wiring diagram incorporating all external equipment controlled from the panel. All control and instrument items and devices inside the panel shall be identified with brass or engraved tags.
- E. Panel electrical wiring, together with all instrument and control device connections shall be complete, checked out neatly bundled, racked and cleaned. Signal leads shall be grouped separately from A.C. leads. Wireways may be used in lieu of bundling. Wiring for external connections shall be terminated at terminal blocks. Terminal blocks shall be provided for spare wires as indicated on the drawings. Additional spares equal to 10 percent of the total number of terminal blocks shall be provided for future use. Panel wiring shall not be less than #14 standard copper conductor having 600 V insulation MTW type, for continuous operation of copper at 90 Deg. C. Terminal blocks shall be factory assembled with pressure type wire connectors and white marking strips. All exposed terminals of terminal blocks and device shall be covered. External wiring beyond terminal strips shall be THWN stranded copper wiring methods.
- F. Each external device or field instrument deriving 120 VAC power from the control panels shall have separate power distribution circuits from panel fuses or panel individual circuit breakers. All PLC discrete output circuits to field mounted devices shall be fused with a isolating fuse

switch terminal block with interposing relays. Circuits for discrete inputs to the PLC I/O shall have flip switch individual switches as isolating switch blocks for testing PLC inputs.

- G. Pushbuttons, switches and indicator lights shall be Eaton E30 Heavy-Duty Oil tight selector switches or approved equal with legend plates. Pilot lights shall have a transformer type light element. Switches shall be rated for 600 volts. Relays shall be 300 volt rated industrial type with convertible contacts, four (4) pole minimum, two (2) spare poles per relay and encapsulated coil, coil voltages shall be 120 VAC.
- H. Human Machine Interface (HMI) operator interface panels shall use 9- to 10-inch devices with touch screen provision for process commands. HMI panels shall be provided from the same manufacturer as the PLC process controllers. Panel mounted devices and exterior mounted equipment shall be installed with suitable gaskets and cover plates to maintain the NEMA ratings. HMI panels mounted in exterior locations shall be rated for exterior conditions.
- I. Engraved name plates shall be provided on the front panel for identification of all components mounted thereon.
- J. Arrangement of devices, wiring, piping, tubing, wireways and mounting brackets shall permit future additions to the panel.
- K. PLC - Programmable logic controller. The panel supplier shall furnish and install the programmable control system in accordance with the Programmable Logic Process Controller section 40 9443 and as detailed on the control diagrams for applicable Contract Drawings. Each PLC shall include but not be limited to processor modules (CPU), communications interface module, power supply, software for applications programming, operator interface system diagnostics, communications, and data acquisition. The PLC shall collect data, process control functions, communicate with other PLCs via Supervisory Control and Data Acquisition (SCADA) system and distribute process information along the data highway, and may have their program down loaded from programmer's terminal, and be locally programmed from a portable programmer.
- L. The PLC system:
 - 1. Manufacturers:
 - a. Allen Bradley.
 - 2. Shall be furnished by a single vendor who has actively been manufacturing programmable logic controllers of the required specified capabilities and whose products have operated successfully for a period of at least eight (8) years. Furnish the I/O for both analog and discrete control points as noted in the contract drawings for the tags and control points as listed in the schedule.
- M. All PLC equipment shall be UL and VDE, and CE listed.
- N. The PLC system manufacturer's representative, integrator, and service technician network, shall maintain, as part of a national network, engineering service facilities within 200 miles of the Project, to provide start-up service, emergency service calls, repair work, service contracts, maintenance, and training of Department personnel. Emergency service shall be available within 24 hours of notification.

O. The PLC software:

1. Rockwell RS Logix micro developer (english version) and associated software packages for both programming and control operation and to integrate the HMI and remote SCADA system interface for the pumping system.

2.2 WIRING

- A. Wiring for 120-volt circuits shall be 12 AWG minimum, and shall be rated for 600-volt service. Power wiring, communication wiring, and low voltage wiring shall be routed in separate wireways and raceways. Separate field and panel wiring in separate wireways and wire troughs also. Paralleled line voltage systems shall be barriered for separation and isolation unless a 2 inch separation can be maintained.
- B. Instrumentation cable shall be 16 AWG, stranded copper, single or multiple-twisted, minimum 2 inch lay of twist, 100 percent shielded pairs, and shall have a 300-volt insulation. Each pair shall have a 20-AWG tinned-copper drain wire and individual overall.

2.3 INDICATOR BAR GRAPHS

- A. Electronic type bar graph, 4-inch nominal vertical scale. Calibrated in engineering units, with digital indicator. Provide with 4/20 mA DC input. Suitable for panel mounting.

2.4 PILOT LIGHT INDICATORS

- A. Provide LED pilot lights, provide heavy duty oil tight type, suitable for voltage supplied. Provide red lens cover for stopped-off or closed valve, provide green lens cover for run, open valve, on, indications, provide white power-on, and amber for alarm status.

2.5 SELECTOR SWITCHES AND PUSH BUTTONS

- A. Heavy duty oil tight selectors and push buttons, provide with stackable contacts, 10 amp rated. Push buttons shall be flush type with semi recessed trim ring.

2.6 GENERAL PURPOSE RELAYS

- A. Plug-in type, 3-pole, normally open, normally closed contacts, 10 amp rated at 120 VAC, 5 amp rated at 28 VDC. Provide dust and moisture resistant covers. Relays shall be rated for continuous duty. Provide with din mounting rails and fasteners.

2.7 SIGNAL ISOLATORS

- A. Provide opto-isolation devices for inputs and outputs of instruments with field devices and power supplies. Provide span and zero adjustments as needed. Din rail mount similar to relay mounting. Provide RFI protection.

2.8 INTRINSIC RELAYS FOR BARRIER OF HAZARDOUS LOCATIONS

- A. Provide solid state electronic relay and barriers to control energy levels of actuating and sensing circuit for safe operation in hazardous locations. Devices shall be UL listed and labeled for area classification in which applied.

2.9 ALARM LIGHTS AND HORNS

- A. Provide a strobe type flashing light with red lens. Furnish with mountain gaskets to ensure NEMA 4x rating when applied in wet or exterior location. Audible horns shall be vibrating type 120 volt AC with adjustable volume compensation.

2.10 POWER SUPPLIES

- A. Provide 24 volt DC regulated instrument power supply with fused input and fused output with local on-off switch and fused output. Size the power supply for required capacity +25 percent space capacity. Provide overvoltage/overcurrent protection to protect instruments from damage and surges. Provide digital LED electronic displays, 4-20 mA DC input, suitable for flush mounting in panels. Power supply input shall be 120 VAC.

2.11 WIRE MANAGEMENT DEVICES

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install items in accordance with manufacturer's instructions. Mount instruments and controls as detailed on drawings or as approved in submittal drawings for process flow and per control schemes as outlined in the control sequence specifications.
- B. Check and verify location of PLCs, UPS, switches, HMI and control devices with plans and room details before installation. Ensure access and clearance around the equipment for routing of wiring systems into and out of the panels.
- C. Install instrumentation and panels so that connecting and disconnecting or wiring, piping and accessories can be made readily, and so that all parts are easily accessible for inspection, operation, maintenance and repair. Minor deviations from indicated arrangement may be made, as approved.
- D. Provide pipe racks or pipe stands for mounting of transmitters.
- E. All wiring in connection with the control panel shall be furnished and installed under this Section of the specifications, except as noted on the Drawings or specified under Division 26, in rigid conduit in accordance with the requirements, and under the direct supervision of the instrument manufacturer.
- F. Wire and conduit shall be as specified under Division 26 Electrical. Unless otherwise indicated on the drawings, electrical power for instruments can be taken from electrical panels as indicated on the Drawings and wiring in accordance to Division 26. AC power leads shall be grouped separately and kept segregated from DC power leads and in separate conduit. Wire markers shall be installed at each end of all wired. Electrical connections to analytical sensing elements shall be made from flexible cable to permit removal of the element from the system for cleaning and maintenance work.
- G. All instrumentation location out of doors shall be installed in NEMA 3R enclosures and shall include thermostatically controlled strip heater to prevent freezing, accumulation of moisture

and/or condensation of moisture.

3.2 COMMISSIONING OF INSTRUMENT AND CONTROL SYSTEMS

- A. The instrument manufacturer shall furnish all labor, tools, material, equipment and services required to completely commission instruments, including loop checkout of control valves electrical interlocks and circuits, analyzers, instruments installed on local panels, and instruments installed on the main control panel after installation an prior to plant startup.
- B. All control loops should be observed for operability and conformance to specifications by impressing a simulated input signal at the primary element, and checking the response of final control element.
- C. Instrument manufacturer shall determine the process dynamics in actual operation and adjust the gain, derivative and integral setting of all instruments. Fine tuning shall be made under all operational status and dynamic conditions including start-up. Set points shall be changed to simulate all operation conditions. No tuning shall be attempted until the process or mechanical system is made operable in accordance with these Specifications.

END OF SECTION

SECTION 40 9816 - SUPERVISORY CONTROL AND DATA ACQUISITION SYSTEM

PART 1 GENERAL

1.1 SUMMARY OF WORK

- A. The Integrated System Supplier (ISS) shall furnish all labor, materials, equipment, services and incidentals required to install and place into operation a computer-based monitoring and control system (SCADA).
- B. The ISS shall supply Uninterruptible Power Supply units for the Project for each PLC, PC, and control system monitoring or field panel.
- C. The ISS shall provide ancillary devices and services necessary to achieve a fully integrated and operational system as shown on the Drawings and specified hereinafter.
- D. The ISS Contractor shall provide all labor, materials, equipment, and incidentals required to furnish and install a supervisory control and data acquisition (SCADA) system, complete and operational.
- E. Provide all hardware, software and programming required to commission the SCADA system. This includes, but is not limited to PC Operator Workstations, telephone modem, Ethernet network, Control Net network, Variable Frequency Drive Parameters and process controller interfaces. Provide all the PLC software licenses, Networking licenses, and HMI software licenses specified in this Section.
- F. Provide the correct HMI/OPC communications interface driver software for each interface that will allow the HMI graphic package to communicate with each of the vendor PLCs over the Ethernet network.
- G. Provide logic tables to communicate directly to PLC via Ethernet/IP. PLCs shall communicate to the SCADA Ethernet/IP network.
- H. The Contractor shall provide input/output (I/O) field wiring diagrams. Control loop drawings shall be incorporated in the I/O drawings. These drawings will illustrate terminal block numbers of control panels, wire numbers, wire colors, and field terminations (terminal numbers) of all field devices including instruments and drives. These drawings shall be furnished in a timely fashion as required by the electrical contractor for conduit routing and wire pulling, labeling and terminations by the electrical contractor.
- I. The Contract Drawings are for the purpose of the design of functional features and required external connections. The documents do not necessarily show all components necessary to accomplish the desired results nor do they necessarily shown all components required to interface with the equipment. The Contractor shall provide all parts, equipment, wiring, control panels, and devices necessary to meet the functional requirements of the system.
- J. Contractor shall provide and install plastic engraved nameplates with instrument/device labels for identification in the field.

1.2 DESCRIPTION OF SYSTEM

- A. Summary of the major functions of the system. The computer based monitoring and control system specified herein shall perform the following generalized functions:
 - 1. Perform real-time process control, including proportional integral derivative control action, sequencing, process calculations, and calculations for sensor records in engineering units.
 - 2. Collect and store accurate data and reliable operating information for present and future uses.
 - 3. Identifying plant alarms and malfunctions.
 - 4. Accumulate and store equipment running times and hour meter monitoring for use in preventative maintenance.
 - 5. Provide trending for all analog values.
 - 6. Provide control system diagnostics.
- B. The system is based on the Control System Architecture Plan included in the Drawings. The system shall include:
 - 1. Process level programmable logic controllers (PLCs) with network communications and other capabilities as specified herein and shown on the Contract Drawings.
 - 2. Control computers Operator workstations (OWS) with associated peripherals.
 - 3. Computer operating system, HMI control /graphic software, PLC programming software, and other application software as specified herein.
 - 4. Managed Ethernet switches for all PLCs and computers operating on the control network.

1.3 RELATED REQUIREMENTS

- A. Section 40 9000 - Process Instrumentation, Control and Monitoring Equipment - General Requirements.

1.4 SUBMITTALS

- A. Refer to Section 40 9000.

1.5 COORDINATION MEETINGS

- A. Refer to Section 40 9000.

1.6 REFERENCE STANDARDS

- A. Refer to Section 40 9000.

1.7 QUALITY ASSURANCE

- A. Refer to Section 40 9000.

1.8 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 40 9000.

PART 2 PRODUCTS

2.1 PROGRAMMABLE LOGIC CONTROLLER SYSTEM

- A. Manufacturers:

- 1. Allen-Bradley.

- B. A programmable logic controller (PLC) shall be furnished to communicate to field mounted transducers, switches, controllers and process actuators. Communications protocol shall be completely transparent to process operators. The PLC shall be an intelligent device that can collect data and process control functions, can be remotely programmed from a central station, and can be locally programmed from a portable programmer and laptop computer.

- 1. The PLC systems shall be a microprocessor based device and shall be furnished with a power supply, processor with Ethernet and RS232 ports, ControlNet network communications cards, Ethernet network communications cards, I/O communication modules and process input and output modules. Ethernet fiber interface is shown for inter-connect using a media convertor.

- 2. Refer to Section 40 9443 for PLC requirements.

- C. The PLC modules shall be housed in the NEMA 4x cabinet, which shall be provided with a circulating fan to reduce heat buildup on the circuit cards.

- 1. The process interface units shall be provided with screw type terminal blocks with barriers between adjacent terminals for connection of field inputs. PLC I/O shall have prewired IFM's. Terminals shall be suitable for accepting up to and including No. 12 AWG wire. All terminals shall be provided with unique identification in accordance with approved loop interconnection diagrams. Each cabinet shall have a print pocket on the inside of the door, suitable for storage of interconnection diagrams for that cabinet.

- 2. For PLC field wiring, provide Interface Modules (IFM's) mounted on DIN rail in the control panels with prewired harness from the PLC to the IFM. Provide IFMs for spare PLC I/O modules. Provide DIN rail space in control panel for PLC I/O rack slot space for future expansion.

- 3. Power provided to each PLC cabinet shall be standard, commercial 120 VAC, single phase, 60 Hz. Provide from an uninterruptible power supply (UPS).

- D. The process interface modules shall be capable of accepting switch contacts, solid state switch and high-level logic inputs; 4-20 mADC analog inputs; and shall provide momentary and latched contact outputs; and 4-20 mADC analog outputs as required.

1. The discrete inputs shall provide power to field dry contacts. Contact inputs shall be optically isolated. Each input circuit shall be individually isolated and shall be designed to withstand transients and surges without damage. Input components shall be individually fused so that failure within one component will not interrupt processing of others. Input circuits shall be tested to IEEE Standard C37. 90 surge withstand capability. Maximum number of inputs per card shall be 16.
 - a. The station microprocessor shall convert contact inputs into minimum 16-bit data words.
 - b. Light emitting diodes, one adjacent to each pair of input terminals shall be provided to indicate a CLOSED Contact, CONDUCTING transistor switch, a LOW positive logic level, or AC line voltage ON conditions.
 - c. All discrete input modules shall be 120 VAC input cards. However if the PLC system manufacturer does not have 120 VAC input modules, then 120 VAC inputs to the enclosure can be remotely terminated using interposing relays. The 120 VAC power to the field contacts must still be isolated and easily disconnected per single loop number basis. Using these interposing relay and terminals shall not increase the size of the cabinets. No relays and terminals shall be allowed on the sides of the panels.
 - d. The discrete outputs shall be capable of providing relay dry-contact outputs in either momentary (pulsed), or latched (sustained) mode to control 120 VAC powered loads.
 - 1) All AC output circuits shall include fuses. Dry contact output contacts shall be rated 2 Amps or more at 120 VAC minimum. Outputs shall be individually isolated. Output failure mode shall be selectable so that upon station or communication system failure all outputs shall be placed in the non-conducting mode, or remain as were prior to failure. Isolation resistance shall be 1000 ohms minimum at 300 VDC between any set of field terminals and any other set or earth ground. Isolation voltage shall be 500 VAC RMS minimum between any set of field terminals and any other set or earth ground. Light-emitting diode type of status indication shall be provided adjacent to each pair of latching (sustained) contact output pair of field terminals. Maximum number of outputs per card shall be 16.
 - 2) All Output circuits shall be wired with an interposing relay rated at 5 amps at 120 VAC.
 - e. The analog inputs shall accept 4-20 mADC differential inputs from field mounted transmitters. Common mode input protection of 30 VDC minimum shall be provided. All analog input signals shall be individually isolated; no single ended or common signals are allowed. Maximum number of inputs per card shall be 8.
 - 1) Input signal conversion shall be a minimum of 12-bit word (11-data bits plus 1-sign bit).

- 2) Input accuracy shall be 0.1 percent of full scales span. The station shall also be capable of providing dc power for the field transmitters as required.
- f. Analog outputs shall convert 12-bit (11-data bits plus one-sign bit) data words into proportional, isolated 4-20 mADC analog output signal to adjust set points of local process controllers, pump speed and valve position. Output load drive capability shall be 750 ohms minimum for each output. Each analog output shall be individually isolated. Accuracy shall be 0.1 percent of full scale output span. Maximum number of outputs per card shall be eight.
- 1) Response to station or communication system failure shall be selectable such that upon failure the output shall either remain at the last value, or goes to zero (4 mA), as required by the process.

2.2 UNINTERRUPTIBLE POWER SUPPLY (UPS) SYSTEMS

- A. The UPS systems shall sustain operation of the indicated equipment and shall provide power for an orderly shutdown to prevent the loss of the System during power failure and shall provide isolation between the following listed components and the plant power system. The UPSs shall sustain operation for the PLCs, PCs, network switches and related equipment.
- B. The UPS shall consist of a microprocessor controlled static inverter, precision 3 step battery charger, batteries to store emergency power, a keypad, an electronic digital meter, and an externally mounted manual isolated make before break bypass switch. The switch shall come equipped with dry contacts to monitor the status of the switch by the SCADA PLC. The dry contacts shall be rated for 5A, 120 VAC.
- C. Under normal operating conditions, the instrumentation loads shall be powered by normal AC line supply that has been filtered. When AC line power is present, the inverter shall be off and the battery charger shall be off if the batteries are fully charged. When AC line power fails, the inverter shall supply AC power to the transformer from the batteries. There shall be no measurable break in the output of the system during transfer from normal AC line supply to the inverter battery supply or back to line.
- D. The UPS system shall come equipped with an automatic static bypass switch. If the static transfer switch senses an overload, an inverter shutdown signal, or degradation of the inverter output, then it shall automatically transfer the critical loads from the inverter output to the alternate AC power. If the alternate AC power source is below normal voltage limits, then the transfer shall be inhibited.
 1. Input power to 3.0 KVA UPS system shall be 120 VAC, single phase. The UPS above 3.0 KVA UPS system output shall be regulated to 120/240 VAC $\pm$ 3%, single phase, 60 Hz $\pm$ 0.5 Hz over the operating range. The system shall be hardwired to the panel. No cord/plug types will be allowed. Each UPS system shall sustain the connected full load for a minimum period of 6 minutes and half load for 15 minutes in an operating environment of 32 Deg. F to 104 Deg. F.
 2. All the UPS systems shall provide computer grade sine wave power with 5 percent or less total harmonic distortion. All UPS shall be true-online type systems.

3. All the UPS systems capacity shall be rated in volt-amperes (VA).
4. Typical computer grade switch mode power supplies having a power factor of 0.6 to 0.7 and crest factor of 2.7 to 3.5.
5. All the UPS systems shall have an efficiency of at least 90% when operated from AC line.
6. Each UPS size shall be verified for actual connected load and plus 25% spare load capacity with a minimum size of 3 KVA.
7. All cables and connectors for power distribution to the system components shall be furnished and installed under this Contract. Each UPS shall come furnished with an external bypass switch. The switch shall come equipped with dry contacts to monitor the status of the switch by the SCADA PLC.
8. The ISS shall coordinate the input voltage and neutral requirements with the electrical contractor before ordering the UPS.
9. The system batteries shall be sealed, maintenance free type. The system batteries shall be mounted in an cabinet to the UPS cabinet.
10. The ISS shall install the UPS in a non-permanent manner so that it may be moved to
11. Provide the necessary clearances for maintenance and servicing.
12. Each UPS shall come equipped with a card that will provide additional dry contacts for the SCADA PLC to monitor UPS "on" status, internal automatic static bypass status, and a common alarm status. The common alarm status shall be comprised of various faults and low battery alarms.
13. Manufacturers: Eaton Powerware, Liebert, APC or equal.

2.3 COMPUTER BASED CONTROL SYSTEM

A. General:

1. Provide fully configured Operator Work Stations (OWS) computer systems including computer hardware, peripherals, operating software, application software, and configuration as specified herein. All computer hardware and software shall be Windows 7.0 Professional certified by Microsoft Corporation. Provide a copy of Microsoft Office Professional 2010 for each computer.

B. Operator Work Stations (OWS) (Two - set up as redundant backup)

1. Workstation Computers:
 - a. The computer shall have the following features as a minimum: Latest Intel Processor; 1 04-key enhanced keyboard; Three Button Mouse; Microsoft Windows 7.0 Professional Workstation, Data/Fax PCI modem; Tower case; Recordable/Rewriteable CD-ROM w/Software; A minimum of four USB ports shall be provided, integral with the tower case.

- b. The case shall be tower style with a minimum of five drive bays. At least three drive bays shall be externally accessible from the front of the computer case. The case shall be provided with sliding door covers over all of the drive bays to prevent dust migration into the drives. The power supply shall be a minimum of 800 watts. A replaceable battery shall be included to power a quartz controlled real-time clock/calendar for a minimum of one year without 120 volt power. The I/O port controls, dual video card, and other internal functions shall be supplied on dedicated plug in function cards. Motherboards that incorporate these features directly into the circuitry on the board
- c. A three-year manufacturer's on-site warranty service contract shall be included with each personal computer. Warranty service from the Supplier directly in lieu of warranty services from the computer manufacturer shall be unacceptable.
- d. Each PC shall be equipped with Ethernet Communications Adapters and necessary software to facilitate communications on the single Local Area Network (LAN). The adapters shall provide for Ethernet IEEE 802.3 network connection capable of high speed (10/100 Mbps) data communications between other equipment on the network. The adapter shall provide two direct 10BASE-T/100BASE-T connectors. The use of bridges or multiple conversion devices for Ethernet communications will not be acceptable.
- e. Provide all software on original diskettes or CD-ROM, software publishers license, and a complete set of manual(s).
- f. Personal computers shall be Optiplex, Dell, IBM, HP or equal as approved by the Engineer and recommended by the manufacturer of the human machine interface software.
- g. Flat Panel Display Monitors (LCD):
 - 1) The two (2) LCD monitors shall adhere to the following specifications (minimum):
 - (a) Display size (diagonal): 32 inch flat screen color monitor
 - (b) Resolution: 1920 x 1200
 - (c) Display Pixel: 0.270mm
 - (d) Horizontal Viewing Angle: 178 degrees
 - (e) Vertical Viewing Angle: 178 degrees
 - (f) Response Time: 5 ms
 - (g) Brightness: 400 cd/m²
 - (h) Contrast Ratio: 1000:1

(i) Display Features: Anti-Glare/ Anti-Static/Plug and Play

- 2) The flat panel display, 20-inch Widescreen LCD Monitor, with color shall be equal that is compatible with manufacturer of workstation computer. Provide three year warranty.

C. Network System:

1. The ISS shall furnish and install a complete 100 Base T Ethernet Local Area Network (LAN) composed of CAT 6 cable and fiber optic capable of supporting communications between all PCs, fiber media convertors, peripherals, and communications between all PLCs. The ISS shall furnish all necessary cables, face plates, connectors, modems, splice kits required for a complete and operational LANs. The system shall be expandable by one hundred percent to accommodate future growth.
2. Ethernet Switch -The Ethernet switch shall be Ethernet/IEEE 802.3u compliant. The switch shall be auto-sensing to detect 10/100 Mbps and channel data accordingly. The switch shall be powered from a 120 VAC, 60 Hz single phase source. The switch shall come with 10BASE-T connectors (RJ-45). The Ethernet switch shall be N-Tron 708 Fx2.
3. Fiber Optic Cables:
 - a. The fiber optic media shall consist of a 7-10/125 Micron single mode (core/clad/coating) micron graded index, single, fiber optic cable containing at least twelve fibers. The fiber optic cable shall be an all dielectric, heavy duty design. The fiber optic cable shall consist of multiple fibers each surrounded by a buffer tube, all contained in a polyethylene outer jacket. The cable shall be designed for installations requiring high pull tensions for conduit pulls, designed to support pull loads up to 600 pounds.
 - b. The fiber optic communications system shall utilize ST or SC style connectors for all fiber optic connections. The connectors shall be designed for use with single mode 7-10 / 125 micron cable, and shall be capable of operating in a range of 0 to 80 degrees C.
 - c. The Contractor shall provide fiber optic power budget for each cable run in excess of 500 feet. Cable budget shall include transmitter power, receiver sensitivity, connector losses, cable losses and a 3 dB aging margin. Fiber optic transmission line shall maintain a minimum 3 dB safety margin. Cable and connections shall meet or exceed Cat 6 ratings and upon completion of the network installation, the system shall be tested to Cat 6 standards.
 - d. Optical Fiber Corporation - OTC Roanoke, VA. Anixter Wire & Cable, Belden.
 - e. ControlNet Network Cable:
 - 1) Provide all hardware and software components required to install the ControlNet network, provide and install RG-6 type trunk cable installed in conduit for physical protection. Provide all necessary hardware for a

functioning network including taps, tees, ferrite bead and terminators as required. Network must be installed per manufacturer's guidelines and recommendations. BCN connectors, plugs and accessories shall not make contact with any grounded metallic surfaces. Network shall be checked for shorts and continuity after installation. Network shall communicate PLC and variable frequency drives per control system architecture drawing. Certify network after installation.

f. Ethernet Cable:

- 1) The unshielded twisted pair cable shall be designed for use with a high-speed (100 Mbps/1 Gbps) Ethernet communications network. The twisted pair cable shall have nominal impedance of 100 ohms at 1 MHz: a maximum attenuation of 10 dB per 1000 feet at 1 MHz. The twisted pair cable shall be plenum rated and shall have a minimum of four 24 AWG solid copper conductor pairs. All RJ-45 terminations on the twisted pair cable shall be done as specified by manufacturer. Terminations shall provide strain relief on the cable jacket - strain relief on the wire and/ or wire insulation shall not be acceptable. Cable and connections shall meet or exceed Cat 6 ratings and upon completion of the network installation, the system shall be tested to Cat 6 standards.
- 2) Manufacturer's: Belden; Phoenix Digital; Corning Cable Systems, or equal.

D. Managed Ethernet Switch (Six):

1. General:

- a. The OWSs and PLCs shall be connected to the network backbone through a 10/100 Industrial Ethernet Switch. Switch shall support fault tolerant ring architecture and shall provide full duplex capability and redundant power. 10/100 Industrial Rail Ethernet Switch shall provide five or more 10/100 Fast Ethernet ports, plus one stand-by port via RJ45 interfaces and one V.24 interface for external management. Two uplink ports shall be provided for integrated connectivity to the Network backbone. Depending upon the fiber used the uplink ports will be single mode fiber with ST or SC connectors. Equal to N-Tron 708 Fx2.
- b. Switching Functions:
 - 1) All data received by the Switch from the system bus or at the ports shall be stored and checked for validity. Invalid and defective frames as well as fragments shall be discarded. The switch shall forward valid frames.
 - 2) The Switch shall learn all source addresses per port. Only packets with: unknown addresses, this address or a multi/broadcast address in the destination address shall be sent to this port.
- c. Self-Healing Functions:
 - 1) The Switches shall allow the backbone to assimilate a ring architecture. If one switch fails or the backbone cable is cut, the ring structure shall change itself

into a line structure within 0.5 seconds with up to 250 Switches on the network.

d. Voltage Supply:

- 1) The voltage supply shall be redundant 24VDC power supplies.

e. Management:

- 1) The Switch shall support SNMP and Web-based management for extensive diagnosis and configuration functions to allow easy startup procedures and provide network and device information. The Switch shall support the TCP/IP protocol family.

f. Technical Specifications:

- 1) Operating voltage 10-30 VDC Regulated.
- 2) Current consumption 330 mA at 24VDC.
- 3) Overload current protection - thermal fuse 1.3A @ 24VDC
- 4) Ambient temperature -40 °C to 85°C
- 5) Storage temperature -40°C to 85°C
- 6) Humidity -10% to 90% (non-condensing) 5% to 95%
- 7) 10 /100 Base tx – 8RJ-45 100 Base Fx 2 (SC or ST) duplex ports.

E. Color Laser Printer:

1. A single color laser printer shall be supplied. The color printer shall be a laser quality printer capable of automatic or manual printing of color or text on 8 1/2 by 11 inches and legal size media. The printer shall be capable of printing on standard bond paper, or glossy paper.
2. The printer shall be capable of printing color graphics at speeds up to 11 pages per minute, and black text only and speeds up to 21 pages per minute for 8-1/2 x 11 size media.
3. The printer shall have an automatic paper-out sensing mechanism, which shall stop the print operation then notify the host computer and the operator to prevent loss of printable information.
4. The printer shall operate on 120 VAC 60 Hz. The printer shall be UL listed and labeled.
5. The printer shall be supplied with a Serial interface and USB.
6. The printer shall print at 2400 x 1200 DPI color resolution, shall be provided with minimum 10 mb of RAM, and shall be 100 percent postscript compatible.

7. The printer shall be manufactured by Hewlett-Packard, Dell or IBM, or equal. Provide three of each type of printer cartridge with each printer.

F. Fiber Panels:

1. Manufacturers:

- a. Corning Cable Systems.
- b. Siemon.
- c. AT&T
- d. Belden.
- e. Patch Panels: Suitable for wall mounting, comprised of internal fiber management mounting plates, slack cable take up/organizer blocks, patch block with connectors and ground lugs as indicated. Panels shall be NEMA 12 construction. Patch panels shall be suitable for singlemode or multimode system. Patch panel to be sized to terminate both 12 fiber cables. All fibers are to be terminated on the patch panel.

G. Copper to Fiber Optic Media Convertor:

1. 10/100 Base T Copper /Coax-to-Fiber Optic Media Converter: The crossover media converter shall comply with IEEE-S02.3 specifications. The converter shall include 1 Copper/Coax port and 1 Fiber Optic ST port, LEDs to allow monitoring of converter activity and status/health checking. The converter shall operate on 120 VAC power and shall be supplied with mounting brackets. The crossover media converter shall be manufactured by Black Box, 3COM, Raylan or equal. See Control System Architecture drawing for location and quantity.
2. Fiber Ethernet switches may negate optical media converter except where coaxial cable conversion is needed and applied by the ISS, or system requirements.

2.4 SYSTEM SOFTWARE

A. General Requirements:

1. Software shall be modular, comprised of an integrated group of proven, standard software modules.
2. All of the programs are to be generalized in nature such that new functions may be added later. Integration of future application programs and the servicing of their input and output requirements, including construction of new printing formats and other system interfaces, shall be accomplished without recompiling of application software.
3. Changes in process parameters, addition and deletion of process schemes or equipment, and addition or modification of CRT graphic displays and printed report formats shall be via the use of process operator and control engineer oriented icons, graphics, and menus organized in a hierarchical fashion.

4. System parameters such as: date, time, set points, alarm limits, PID tuning constants, etc., shall be entered or modified via the CRT/keyboard. Any input, which modifies the system, shall be logged on the logging printer and a historical disk file with date, new value, and previous value
5. All licenses are to be assigned to the Owner.

B. Operating System Software:

1. The operating system software shall provide system resource allocation and management in real-time environment. The Operating System shall control storage allocation and program movements; program scheduling; monitoring of system security timers; and interrupt processing for internal and external events such as Input/Output transfer completion, real-time program initiation, and detection of abnormal system conditions.
2. The operating system shall provide automatic start-up of the system, including processor and network communication, and all application software functions, upon initial power up or restoration of power after a power failure without operator intervention.
3. Provide operating system to monitor and control the execution of all programs; handle job initiation and termination requests; monitor program requests for system service; accept job control statements, operator commands, respond to and report of errors condition relating to program processing.
4. Process Input/Output Handler: Process Input/Output routines shall be main memory resident, and shall provide interface to programs, process measurements and control system, and perform "reads" and "writes" and monitor device status.
5. Security: Provide operating system with provisions for password protection and security access to files and programs. On log-off, access to all computer functions shall be inhibited including boot-access via floppy diskettes. Configure the system and develop file structure for three user types initially.
 - a. System Administrator: Full access to system.
 - b. Engineer/Supervisor: Full access to all HMI and control system variables, databases, and programs. Restricted access to system/network parameters.
 - c. Operator: Read access to all HMI and control system variables, databases, and programs. Full access to treatment plant operating functions including stop-start, control setpoints, manual overrides, reports, and alarm acknowledgment, etc.
 - d. Provide Microsoft Windows 7.0 Professional Workstation with the latest Service Packs as recommended by the HMI software manufacturer. Provide Microsoft Remote Access Service for remote access of the HMI.

C. Support Software:

1. Provide the latest version of Microsoft Office for each computer system.

2. Software shall include, as a minimum, Excel, Access, PowerPoint, Word, and the knowledge base.
3. Provide an original CD version with licenses for each computer system.

D. PLC Program Development Software System:

1. The ISS shall provide as part of the System a software package with a license for the PLC system to allow off-line and on-line ladder logic diagrams, structure text, function block diagrams, advanced process blocks and sequential function chart program development, annotation and monitoring on a Pentium based personal computer operating under the computer operating system specified herein.
2. The software shall be utilized for development of the all types of programs and transfer to the PLC.
3. The software package shall be completely menu driven and shall be distributed on standard CD-ROM media.
4. All required hardware (including cables, cable adapters, etc.) to allow the PLCs connection to PLC network interface card shall be furnished.
5. The software package shall be licensed to the Owner to utilize the software as required for any current or future modification, documentation, or development of the PLCs furnished for this project.
6. The software shall provide as a minimum the following functions:
 - a. Annotation of all ladder elements, block diagrams, function charts etc with at least 3 lines of 6 characters each.
 - b. Annotation of all ladder rungs, block diagrams, function charts etc. with at least 240 characters.
 - c. Provide annotated ladder diagram, block diagrams, function charts printout on laser printer supplied under this Contract for documentation purposes.
 - d. On-line help facility.
 - e. Download or upload ladder program from the PLC to the PC.
 - f. Provide a program element and I/O cross reference table.
 - g. Provide all monitoring, forcing, programming error detection, searching, configuration, etc., functions as required to allow an operator/programmer to completely program a PLC.
 - h. Development software shall be the latest version of software. Software shall be suitable for simultaneous operation with the computer based control system software specified herein. Provide means for development software operation without affecting on-line operation of the computer control system.

- i. The programming software for each type of PLC system shall be the Professional Edition with all features included.
- E. Network Commissioning Software:
 - 1. The ISS shall provide as part of the System a software package with a license for the commissioning the SCADA networks.
- F. Operator Work Station Graphics Software:
 - 1. The ISS shall provide as part of the System a software package with a license of Iconics, Genesis 32 software for the maintenance of screen graphics/operator interfaces of the OWS/HMI's.

2.5 PROCESS CONTROL SOFTWARE (OWS/HMI SOFTWARE)

- A. General:
 - 1. The HMI software shall exhibit strong compliance with Microsoft's Windows Open Systems Architecture (WOSA) standards, such as in its use of dialog boxes and menus.
 - 2. The HMI software shall support running as a service under the Windows 7.0 operating system, making it independent of the 7.0 user login limitations.
 - 3. The HMI software shall provide a mechanism for accepting configuration input either directly from the keyboard, via a mouse, or as appropriate, indirectly through ASCII files that are created by an external text editor or relational database program.
 - 4. Source code modifications, re-assembly or recompilation shall not be required for implementing user-level system changes.
 - 5. All configuration changes shall be capable of being made on-line, while the HMI software is operating. Data definitions, operator displays, etc. shall be capable of being modified, added or deleted without having to interrupt the data acquisition.
 - 6. The HMI software shall include complete user documentation, including examples of how to operate the various modules within the system.
 - 7. The documentation shall be in electronic format, HTML based with the ability to search for topics by keyword or search or specific text.
 - 8. The HMI software shall include a help facility that is capable of being invoked on-line through a point-and-click operation and shall be based upon Windows standard Hypertext, and shall provide useful, context-sensitive information on the operation of the package.
 - 9. The help utility shall also support the ability to perform full text word search, add custom comments, bookmark topics, copy and pasting into another application, printing, and use of fonts and colors.

10. The HMI software shall be able to display data from and write values directly to other nodes without the need to duplicate the data in the local system.
11. Configurations that are not attached to I/O and do not contain tags shall also be available. The HMI software shall have two types of rights available, controlled by the developer using security, to a tag:
 - a. Right to read and write to tags in other nodes.
 - b. Right to only read tags from other nodes.
 - c. The OWS/HMI licenses are as follows:
 - 1) Provide a licensed copy ICONICS Genesis 64 Automation Suite Version 9 or latest version available. This software for the two workstations shall be Redundant nodes such that they are a backup to one another, trending shall be synchronized. Provide software for 1000 monitored variables. Provide the MMX alarming software, Report Works software and OPC server required for communications to PLC hardware.
 - 2) The software licenses shall allow for unlimited amount of log-in users.

2.6 GRAPHIC CREATION

- A. Process graphic displays, shall be based on the PID and site plan drawings, mechanical drawings and electrical drawings included in these contract documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.
- B. All process flow streams shall be labeled and color coded. All structures and equipment shall be identified by name and appropriate equipment and loop tags.
- C. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.
- D. Color coding for equipment status and alarms shall be as follows:
 1. Red for on or open.
 2. Green for off or closed.
 3. Flashing red for alarm.
 4. Yellow for acknowledged alarm.
- E. The ISS shall provide a minimum of 40 screen displays including all pop windows.
- F. All main graphic screens shall include a title bar, main graphic area, navigation buttons, and alarm summary bar. Title bar shall be displayed on the top of each screen and include display name, description and time/date. The main graphic area shall contain primary screen data in graphic format. Navigation buttons shall include a minimum of main menu, trends, main alarm

summary, and security log in. The alarm summary bar shall display the last three valid alarms on the bottom of each screen. The following types of displays shall be included as a minimum:

1. Main menu screen shall include a site plan representation, indicating the geographic location of each process, and each building.
2. Overall process block flow diagram screen shall show all major processes in block form with flow arrows. Each block will include a text description of key individual treatment processes. Navigation buttons to the individual treatment processes will be performed by pressing on the text description.
3. Individual treatment process screens shall graphically display key process variables and equipment. No operator entries shall be done from these screens. Individual process flow screens for each process shall include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves. These diagrams shall be generally depicted from the P&ID's.
4. Individual unit process screens depicted from the P&ID's shall be used for control and display of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives etc. Navigation buttons shall consist of the P&ID's flow arrows to other individual unit processes.
5. The unit process screens shall provide the ability for the operator to go to individual equipment popup screens.
6. Popup screens for each piece of equipment shall be used to start/stop equipment, open / close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.
7. PLC system diagnostic displays shall show, the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIT's, power supplies and UPS units.
8. Communications diagnostic displays shall show the operational status and fault conditions of all major components including Operator Work Stations, peripheral devices and network components.
9. Trend screens shall be provided with the capability to display up to eight, operator assigned, analog and or digital process variables.
10. The main alarm summary screen shall display the following information on each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.
11. Analog variable screens shall show a tabular summary of all plant process variables, in operator assigned groupings.

2.7 REPORT SOFTWARE

A. General:

1. The software reporting package shall be capable of generating the following types of reports. The software shall be able to easily communicate with the HMI software specified in Section 2.6. Regardless of the type of report, all reports shall be generated within one minute after initiation (either automatic at 12:00 a.m. time or manually from HMI screen).
2. Reports shall be capable of download to an Excel spreadsheet file for customization in requirements of the VDH formats.

B. Daily Summary Report:

1. The daily report shall be capable of summarizing plant operation from 12:01 a.m. of the previous day through 12:00 a.m. of the current day.
2. Values for which there are no data available shall be left blank or identified with a special character. Thus, only values, which are actually zero, shall be printed as such.
3. The Daily Report shall be available for printing on demand, as often as preferred, until midnight of the following day. Normal operation shall be for reports to automatically generate at an operator specified time on a daily basis.
4. The Daily Operation Summary Report shall consist of approximately 2-3 pages.
5. The actual variables for the monthly report will be Owner/operator selected and for VHD requirements.

C. Monthly Operation Summary Report:

1. The Monthly Operation report shall be capable of summarizing plant operation for the previous calendar month. The report shall be generated on demand from the Operator's Console, usually after all results for the previous month have been entered. The information printed will consist of daily averages or totals.
2. The report format shall be similar to the daily report, and shall consist of: the month and year, plant name, report name, page number, group headings, sub-headings, point identifications, engineering units, and a table of daily averages or totals for points included on the page. Monthly minimum, average, maximum, runtimes, and totals, where applicable, shall also be printed for each column of points printed.
3. The Monthly Operation Summary Report shall be available for printing on demand during the entire following calendar month. However, normal operation shall be for reports to automatically generate on the first of the month at 12:00 a.m.
4. The Monthly Operation Summary Report shall consist of approximately 6-10 pages.

D. Annual Plant Operation Summary Report:

1. The Annual Plant Operation Summary Report shall be capable of summarizing plant operation for the previous calendar year. The report shall consist of monthly averages or totals for important plant variables and manual inputs, stored on-line on the disc or memory media.
 2. The format of the report shall be identical with the Monthly Operation Summary Report with the exception of the month being deleted from the heading, replaced by the year and the date column replaced by calendar months. Annual report accumulated monthly data and operating conditions.
- E. The reporting software shall manage the data while creating reports and graphs to display the data.

2.8 SYSTEM PROGRAMMING GUIDELINES

A. General:

1. The programmer shall adhere to the guidelines stated below.
2. Physical and Derived PLC I/O Register Naming Convention:
 - a. General Tag (Point) Naming Convention- Process monitoring and control system requirements dictate that a unique tag name be given to each point in the system. In general, the term "points" refers to inputs or outputs to a PLC from field instruments or equipment. Other system points may include historical database points, alarm signals, or values internally calculated by the SCADA system. It is imperative that logical naming standards be used to identify all PLC program and supervisory software tag names. The naming convention shall also be used to identify field instrumentation in the Contract Documents and on equipment nameplates in their final installed locations.

B. General Programming Requirements:

1. All calculations and control logic shall be performed by the PLC. The supervisory software shall not be used to calculate any values, scale inputs or outputs, or perform any control algorithms.
2. Calculate daily minimum, maximum, and average flow values and write each to a storage device for each flow meter.
3. Alarm Enable - Identify alarm from the PLC program by using the tag. Setting an alarm. Set point shall be available.
4. Runtimes -For all motors that run indication is monitored, totalize runtime in hours to the tenth of an hour is required.

C. Picture Format:

1. All screens shall be configured within a 1024 x 768 resolution. Configuration of pictures, or screens, shall allow standard viewing:

D. Graphic Development:

1. Show all the processes as installed. Include interconnecting pipe to tanks and pumps. Label where all process pipes are going to and coming from. All pipe graphics shall be three-dimensional. Detailed graphics for transmitters, and control devices analyzers are not necessary, simply illustrate the analog value near where it is located in the process with units and a title. Label all holding tanks with their respective volumetric capacities. Graphics on screens depicting processes shall be in reasonable approximation to scale.
2. Indication of Equipment Operational Status on Animated Screens -The operational status of pumps, motors, systems, etc shall be indicated via change in color of a portion, not the entirety, of the graphic. Text shall not be used to indicate the operational status of equipment on any full-size screen. Colors shall be as follows:
 - a. Equipment Running, Valve Open, or Filter On-line - Red
 - b. Equipment Not Running or Valve Closed - Green
 - c. Modulating Valve is not fully opened or fully closed - Blink red to green.
 - d. Equipment failed - Yellow
 - e. Supervisory software is receiving a value outside of the configured parameters to animate an object - Magenta
 - f. It is not acceptable to utilize colors that indicate operational statuses in any other graphics, excluding trending pen line color. Colors that indicate operational status shall be strictly reserved for such indication.
 - g. Do not indicate alarm conditions on the animated screen via animated lights or blinking text.
 - h. Changing levels in tanks shall be shown through animation of geometric shapes to show level in the tanks and by numerical values representing tank level, percentage of capacity, or number of gallons remaining. Engineering units for values shall be used.
 - i. Create a Microsoft Excel spreadsheet for submission to the Engineer for approval of the structure of security groups. This spreadsheet shall utilize a column for "Application Features," "Allows the user to...", and one column for each security group. In the "Application Feature" column, list each available application feature in rows. For each application feature describe what access to the security feature enables the user to do under the "Allows the user to..." column. Place "Yes" or "No" under each group account column to indicate which application features the group account has access to. Submit this spreadsheet to the Engineer within 160 days after the Notice to Proceed is issued.
 - j. Configure a minimum of six reports. Five of the six reports shall be as follows:

- 1) Daily Report - List the critical data for each day including: running and daily flow totals; minimum, maximum, and average analyzer flowmeter values; chemical usages; storage tank usage; etc. Provide one sheet for each day and one workbook for each month. List tag description, corresponding data value, and corresponding engineering units in each row, populate down.
- 2) Runtime Report - List the runtimes and number of starts for all equipment with run indications. Provide one sheet for each month, one workbook for each year. Equipment shall be listed in column headers and dates in rows.
- 3) EPA Report - Obtain EPA report from Owner, reproduce identically with Excel and populate all data that is available from the SCADA system. Provide one workbook per month.
- 4) Extract data points from the supervisory software database, not from the historical database. Reports shall utilize uniform format of text font style, text font size, alignment, page headers, page footers, etc. between all reports. Obtain the Owners official logo in *.jpeg format and insert into the header of the first page of all reports. Format and function of all reports are subject to review and approval by the Engineer. Make changes to reports per the Engineer's request. All reports shall be fully functional, approved by Engineer, and data must be reading correctly prior to training. Schedule reports to automatically print out at the appropriate intervals. Consolidate reports by creating new sheets within an Excel workbook for each day. Generate a new workbook each month. New Excel workbooks shall be created once a month, maximum. Individual Excel files shall not exceed 700 KB.
- 5) Collect data necessary for the Computerized Maintenance Management System (CMMS) software to track equipment data for predictive maintenance. Coordinate with the Engineer for all necessary data required by the CMMS software.

PART 3 EXECUTION

3.1 GENERAL INSTALLATION

- A. Refer to Section 40 9000.

3.2 FIELD TESTING AND INSPECTION

- A. Refer to Section 40 9000.

3.3 TRAINING

- A. Refer to Section 40 9000.

3.4 DOCUMENTATION

- A. Documentation of the final integration and system control shall be furnished to the Engineer along with shop drawing submittal in both hard copy and electronic media.

- B. System programs shall be furnished via electronic storage media for maintenance “reboot” and for baseline original plant control at substantial completion, starting and commissioning for the control validation.
- C. Written descriptions shall be provided as well as updated ladder diagrams of the as-built system conditions. For all programmed systems as furnished with about documents for the supervisory control and data acquisition system.

END OF SECTION

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SECTION 41 1213.19 - BELT CONVEYORS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. The sludge conveyance system described shall be from a single belt conveyor manufacturer, complete with all necessary components, drives, motors, ancillary items and supports. Interconnecting chutes between belt conveyors shall be provided by the manufacturer so that a complete belt conveyor system, from the point of receiving sludge to the final discharge point, is supplied by a single manufacturer.

1.2 QUALITY ASSURANCE

- A. The Manufacturer of the belt conveyor must have had direct responsibility for design, manufacture and commissioning of at least ten (10) systems of similar sizes, capacities and material with similar characteristics, operating for a minimum of five (5) years. Manufacturer must be able to produce an installation list consisting of a minimum of 50 active installations in municipal water and wastewater plants across North America.
- B. Manufacturer shall carry a current, valid certificate of ISO-Certification.
- C. Manufacturer shall be a current member of the Conveyor Equipment Manufacturer's Association.

1.3 SUBMITTALS

A. General:

1. All data and drawings to be provided in Imperial system. Any metric material sizes, drawing dimensions, or hardware are unacceptable. This ensures replacement parts are easily obtained in North America.
2. Data sheets with description of the proposed equipment, size, length, type, capacity, arrangement, materials of construction, motor size, motor type, motor power requirements and equipment weight.
3. List of components and accessories to be furnished with catalog information.

B. Design Calculations:

1. Submit certified capacity, power and elongation calculations for the screw conveyor and spiral, respectively.
2. Submit certified torsional analysis for the conveyor drive shaft.
3. Submit structural calculations for the conveyor supports stamped by an Engineer certified to practice in the State in which the equipment will be serviced.
4. Submit bearing life calculations for the gear reducer bearings and/or drive end bearings.

5. Design loadings to be transmitted to foundations or supports.
- C. Shop Drawings:
1. Drawings and specifications for components of the equipment, showing principal dimensions and parts, materials of construction, material thicknesses.
 2. Screw diameter, pitch, rotational speed and torque tube diameter.
 3. Equipment performance specifications.
 4. Drive details, including service factor of gear reducer based on absorbed horsepower and installed motor horsepower.
 5. Size and location of anchor bolts or attachments to the foundations or supports.
 6. All drawings to be generated using a 3D Computer Aided Drafting program including but not limited to Autodesk Inventor, PTC ProEngineer, Dassault Systèmes SOLIDWORKS, or equal.
- D. Quality Assurance and Control Submittals:
1. Manufacturer's Certificate of Compliance, including performance guarantee.
- E. Operation and maintenance manuals, including recommended maintenance schedule.
- F. Special shipping, storage, protection and handling instructions.
- G. Manufacturer's installation instructions.
- H. Manufacturer's Certificate of Proper Installation.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Equipment Systems specified in this Section shall be product of KWS Environmental Inc. This statement is not to prevent or preclude other manufacturers; however, if performance or material quality differs, exceptions to these specifications shall be noted with bid.
- B. The drawings and specifications were prepared based on KWS Environmental. Bidder shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate other equipment including but not limited to structural, mechanical, and electrical work.

2.2 GENERAL

- A. Fasteners:
1. All fasteners and grease fittings shall be Imperial sizing. Metric fasteners and fittings shall not be used.

B. Welding:

1. Except as otherwise indicated, welding shall comply with ANSI/AWWA D100 and AWWA C206, and the following:
 - a. Welding shall be by the metal-arc method or gas-shielded arc method described in the American Welding Society's "Welding Handbook" as supplemented by other AWS standards. Qualification of welders shall comply with AWS Standard AWS D1.198. Manufacturer must be an Affiliate Company Member of the AWS and the equipment must be welded ASME and AWS certified welders. The equipment must be inspected by AWS certified welding inspectors and instructors.
 - b. In assembly and during welding, the component parts shall be clamped, supported and restrained to minimize distortion and for control of dimensions. Weld reinforcement shall comply with the AWS code. Upon completion of welding, weld splatter, flux, slag and burrs left by attachments shall be removed. Welds shall be repaired to produce a workmanlike appearance with uniform weld contours and dimensions. Sharp corners of material which is to be painted or coated shall be ground to a minimum of 1/32" on the flat.

C. Safety Devices:

1. The completed work shall include all necessary permanent safety devices, such as machinery guards and similar items as required by OSHA and other federal, state and local health and safety regulations. Conveyors shall be equipped with emergency stop pullcords.

D. Flanges and Pipe Threads:

1. Flanges on equipment shall comply with ANSI B16.1, Class 125 or B16.5, Class 150, unless otherwise indicated. Threaded flanges and fittings shall have standard taper pipe threads complying with ANSI/ASME B1.20.1. Metric flanges, piping and threads shall not be used.

E. Nameplates:

1. Equipment nameplates shall be fastened to the equipment in accessible. Nameplates shall contain the Manufacturer's name and telephone number for service.

F. Bearings:

1. Bearings shall conform to the standards of the Anti-Friction Bearing Manufacturers Association, Inc. (AFBMA).
2. Except where otherwise indicated, bearings of process equipment shall have a minimum B-10 life expectancy of 50,000 hours.
3. There shall be no projecting set screws or other parts to endanger workmen. All devices required for the compliance with safety laws shall be provided.

4. Provision shall be made for ample and convenient lubrication of all machinery without danger of injury to the operators.
 5. All shafting shall be of ample diameter and provided with suitable bearings for the service required. Suitable means for making adjustment on parts subject to wear shall be provided where necessary.
- G. Installations shall be easy to maintain and keep clean. The equipment shall be capable of withstanding a daily wash down using high pressure water.
 - H. Each conveyor shall be completely assembled in the manufacturer's shop to ensure proper fitting of parts, then match-marked for erection and disassembled for shipment. All welding shall conform to the latest standards of the AWS.
 - I. Furnish all required anchor bolts and other anchorage to the structure. Fasteners, anchor bolts, nuts and washers shall be stainless steel.
 - J. Patents. The Bidder warrants that the use of this system and its equipment, in the process for which the system has been expressly designed, will not infringe on any US or foreign patents or patents pending. In the event of any claim of infringement the Bidder shall defend and indemnify the owner free from any liabilities associated with the use of the patented equipment or process.
 - K. The Bidder hereby grants to the Owner, in perpetuity, a paid-up license to use any inventions covered by patent or patents pending, owned, or controlled by the Bidder in the operation of the facility being constructed in conjunction with equipment supplied under this contract, but without the right to grant sublicenses.

2.3 SERVICE CONDITIONS

A. Material:

Material Conveyed: 25% dewatered biosolids

Material density: 70 lb/ft³ maximum, 50 lb/ft³ minimum

Ambient temperature: 120 maximum, 70 minimum degrees Fahrenheit

B. Service Duty:

1. Number of hours per day: 12
2. Number of days per week: 5
3. Number starts per hour (max): 4

C. Start-up:

1. Belt Conveyor must be able to start when loaded to 150% of the maximum capacity with material described

D. Design Capacity:

1. The belt conveyor shall be designed to operate continuously under the specified operating conditions with peak loads of up to 150% without damage or significantly reduced service life.

2.4 BELT CONVEYOR

A. Conveyor Belts

1. Belt Construction
 - a. Base belt to be cross rigid construction, with two cross rigid plies preferred.
 - b. Maximum belt stretch should be 1-1/2% at 100% rated tension.
 - c. Minimum covers for fabric construction should be 3/16" top by 1/16" bottom.

B. Corrugated Sidewalls

1. All belts with rubber cleats must have 3" tall sidewalls bolted or otherwise attached to cleat ends. This is not necessary for urethane cleats up to 75 degrees incline.
2. Sidewalls to be molded from fiber loaded compound.
3. On belts with recessed sidewalls, the recess shall be a minimum of $[0.1 \times (\text{belt width} + \text{sidewall height})]$.

C. Cleats

1. Cleats are to be hot molded to the base belt with the cleat rubber being cured as it is vulcanized into the base belt.
2. Cleat ends must be flush with the inside of the sidewall convolutions.
3. All cleats must be a minimum of 1/2" (13mm) less in height than sidewalls.
4. Two-part cleats should be used over 5-1/2" (140mm) in height with rubber base hot vulcanized to the base belt and urethane cleats bolted into the cleat base.

D. Idlers

1. Idler spacings on both carrying and return sides shall be a maximum of 3' 6" (1m) on horizontal sections, and a maximum of $[3' 6" (1\text{m}) \div \cos(\text{angle of incline})]$ or 6' (1.35m), whichever is less, on all inclined sections. Stub idlers must be used on the return run on all systems with a 10' maximum spacing. Idler diameter shall be 4" (102mm) minimum..
2. Idlers shall be Superior, PPI, Rexnord Corporation, or equal.

E. Pulleys

1. The conveyor shall have painted mild steel head and tail pulleys with mechanical take-up. All pulleys shall be 16-inch diameter crown faced with QD or XT style compression

bushings and a Neoprene or BUNA-N rubber lagging. The head pulley shall have 1/2 inch herringbone rubber lagging. The tail pulley shall have 1/2 inch smooth rubber lagging. Closure for all lagging shall be by vulcanizing. Pulleys to be Superior, PPI, or equal.

F. Shafts

1. Shafts shall be of C1045 cold rolled steel. All shafts shall be polished and shall be straight and true. Shafts shall be adequate to withstand all combined bending and torsional stresses developed under the design conditions. Minimum shaft size shall be 2 7/16 inch. Tail shafts shall have mechanical take-up devices as herein specified.

G. Bearings

1. Bearings shall be heavy-duty roller bearing units housed in malleable iron pillow blocks with elongated holes for adjustment and shall be Dodge S-2000 or equal.

H. Head & Tail Section

1. The conveyor head section shall be welded construction and fabricated from a minimum 10 gauge carbon steel. The head pulley shaft and bearings shall be sealed to head section to contain dust and odors. The head section shall be provided with a head pulley and belt cleaner.
2. The conveyor tail section shall be a welded construction and fabricated from a minimum 10 gauge carbon steel. The tail section will be provided with a tail pulley, and manual take-up.

I. Take-Up Units

1. Take up units shall have steel frames, malleable ends, carbon steel adjusting screws and shall provide a minimum adjustment as shown in the Performance Design Requirements. The take up units shall be Browning "T-900 Series" equipped with "901 Series" bearings, or equal with proper drilled and tapped holes.

J. Frame

1. The conveyor head and tail pulleys, idlers, drive mechanisms, motors and other components shall be mounted on a formed sheet metal, carbon steel framework. The structural design of the framework shall be based on the design loads including product, equipment weight, and the maximum torque developed from the equipment. Maximum deflection shall not exceed L/360. The frame shall be designed to resist two times the breaking strength of the belt. All structural members and connections shall be designed so that the unit stresses do not exceed the allowable stresses as set forth by the American Institute of Steel Construction, when subject to the maximum loadings. All members shall be a minimum thickness of 10 gauge, carbon steel, unless otherwise specified. The minimum depth of the main frame shall be 6 inches. All steel framing, except finished aluminum and stainless steel, shall be carbon steel.

K. Conveyor to be supplied without top and bottom covers, drip pans, or side guides.

- L. Safety Stop Switch: The conveyor(s) shall be provided with safety stop switches on one (1) side. Safety switches shall be complete along the full length of each conveyor with vinyl coated cable and cable supports. Switches shall be rated NEMA-4.

2.5 BELT THUMPER

- A. Inclined portion of belt conveyor shall be provided with a belt thumper, or beater, mounted on the return side of the conveyor to provide vibration to remove attached material before returning to feed location. Thumper shall consist of a set of heavy wall rollers

2.6 SAFETY SWITCH

- A. Provide a zero speed switch with two form c (spot\}) contacts rated for 0.5 amps 24 vdc. The zero speed switch shall change state at no more than 25% of rated speed and be enclosed in a nema type 4 rated enclosure. All exposed parts of the sensor assembly shall be stainless steel. Locate the zero speed switch at the end opposite from the drive.

2.7 DRIVE

- A. The conveyor shall be driven to a maximum belt speed of 105 feet per minute by a drive train consisting of a high efficiency, low maintenance, shaft mounted drive.

2.8 GEAR MOTOR

- A. The shaft mounted gear motor shall consist of a minimum 1 hp, 480 volt, 60 hz, 3 phase, 1750 rpm tefc motor which is direct connected to a shaft mounted AGMA Class-II minimum, helical gear, reducer. The gear motor shall be as manufactured by Dodge, Nord, or equal.

2.9 SUPPORTS

- A. The conveyor manufacturer shall provide all supports as required to carry the design load and meet the deflection requirements for all loading conditions, including conveyor fully loaded. All supports shall be carbon stainless steel.

2.10 CONTROLS

- A. The motor controls for the Equipment in this Section will be provided by the dewatering equipment manufacturer to ensure that all interlocks and sequencing logic is correctly designed and coordinated. Conveyor manufacturer to supply a local control panel with e-stop and hand/off/auto.

PART 3 EXECUTION

3.1 FACTORY-APPLIED PROTECTIVE COATINGS

- A. Exterior Surface Preparation and Protective Coating:
 - 1. For exterior ferrous components, except drive, and all stainless steel surfaces, sandblast all ferrous steel surfaces to SSPC-SP-6. Carbon steel surfaces to be coated with Manufacturer's standard paint system.

B. Stainless Steel Surfaces:

1. Glassblast all exterior stainless steel surfaces only to a uniform finish.

C. Gearboxes, motors, bearings, etc. are to be supplied in Manufacturer's standard enamel finish.

3.2 SPARE PARTS

- A. Manufacturer must have spare parts inventory within the continental USA and must be able to respond to spare parts requirements within thirty (30) days.

3.3 FACTORY ASSEMBLY AND TESTING

- A. Completely shop-assemble as many components as feasible with drive prior to shipment and run under no load for a minimum of 15 minutes to ensure proper operation. Provide a signed shop test certificate and record amperage on motor. Shop testing must be done at the same facility where the engineering staff is located.
- B. Inspect equipment and test for proper alignment, quiet operation, proper connection and satisfactory performance of components. Match-mark any sections which have to be disassembled for the purposes of shipping.

3.4 SITE SERVICES

- A. Manufacturer to provide the following site services, using a licensed and factory-trained service technician:
1. Commissioning and operator training, minimum of 1 trip for 1 day.

END OF SECTION

SECTION 41 2213.19 - ELECTRIC MONORAIL HOISTS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown on the Drawings, as specified herein, and as required to furnish and install complete hoist system.
 - a. Components generally include:
 - 1) Electric hoist with pendant operator.
 - 2) Manual trolley.
 - 3) Trolley stops.

1.2 RELATED SECTIONS:

- A. Section 46 1010 - Wastewater Pumps.

1.3 REFERENCES

A. Reference specifications are referred to by abbreviations as follows:

1. Monorail Manufacturers Association (MMA)
 - a. Specifications for Underhung Cranes and Monorail System.
2. Hoist Manufacturers Institute (HMI).

1.4 SUBMITTALS

- A. ~~Section 01 3000—Administrative Requirements:~~ Requirements for submittals.
McGill Section 013300
- B. Product Data: Submit manufacturer's product data for system materials and component equipment, including electrical characteristics and connection requirements.
- C. Shop Drawings:
1. Indicate system materials and component equipment.
- D. Manufacturer's Instructions: Submit detailed instructions on installation requirements.

1.5 CLOSEOUT SUBMITTALS

- A. ~~Section 01 7000—Execution and Closeout Requirements:~~ Requirements for closeout procedures.
McGill Section 017700
- B. Project Record Documents: Record actual locations and final orientation of equipment.

- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.
- D. Submit Certificate of Proper Installation.

1.6 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section, regardless of component manufacture, from one single manufacturer.
 - 2. The single manufacturer supplying the equipment required by this Section shall review and approve, or prepare, all shop drawings and other submittals for components required under this Section.
 - 3. No equipment with less than 3 years of proven reliability shall be provided under this section. The manufacturer shall be capable of producing a list of 5 successful installations along with shop drawing, date of installation, contact person and contact number for each installation.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' verifiable experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. ~~Section 01 6000—Product Requirements:~~ McGill Section 011200 Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept equipment on-Site in original packaging. Inspect for damage.
- D. Store equipment according to manufacturer's instructions.
- E. Protect equipment from water and wet weather.

1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. ~~Section 01 7000—Execution and Closeout Requirements:~~ McGill Section 017700 Requirements for warranties.
- B. Furnish one-year manufacturer's warranty for each equipment assembly as specified in this Section.

PART 2 PRODUCTS

2.1 ELECTRICAL HOIST WITH GEARED MANUAL TROLLEY

- A. System shall consist of trolley, hoist, runway beams, bridge beams and all related appurtenances.
 - 1. Hoist shall be underhung, electric, chain operated trolley hoist with a mechanical load brake, suspended by a hand-gearred trolley from the bridge beam.
 - 2. Hoists with 10 feet or less lift shall be manual.
 - 3. Hoists with lifts over 10 feet shall be electric and shall have motor, rating, and lift as shown on the Drawings.
 - 4. Hoist motors shall be spark resistant, or explosion proof as required by hazardous location rating of space.
 - 5. Provide electrical hoist with pendant operator.
 - 6. Lift speed shall be single speed at 8 feet per minute, minimum.
 - 7. Trolley shall have two plain wheels and two geared wheels and shall be provided with a cast hand chain wheel, hand chain guide, and operating hand chain.
 - 8. Trolley shall be compatible with the bridge and runway beams as shown on the Drawings.
 - 9. Trolley stops shall be furnished on all beams.
 - 10. Trolley and hoist shall be by the same manufacturer.
 - 11. Trolley and hoist shall be by Wright, ACCO Industries, Budgit, Harrington, or approved equal.
- B. System is intended to lift and convey the following equipment.
 - 1. Influent pumps in main pump station.
- C. System shall be suitable for installation in wet area and shall be corrosion resistant.
- D. Finish shall be epoxy in manufacturer's standard color.
- E. Provide unspecified components to provide a complete and operational system.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install the underhung system in accordance with MMA recommendations and the manufacturer's specifications.

3.2 TESTING

- A. Test each system under approximately full load over entire operational range. Correct or replace system components until each system successfully transfers load over full range.

END OF SECTION

SECTION 43 1133 - ROTARY LOBE BLOWER PACKAGES

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: The Contractor shall provide all labor, materials, equipment and services necessary for furnishing eight (8) Positive Displacement Blowers. The blowers shall be furnished completely packaged with all accessories, tested and ready for operation.

1.2 QUALITY ASSURANCE

- A. Manufacturer or Packager Qualifications: Supplier shall have experience in providing similar equipment, and shall show evidence of satisfactorily operating installations in the eastern region of the United States.
- B. Blower Packagers must be an Authorized Distributor or Representative of the blower being supplied and must be authorized to perform warranty service.

1.3 SUBMITTALS

- A. Shop Drawings: Submit as per ~~Section 01 3000 - Administrative Requirements.~~ McGill Section 013300
- B. Installation, Operation, and Maintenance Manuals: Submit five (5) copies of the manuals within four (4) weeks of receiving approved shop drawings.
- C. Submit Certificate of Proper Use.

1.4 MANUFACTURER'S REPRESENTATIVE

- A. General: Provide the services of a qualified factory certified representative for the required days as specified hereunder. A man-day is defined as eight (8), on-site, working hours.
- B. Initial Operation/Training: Upon notification of completion of aeration system by the Contractor, provide a minimum of one (1) day for blower equipment installation inspection, certification, start-up, training, and corrective adjustments.

1.5 TESTING

- A. A factory slip test report from the actual blower manufacturer shall be supplied for each blower.
- B. Each blower shall be tested in accordance with ASME PTC-9 testing procedures for positive displacement blowers. The results of this test shall be certified and submitted prior to shipment of the blowers.
- C. Submit Certificate of Proper Installation.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

A. Manufacturer List:

1. Pre-approved equipment manufacturers include Excelsior, Gardner Denver, Kaeser, and Roots.
2. Substitutions: Section 01 6000 – Product Requirements.
 - a. The naming of a manufacturer and model number is not an indication that the manufacturer's standard equipment offering is acceptable in lieu of the specified features. Naming of a manufacturer is instead an indication that the manufacturer may have the capability of providing the system as specified. Manufacturer shall make any necessary modifications to meet all the requirements of the Contract Documents.
 - b. Dimensions and locations shown on the Drawings for the equipment and accessories in this section are based on the equipment named as the basis of design. Any change to dimensions or locations of equipment and accessories required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner.
 - c. Any costs or modifications incurred by using equipment other than the basis of design, if any, including building construction, structural, piping, electrical, mechanical, plumbing and instrumentation systems, shall be made by the Contractor at no additional expense to the Owner.

2.2 DESIGN CRITERIA

- A. The air blowers shall be fabricated, assembled and located as shown on the drawings.
- B. Operating conditions are as scheduled on the drawings.

2.3 ROTARY POSITIVE DISPLACEMENT BLOWERS

- A. General: Each blower shall be of the horizontal, rotary, positive displacement type. Each assembly shall be rugged in construction and of such design that it may be disassembled and inspected without disturbing the inlet or discharge piping.
- B. Casing: Casing shall be of one piece with separate head plates, and shall be made of close grained gray cast iron suitably ribbed to prevent distortion under service conditions.
- C. Head Plates: Fabricate drive end and gear end head plates of close grained cast iron which are precision machined for exact bearings housing fit.
- D. Impeller and Shaft: Impeller and shaft shall be made from common cast iron. Impeller shall be of the trilobe design. Blower shall be positively timed by a pair of accurately machined heat-treated alloy steel, timing gears.
- E. Bearings: Each impeller/shaft shall be supported by double row ball or spherical roller bearings sized for a minimum of 100,000 hours of B-10 life.

- F. Bearing Seals: Provide a piston ring type oil seal at each bearing, designed to prevent lubricant from leaking into the air stream. Provisions shall be made to vent the lubrication system to prevent any possible carryover of lubricant into air stream.
- G. Lubrication: The timing gears and the bearings shall be splash oil lubricated from oil slingers. Sight glasses for oil level observation shall be provided. Grease lubricated bearings are not acceptable. Smaller gear diameter than 5" shall not be considered.

2.4 ELECTRIC MOTORS

- A. Motors: Provide a single speed, constant torque, TEFC 1800 RPM motor, 1.15 S.F., PREMIUM efficiency suitable for mounting on a slide base. Motor shall have a cast iron frame and brackets. Motors shall be as manufactured by GE, Marathon, Baldor, WEG Electric, or World Wide Electric.

2.5 BLOWER PACKAGE ACCESSORIES

- A. General: The blower packages shall be fabricated and assembled with the following accessories and shipped complete as a unit. Packages knocked down for shipment are not acceptable.
- B. Equipment Base: The base shall be built so that the blower and the motor are mounted to provide for horizontal tensioning of the v-belt drive. The base shall be a minimum of 3/8" plate steel with angle legs and gussets. These items shall also have a minimum thickness of 3/8". The blower package base must weigh at least 80% of the blower weight. Bases constructed of all angle iron shall not be acceptable.
- C. Drive: Provide V-belt drive assembly consisting of Sheaves, quick detachable bushings, V-belts, and sliding motor base. Provide drive assembly with a 1.4 service factor based on motor nameplate horsepower.
- D. Guard: Provide OSHA Style steel belt guard to enclose drive and belts. Design guard for easy removal. The guard shall be constructed to allow visual inspection of the drive system without removing the guard.
- E. Intake Filter: Provide each blower with a suitably sized air filter. Filters to be Model CCS-6" as manufactured by Universal Silencer.
- F. Intake Silencer: Provide a heavy duty, all welded, noise attenuation unit constructed of carbon steel sheet and plate and featuring an acoustically treated outlet for pulse control. Provide silencer equal to Model RISY on silencers larger than 4" and RIS type on sizes 4" and smaller. Silencers to be Model RISY-6" manufactured by Universal Silencer or equal.
- G. Discharge Silencer: Provide a heavy duty, all welded, noise attenuation unit constructed of carbon steel sheet and plate and featuring an acoustically treated outlet for pulse control. Provide silencer equal to Model SDY on sizes larger than 4" and RD type on 3" and smaller. Silencers to be Model SDY-6" manufactured by Universal Silencer or equal.
 - 1. The discharge silencer may not be welded to the base nor should it be an integral part of the base plate. The silencer shall bolt to the base.

2. Supports: Provide two (2), carbon steel, clamp type supports at each end of silencer for rigidly mounting silencer horizontally to the blower package base.
3. Expansion Joints: Provide threaded sleeved cylindrical type, three ply bias fiberglass reinforced silicone rubber connectors for blower inlet and discharge connections. Furnish units which are capable of withstanding 25 psi and handle operating temperatures of 250°F. Expansion joints to be equivalent to XL-Fab Series 500, General Rubber Corp. or Metra Flex Co.
4. Pressure Relief Valve: Provide weight type relief valve with proper sizing and weights for set point pressure. Provide valves equal to Sutorbilt PL. Spring type or Kunkle valves are not acceptable.
5. Check Valves: Provide wafer type, cast iron body, aluminum internals for mounting on blower discharge piping. Provide valve equivalent to Flexi-Hinge Model 518-6".
6. Discharge Butterfly Valve: Provide wafer type, resilient seated, lever operated, tight closing butterfly valve for isolating the blower from the manifold system. Furnish valve with cast iron body and disc of nodular iron; Stainless steel stem; Acetal Bushing; Buna-N seat; and 316 SS Torque plug. Valve shall be Mueller 87M-6" or equal.
7. Discharge Pressure Gauge: Provide a stem mounted discharge pressure gauge on the blower package to be equivalent to U.S. Gauge, McDaniel Instruments or approved equal.
 - a. Range: 0-15 psig.
 - b. Accuracy: 2 percent of full scale.
 - c. Dial: 2.5", 270 degree scale.
8. Inlet Restriction Gauge: Provide each blower with a Dwyer Model 2020 inlet gauge to measure loss through the inlet filter.
9. Vibration Isolation: Each blower package shall be mounted on Korfund vibration pads.

2.6 SHOP PAINTING

- A. Shop Prime Coating: Prime paint all components with gray Kem-Flash prime paint manufactured by Sherwin Williams Company, or approved equal. Prime paint by the individual component manufacturer is not acceptable.
- B. Shop Finish Coating: Finish paint all component parts before assembly with machine tool gray Kem-Lustral Enamel as manufactured by Sherwin Williams Company, or approved equal. Field painting of blower equipment shall not be acceptable.

2.7 SPARE PARTS

- A. The Contractor shall deliver the following spare parts for each blower:
 1. One (1) Set of V-belts.

2. One (1) Filter Elements.
3. One Case of Blower Oil
4. The spare parts shall ship with the blower packages. Coupons or Certificates for the purchase of the spare parts at a later date is not acceptable.

2.8 SOUND REDUCTION ENCLOSURE

- A. Each blower assembly shall be furnished with a weather tight, sound attenuating enclosure. The enclosure shall be manufactured of fiber reinforced plastic and meet the 80 dba attenuation requirement at one meter from any exterior surface of the enclosure. The enclosure shall have removable side panels which shall allow full access to the assembly for maintenance or repair.
- B. An air ventilation fan shall be mounted on the enclosure and sized as necessary to keep the assembly at a temperature needed to maintain proper operation as recommended by the assembly manufacturer. The ventilation fan motor shall be 115v/1 ph/60 hz; provide approx. 10 CFM/motor HP.
- C. The two side panels shall provide for a minimum of 50% of each side to be removed for access. The panels shall include 2 locking latch assemblies and a minimum of two lifting handles.
- D. Any pipe penetration holes in the enclosure shall be sized to allow for passage of pipe flanges. All penetration holes shall have flash rings installed to seal around the pipe.
- E. The enclosure shall be free standing and not attached or mounted onto the blower package frame in any way. The enclosure shall be supplied with installation instructions as well as all fasteners required for assembly.

PART 3 – EXECUTION

3.1 EXAMINATION

McGill Division 01

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Requirements for installation examination.
- B. Verify that designated areas, clearances, structural requirements, piping, utility connections, and electronic signals are ready to receive equipment.

3.2 PREPARATION

McGill Division 01

- A. ~~Section 01 7000 – Execution and Closeout Requirements:~~ Requirements for installation preparation.

3.3 INSTALLATION

- A. Install according to manufacturer's instructions.
- B. Equipment Bases and Supports:

1. Provide housekeeping pads.
2. Install anchor bolts and accessories for mounting and anchoring equipment.
3. Supports:
 - a. Construct supports of steel members.
 - b. Brace and fasten with flanges bolted to equipment structure.
 - c. Provide flexible connects as required to isolate equipment from piping.
4. Provide rigid anchors for pipes after vibration isolation components are installed.
5. Lubricants:
 - a. Provide the necessary oil and grease for initial operation.

3.4 FIELD QUALITY CONTROL

McGill Division 01

- A. ~~Section 01 7000—Execution and Closeout Requirements:~~ Requirements for start-up, testing, adjusting, and balancing.
- B. Testing:
 1. Test for proper alignment and freedom from binding, scraping, shaft runout, or other defects.
 2. Test control system by operating hardware and process control logic under supervision of manufacturer's representative.
 3. Start up, inspect, and operate the unit over its entire speed range.
 4. If unit driven by variable speed drive, test at 100-rpm increments; if unit driven at constant speed, test at maximum rpm.
 5. Confirm that bearings are not overheating.
 6. If system fails to meet indicated requirements, modify or replace, and retest.
- C. Certification: Certify in writing that unit has been satisfactorily tested and that final adjustments have been performed.
- D. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than one (1) day on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.

3.5 DEMONSTRATION

McGill Division 01

- A. ~~Section 01 7000—Execution and Closeout Requirements:~~ Requirements for demonstration and training.

1. Demonstrate equipment startup, shutdown, routine maintenance, alarm condition responses, and emergency repair procedures to Owner's personnel.

END OF SECTION

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SECTION 46 0006 - WASTEWATER TREATMENT SYSTEM

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Overall system description.
- B. Definitions.
- C. Design criteria for liquid processes.
- D. Site conditions.
- E. Startup requirements.
- F. System-wide field quality control requirements.

1.2 RELATED REQUIREMENTS

- A. See drawings for physical layout and dimensions.
- B. Section 00 7200 - General Conditions: Definition of Substantial Completion.
- C. Section 40 9200 - Process Control Descriptions
- D. Section 46 0103 - Startup and Commissioning Procedures.
- E. Section 46 0106 - Operation and Maintenance Manual.
- F. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Requirements that apply system-wide and to many equipment items.
- G. Other Sections in Division 46: Wastewater treatment equipment.

1.3 REFERENCE STANDARDS

- A. NFPA 70 - National Electrical Code Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.4 DEFINITIONS

- A. Owner's Representative: Architect/Engineer.
- B. Regulatory Agency: Virginia Department of Environmental Quality (DEQ) - State agency administering national discharge permits.
- C. Startup: Startup (capitalized) is the date at which the work is placed into service treating wastewater.
 - 1. All portions of the project and the process control system must be ready for full operation upon Startup.

2. By law, startup of the plant, or the portions constructed in this project, cannot occur before the O&M Manual has been approved by the regulatory authorities.
- D. Startup Period: The period between Startup and Date of Substantial Completion, during which the work is functionally tested, adjusted, and corrected.

1.5 ADMINISTRATIVE REQUIREMENTS

- A. Scheduling: Submit drafts of the following submittals:
 1. Startup Plan.
 2. Outline of Operation and Maintenance Manual.
 3. List of Operation and Maintenance Data Submittals.

1.6 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000 Administrative Requirements~~, and Section 46 0500 for submittal procedures.

PART 2 SYSTEM DESCRIPTION

2.1 INTAKE

- A. Primary Intake: From municipal sanitary sewer.
- B. Influent Volume:
 1. Minimum Daily Flow: 1 million gallons per day.
 2. Average Daily Flow: 2.7 million gallons per day.
 3. Peak Daily Flow: 10.1 million gallons per day.

2.2 LIQUID EFFLUENT REQUIREMENTS

- A. Effluent From Disinfection Process:
 1. 30-Day Fecal Coliform Count: Maximum of 126 most probable number (MPN) per 100 mL, on a 30-day geometric mean of daily samples.
- B. Final Effluent:
 1. Total Suspended Solids: 30 mg/L, maximum.
 2. BOD5: 18 mg/L, maximum June 1 to November 31. mg/L, maximum December 1 to May 31.
 3. Ammonia Nitrogen (NH3-N): 3.6 mg/L, maximum June 1 to November 31. 7.3 mg/L, maximum December 1 to May 31.

2.3 SITE CONDITIONS

- A. Location Parameters:
 - 1. Latitude: 37°05'28" N.
 - 2. Longitude: 81°49'51" W.
 - 3. Altitude Above Mean Sea Level: 1920 feet.
- B. NFPA 70 Hazardous Location Areas: Indicated on drawings.

PART 3 EXECUTION

3.1 WORKING IN EXISTING PLANT

- A. Existing plant will remain in full operation during modification work; do not interrupt operation or degrade the quality of treatment.
- B. Where redundant equipment or unit processes can be taken off-line, coordinate scheduling with Owner.
- C. If it is not possible to make tie-ins to existing pipelines or channels without leakage or spills, notify Owner as soon as this is discovered.
- D. Comply with Owner's requirements for access to plant, security, parking, temporary facilities, and staging areas.

3.2 FIELD QUALITY CONTROL - PRIOR TO STARTUP

- A. Test entire liquid process using water, for proper flow; operation of valves, gates, pumps, and other moving equipment; and adjustment of weirs and other level controls.
- B. Test with water as much of the solids process as can be tested using water, for proper flow and operation of valves, pumps, and other moving equipment.
- C. Test Period: 72 hours.
- D. Water Volume: Enough to fill system and provide some flow for testing.
- E. See individual equipment sections for other testing and inspection prior to Startup.

3.3 STARTUP AND COMMISSIONING

- A. Startup and commissioning apply to all operating components in this contract.
- B. Prerequisites for Startup: Begin the following as soon as possible after start of work.
 - 1. Operation and Maintenance Manual.
 - 2. Startup Plan.
 - 3. Commissioning Plan.
- C. Startup and commissioning are to be performed in three phases.

- D. Phase 1 - Pre-Startup:
 - 1. Field quality control tests and demonstrations that can be conducted before Startup; these are specified in each relevant specification section.
 - 2. Functional tests that can be conducted before Startup; some of these are specified in relevant specification sections.
 - 3. Submission of Pre-Functional Checklists.
 - 4. Training of Owner's operating personnel, as specified in individual sections.
- E. Phase 2 - Startup Period: Startup date at Owner's direction; ends upon Owner's acceptance.
 - 1. Startup of each Unit Process and its equipment.
 - 2. Tests and demonstrations specifically indicated as Startup activities.
 - 3. Functional tests that could not be conducted before Startup.
 - 4. Training of Owner's maintenance personnel, as specified in individual sections.
- F. Phase 3 - Commissioning: Begins after Owner's acceptance of Phase 2.
 - 1. Adjustment of processes and process controls to achieve effluent targets.
- G. Phases 1, 2, and 3 are to be conducted by Contractor with observation by Owner's representative .
- H. Completion of Phase 2 is required before Date of Substantial Completion can be established.

END OF SECTION

SECTION 46 0103 - STARTUP AND COMMISSIONING PROCEDURES

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Pre-Startup and Startup procedures.
- B. Submittal requirements.
- C. Owner operating personnel pre-Startup orientations.
- D. Prefunctional checklist requirements.
- E. Functional test procedures.
- F. Scope and procedures for commissioning.

1.2 RELATED REQUIREMENTS

- A. Section 46 0006 - Wastewater Treatment System: System-wide Startup and commissioning requirements.
- B. Section 46 0106 - Operation and Maintenance Manual.
- C. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Training procedures and documentation.

1.3 SUBMITTALS

McGill Section 013300

- A. See ~~Section 01 3000 - Administrative Requirements~~, for submittal procedures; except:
 - 1. Make submittals on time schedule specified by Owner's representative.
 - 2. Submit draft submittals intended for the use of the Owner's representative, in preparing final documents, in editable electronic format, Microsoft Word 2010, or later edition, preferred.
 - 3. Allow for time required for review and approval.
- B. Summary Startup and Commissioning Schedule: Within 60 days after award of Contract, submit anticipated dates for Phases 1 and 2, with start and duration of major testing activities; indicate activities on the critical path.
- C. Startup Plan and Forms.
- D. Pre-Functional Checklists.
- E. Functional Test Procedures and Forms.
- F. Completed Pre-Functional Checklists.
- G. Completed Startup Reports.

- H. Completed Functional Test Reports.

PART 2 PRODUCTS

2.1 DOCUMENTATION IDENTIFICATION SYSTEM

- A. Give each submitted form or report a unique identification; use the following scheme.
- B. Type of Document: Use the following prefixes:
 - 1. Pre-Functional Checklist: PFC-.
 - 2. Startup Plan: SP-.
 - 3. Startup Report: SR-.
 - 4. Functional Test Procedure: FTP-.
 - 5. Functional Test Report: FTR-.
- C. For Unit Processes: Use the Unit Process specification section number (series 4600xx) and assign letters sequentially (A, B, C, etc) to indicate the commissioning activities relevant to the process as a whole.
- D. For Individual Components: Use the unique Plant ID number; see Section 46 0500.
- E. Test, Revision, or Submittal Number: Number each successive iteration sequentially, starting with 1.
- F. Example: FTP-460023-A.2 would be the Functional Test Procedure for the whole Influent Pump Station, revision 2.
- G. Example: FTP-460023-001.1 would be the Functional Test Procedure for equipment item 1 in the Influent Pump Station, probably a pump, first submittal.
- H. Example: PC-460023-001.2 would be the Pre-Functional Checklist for equipment item 1 in the Influent Pump Station, probably a pump, revision 2.

2.2 TEST EQUIPMENT

- A. Provide all testing equipment required to perform startup and initial checkout and required Functional Testing; unless otherwise noted such testing equipment will not become the property of Owner.
- B. Test Equipment Calibration Tolerances: Provide testing equipment of sufficient quality and accuracy to test and/or measure performance with the tolerances specified. If not otherwise noted, the following minimum requirements apply:
 - 1. Temperature Sensors and Digital Thermometers: Certified calibration within past year to accuracy of 0.5 degree F and resolution of plus/minus 0.1 degree F.

2. Pressure Sensors: Accuracy of plus/minus 2.0 percent of the value range being measured (not full range of meter), calibrated within the last year.
3. Calibration: According to the manufacturer's recommended intervals and when dropped or damaged; affix calibration tags or keep certificates readily available for inspection.
- C. Equipment-Specific Tools: Where special testing equipment, tools and instruments are specific to a piece of equipment, are only available from the vendor, and are required in order to accomplish startup or Functional Testing, provide such equipment, tools, and instruments as part of the work at no extra cost to Owner; such equipment, tools, and instruments are to become the property of Owner.
- D. Dataloggers: Independent equipment and software for monitoring flows, currents, status, pressures, etc. of equipment.

PART 3 EXECUTION

3.1 STARTUP PLAN AND STARTUP

- A. Startup Plan: Prepare an overall startup plan covering all operating equipment, devices, and unit processes, with forms for startup reports.
 1. Organize the plan in sequence of startup, grouped by Unit Process, and proceeding from individual components to sub-systems to Unit Process.
 2. For each Unit Process, prepare a Startup Report form.
 3. List all equipment by Plant ID and description.
 4. Include anticipated date and duration of startup and functional testing for each item.
 5. Cross-reference individual equipment Startup Plans, Startup Report forms, Pre-Functional Checklists, and Functional Test Procedures by identifying number.
 6. If special equipment, personnel, or other conditions are necessary for startup or testing, describe them.
 7. Submit for approval and revise as directed.
- B. Unit Process Startup Report Forms: Prepare a form for each Unit Process, for recording results of startup.
- C. Updating Plan: Keep plan up to date as startup and testing progress.
- D. Equipment Startup Plans: Prepare a Startup Plan for each item of operating equipment and device.
 1. Incorporate manufacturer's recommended startup procedures, checklists, etc.
 2. Reference Pre-Functional Checklist by identifying number.

3. If Pre-Functional Checklist covers all startup activities, no separate equipment startup plan is necessary; cross-reference the Pre-Functional Checklist on overall Startup Plan with notation that no separate equipment startup plan is required.
- E. Operating Personnel Orientations: Prior to startup of any Unit Process, or modified portion of existing Unit Process, conduct an operating personnel orientation.
1. Timing: Not more than 2 weeks and not less than 1 week prior to startup so that personnel can review O&M Manual.
 2. Owner will designate personnel to attend; also require attendance by installers' and manufacturers' representatives.
 3. Handouts: Make minimum of 10 printed copies of relevant layouts and diagrams from O&M Manual.
 4. Review the sequence of startup activities, the Pre-Functional Checklists and startup forms, and explain the expected results.
 5. Review and discuss problems that might occur during startup, especially any not discussed in the O&M Manual because they would not be encountered in normal operation, and preparations made to correct them.
 6. Spend at least 1 hour in visual orientation on-site, pointing out all components of the process and answering questions.
- F. Execution: Execute startup of each item of operating equipment, device, and unit process; fill out relevant Startup Report form
1. Verify that startup procedures are correctly described in O&M Manual.
 2. Submit Pre-Functional Checklists and equipment startup reports together with overall Unit Process Startup Report.
 3. Submit completed Unit Process Startup Reports within two days of completion.
- G. Deficiencies: Correct deficiencies and restart, at no extra cost to Owner; if difficulty in correction would delay progress, report deficiency immediately.

3.2 PREFUNCTIONAL CHECKLISTS

- A. Draft Checklists: Prepare a Pre-Functional Checklist for each item of operating equipment, device, and unit process.
1. Submit for approval and revise as directed.
 2. No sampling of identical or near-identical items is allowed.
 3. These checklists do not replace manufacturers' recommended startup checklists, regardless of apparent redundancy.

B. Forms: Include the following types of information:

1. Plant ID number.
2. Manufacturer, model number, and relevant capacity information.
3. Serial number of installed unit.
4. List of inspections to be conducted to document proper installation; these will be primarily static inspections and procedures; for equipment and systems may include normal manufacturer's start-up checklist items and minor testing.
5. Include field quality control inspections and tests specified in individual specification sections.
6. Sensor and actuator calibration information.
7. Status of O&M data submissions.
8. Status of Startup Plan submissions.
9. Status of Training Plan submissions.
10. Certification by installing contractor that the unit is properly installed and ready for Startup
11. Spaces for witnessing, dates, and conditions.

C. Execution: Fill out and submit Pre-Functional Checklists after completion of installation of each item of equipment.

1. Each line item without deficiency is to be witnessed, initialed, and dated by the actual witness; checklists are not complete until all line items are initialed and dated complete without deficiencies.
2. Checklists with incomplete items may be submitted for approval provided the Contractor attests that incomplete items do not preclude the performance of safe and reliable Functional Testing; re-submission of the Checklist is required upon completion of remaining items.
3. Individual Checklists may contain line items that are the responsibility of more than one installer; assign responsibility to appropriate installers or subcontractors, with identification recorded on the form.
4. If any Checklist line item is not relevant, record reasons on the form.
5. Regardless of these reporting requirements, Contractor is responsible for correct startup and operation.
6. Submit completed Checklists within two days of completion.

- D. Deficiencies: Correct deficiencies and re-inspect or re-test, as applicable, at no extra cost to Owner; if difficulty in correction would delay progress, report deficiency immediately.

3.3 FUNCTIONAL TESTS

- A. At least one Functional Test is required for each item of operating equipment, device, and unit process, unless sampling of multiple identical or near-identical units is allowed by the final test procedures.
 - 1. Some test procedures are included in the Contract Documents; where Functional Test procedures are not included in Contract Documents, propose test procedures appropriate to the equipment or process being tested.
 - 2. Examples of Functional Testing:
 - a. Test the dynamic function and operation of equipment using manual (direct observation) or monitoring methods under full operation (e.g., the clarifier rake is operated under mature sludge blanket conditions to verify speed and torque under load).
 - b. Unit processes are run through all the control system's sequences of operation and components are verified to be responding as the sequence's state.
- B. Functional Test Procedures: Prepare descriptions of functional tests, with forms for recording test conditions and results.
 - 1. Submit for approval and revise as directed.
 - 2. List steps to be taken to demonstrate performance, in order of occurrence.
 - 3. List test apparatus, if any.
 - 4. List performance criteria which if achieved demonstrate satisfactory performance.
- C. Functional Test Report Forms: Include the following types of information:
 - 1. Plant ID number, for equipment, or Unit Process identification.
 - 2. Manufacturer, model number, and relevant capacity information.
 - 3. Serial number of installed unit.
 - 4. Test apparatus calibration information.
 - 5. List of test steps, with spaces for results, witnessing, and dates.
 - 6. Final results.
- D. Execution: Perform Functional Tests and fill out and submit test report form after completion of test.

1. Verify that operating functions and procedures are correctly and completely described in O&M Manual.
 2. Use the approved test report form.
 3. Submit completed test report form within two days of completion.
 4. If a deficiency is not corrected and re-tested immediately, document the deficiency and intentions regarding correction.
- E. Deficiencies: Correct deficiencies and re-test at no extra cost to Owner, including cost of Owner representative witnessing; if difficulty in correction of deficiency would delay progress, report deficiency immediately.
1. Deficiencies are any condition in the installation or function of a component, piece of equipment or system that is not in compliance with Contract Documents or does not perform properly.
 2. Coordinate scheduling of re-tests with Owner's representative.
 3. Identical or Near-Identical Items: If 10 percent, or three, whichever is greater, of identical or near-identical items fail to perform due to material or manufacturing defect, all items will be considered defective; provide a proposal for correction within 2 weeks after notification of defect, including provision for testing sample installations prior to replacement of all items.
- F. Deferred Functional Tests: Some tests may need to be performed later, after substantial completion, due to seasonal requirements or other conditions; performance of these tests remains the Contractor's responsibility regardless of timing.

3.4 TEST PROCEDURES - GENERAL

- A. Provide skilled technicians to execute starting of equipment and to execute the Functional Tests. Ensure that they are available and present during the agreed upon schedules and for sufficient duration to complete the necessary tests, adjustments and problem-solving.
- B. Provide all necessary materials and system modifications required to produce the flows, pressures, temperatures, and conditions necessary to execute the test according to the specified conditions. At completion of the test, return all affected equipment and systems to their pre-test condition.
- C. Sampling: Where Functional Testing of fewer than the total number of multiple identical or near-identical items is explicitly permitted, perform sampling as follows:
1. Identical Units: Defined as units with same application and sequence of operation; only minor size or capacity difference.
 2. Sampling is not allowed for:
 - a. Major equipment.

- b. Life-safety-critical equipment.
 - c. Pre-Functional Checklist execution.
- 3. XX = the percent of the group of identical equipment to be included in each sample; defined for specific type of equipment.
- 4. YY = the percent of the sample that if failed will require another sample to be tested; defined for specific type of equipment.
- 5. Randomly test at least XX percent of each group of identical equipment, but not less than three units. This constitutes the "first sample."
- 6. If YY percent of the units in the first sample fail, test another XX percent of the remaining identical units.
- 7. If YY percent of the units in the second sample fail, test all remaining identical units.
- 8. If frequent failures occur, resulting in more troubleshooting than testing, stop the testing and perform and document a checkout of the remaining units prior to continuing testing.
- D. Manual Testing: Use hand-held instruments, immediate control system readouts, or direct observation to verify performance (contrasted to analyzing monitored data taken over time to make the "observation").
- E. Simulating Conditions: If necessary, artificially create the necessary condition for the purpose of testing the response of a sensor or process.
- F. Simulating Signals: Disconnect the sensor and use a signal generator to send an appropriate signal to amperage, resistance or pressure to the transducer and control system to simulate the sensor value.
- G. Over-Writing Values: Change the sensor value known to the control system in the control system to see the response of the system; for example, change the dissolved oxygen level to see the response of the aeration system.
- H. Indirect Indicators: Remote indicators of a response or condition, such as a reading from a control system screen reporting a valve to be 100 percent closed, are considered indirect indicators.
- I. Trending: Where trending is called for in Functional Test Procedures:
 - 1. For points monitored by the process control system, use the trending function of the process control system, after having verified its proper operation using its Functional Test.
 - 2. For characteristics that cannot be measured using sensors, take samples and perform laboratory analysis.
 - 3. Provide hard copies of trended data in columnar format with time down left column and at least 5 columns of point values on same page.

4. Graphical output is desirable and is required for all output if the system can produce it.
 5. Organize trended data by Unit Process.
 6. Trending may be used to augment, but not replace, manual testing.
- J. Laboratory Analysis: Use an independent testing agency specializing in water/wastewater testing; obtain Owner's approval of agency prior to starting testing.

3.5 COMMISSIONING PLAN AND COMMISSIONING

- A. Commissioning Plan: Prepare an overall commissioning plan covering all unit processes, with forms for reports.
1. Organize the plan in sequence by Unit Process.
 2. List the commissioning activities to be conducted.
 3. Include anticipated date and duration of each activity.
 4. Cross-reference individual equipment Startup Plans, Startup Report forms, Pre-Functional Checklists, and Functional Test Procedures by identifying number.
 5. If special equipment, personnel, or other conditions are necessary for commissioning, describe them.
 6. Submit for approval and revise as directed.
- B. Execution: Execute each commissioning activity; fill out relevant report form.
1. Submit completed Reports within two days of completion.
- C. Deficiencies: Correct deficiencies found at no extra cost to Owner.

END OF SECTION

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SECTION 46 0106 - OPERATION AND MAINTENANCE MANUAL

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Operation and maintenance data submittals.

1.2 RELATED REQUIREMENTS

- A. McGill Section 013300 ~~Section 01 3000—Administrative Requirements~~: Submittals procedures, shop drawings, product data, and samples.
- B. McGill Section 017700 ~~Section 01 7000—Execution and Closeout Requirements~~: Contract closeout procedures.
- C. Section 46 0006 - Wastewater Treatment System.
- D. Section 46 0500 - Common Work Results For Water and Wastewater Equipment.
- E. Individual Product Sections: Additional requirements for operation and maintenance data.

1.3 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000—Administrative Requirements~~, and Section 46 0500 for submittal procedures.

PART 2 OPERATION AND MAINTENANCE MANUAL

2.1 EXISTING MANUAL

- A. Furnish new information to Engineer for incorporation into manual.

2.2 DOCUMENT FORMATS

- A. Editable Document Format: Microsoft Word 2010 or later, Open Document Format (ODF), or Rich Text Format (RTF); use for documents prepared specifically for this plant.
- B. PDF Format: Adobe Reader version 7 or later; use for:
 - 1. Approved submittals, such as product data, shop drawings, O&M data; furnish PDF of approved copy, not original
 - 2. O&M documents prepared by manufacturers.
 - 3. Project record documents, as described in Section 01 7800 - Closeout Submittals and in individual Sections.
 - 4. Startup checklists and functional test reports.
 - 5. Other documents that will not need to be modified in the future.
- C. Drawings: Convert to PDF format, maintaining original document page size (i.e. do not reduce a large size drawing to 8-1/2 by 11, or any different size).

2.3 ORGANIZATION OF MANUAL

- A. The function of this manual is to make needed information quickly and easily found and understood. To increase effectiveness the following general principles should be observed:
 - 1. Generally, use less narrative and more diagrams, charts, and checklists.
 - 2. An operator looking for a specific piece of information should not have to read an essay to find it.
 - 3. Do not include information that is not specific to this plant.
 - 4. If both graphic and text are needed for the same subject, place the graphic above the text.
 - 5. If footnotes or legends are used, make them large enough to read easily and place above or to the left of the chart or table they refer to, so they are not overlooked.
 - 6. If a graphic will fit in a page of a normal browser window, insert it as a picture in the page; if very large, link to it as an external PDF file.
 - 7. Very large drawings and diagrams should not be used as a primary information source; if they are the only source of a particular item of information, consider snipping relevant portions to insert as pictures.

2.4 EQUIPMENT INFORMATION

- A. For each individual item of equipment, provide the following information; use a consistent format for all equipment, including order of presentation of information and starting each item on a new page.
- B. See individual product specification sections for additional requirements.
- C. Equipment Summary Sheet:
 - 1. Plant identification number; if there is more than one item that is exactly identical, use one sheet for all.
 - 2. Generic name of item (e.g. Return Activated Sludge Pump).
 - 3. Location in plant, such as Unit Process.
 - 4. General description including component parts.
 - 5. Manufacturer name, model or series name or number, serial number, and date installed.
 - 6. Installer/Supplier name, address, contact name and phone number.
 - 7. Service organization name, address, contact name and phone number.
 - 8. Identify where spare parts and consumables are stored on site.

- D. Design Data: List design capacity and other operating parameters.
 - 1. Pumps: Include pump curve for the specific pump installed, shutoff head, discharge head, and suction head; identify impeller trim and motor horsepower.
 - 2. Startup Form: Recorded actual values of design parameters at startup.
 - 3. Manufacturer's design data sheets may be linked to or referenced.
- E. Product Data: Project record copy of approved submittals.
 - 1. If no approved product data submittal exists, provide manufacturer's current data sheet marked to clearly identify specific products and components that were installed; delete or cross out inapplicable information.
- F. Shop Drawings: Project record copy of approved shop drawings.
- G. Wiring Diagrams: As installed.
- H. Operating Procedures:
 - 1. Describe start-up, break-in, and routine normal operating instructions and sequences. Include regulation, control, stopping, shut-down, and emergency instructions. Include summer, winter, and any special operating instructions.
 - 2. Manufacturer's printed procedures may be used, provided they are in electronic form.
 - 3. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific equipment.
- I. Maintenance Requirements:
 - 1. Provide summary of necessary maintenance activities for this equipment in this particular plant, prepared from manufacturer data, with necessary frequency.
 - 2. Describe routine procedures for preventative maintenance and trouble shooting; disassembly, repair, and reassembly instructions; and alignment, adjusting, balancing, and checking instructions.
 - 3. Manufacturer's servicing and lubrication schedule, and list of lubricants required.
 - 4. Manufacturer's illustrations, assembly drawings, and diagrams required for maintenance.
 - 5. Manufacturer's printed procedures may be used, provided they are in electronic form.
 - 6. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the operation and maintenance of the specific equipment.

- J. Tools: List of tools necessary for adjustment, operation, maintenance and disassembly; identify by manufacturer and model number any special tools that are specific to the equipment, not commonly encountered in repair shops, or only available from limited sources.
- K. Replaceable Parts and Consumable Supplies:
 - 1. Manufacturer's parts list with model numbers, prices, and edition date.
 - 2. List of parts that manufacturer recommends having on hand, with quantities.
 - 3. List of parts that require long lead time, with time estimates.
 - 4. Nearby Sources: Name, address, phone number.
- L. Equipment Startup Reports:
 - 1. Completed Pre-Functional Checklist.
 - 2. Completed Functional Test report.
- M. Additional Requirements: As specified in individual product specification sections.

2.5 PROTECTIVE FINISHES INFORMATION

- A. For each protective finish, provide the following information:
 - 1. Product data, with catalog number, size, composition, and color and texture designations.
 - 2. Information for ordering additional material.
 - 3. Manufacturer's recommended inspection schedule.
 - 4. Instructions for repair of damaged and deteriorated coatings, including surface preparation.
 - 5. Additional information as specified in individual product specification sections.
- B. Where additional instructions are required, beyond the manufacturer's standard printed instructions, have instructions prepared by personnel experienced in the maintenance of the specific products.

END OF SECTION

SECTION 46 0500 - COMMON WORK RESULTS FOR WATER AND WASTEWATER EQUIPMENT

PART 1 GENERAL

1.1 APPLICABILITY

- A. Requirements of this section apply to other sections of Division 46.
- B. Some requirements of this section are specified only in this section; these apply to other sections of Division 46 whether specifically cross-referenced or not.
- C. Some requirements of this section amplify requirements of other sections of Division 46; these also apply to those sections unless a requirement of this section and another section cannot both be met; in that case, comply with the requirement of the other section.

1.2 SECTION INCLUDES

- A. Administrative requirements applicable to all equipment, including:
 - 1. Definitions of corrosion zones.
 - 2. Submittals relating to other sections.
 - 3. Quality assurance.
 - 4. Delivery, storage, and handling.
 - 5. Temporary water.
- B. Product requirements applicable to all equipment, including:
 - 1. General equipment requirements.
 - 2. Requirements relating to equipment with moving parts.
 - 3. Requirements relating to electrically operated equipment.
 - 4. Language and units of measure.
 - 5. Identification of equipment, piping, and enclosures.
 - 6. Protective finishes.
 - 7. Metals and construction materials used in equipment.
 - 8. Access walkways, platforms, ladders, and railings.
- C. Execution procedures applicable to all equipment, including:
 - 1. Examination.
 - 2. Equipment installation.

3. Penetrations through building construction.
4. Field finishing.
5. Owner personnel training procedures.
6. Cleaning and protection.

1.3 RELATED REQUIREMENTS

- A. Section 03 3000 - Cast-in-Place Concrete: Concrete for basins and channels, equipment bases and foundations, and grout for setting equipment.
- B. Section 05 1200 - Structural Steel Framing.
- C. Section 09 9110 - Painting: Finishes for architectural and structural surfaces outdoors and in the indoor dry zone.
- D. Section 09 9600 - High-Performance Coatings: Protective finishes.
- E. Section 46 0006 - Wastewater Treatment System: Plant system description, design criteria, and performance requirements.
- F. Section 46 0103 - Startup and Commissioning Procedures: Putting equipment and systems into complete operating condition, functional testing, and Owner personnel training.
- G. Section 46 0106 - Operation and Maintenance Manual.
- H. Section 46 0916 - Control Valves: Identification.

1.4 DEFINITIONS

- A. Buried: Equipment, piping, and structures are in contact with earth or which would be in contact with earth without the protection specified.
- B. Corrosive Atmosphere Zone: Where raw sewage runs in open channels; surfaces subject to corrosive atmosphere include floors, walls, ceilings, structural members, and inside and outside of equipment housings.
- C. Hazardous Atmosphere Zone: Chlorine gas storage and handling and spaces where explosion hazard exists.
- D. Indoor Dry Zone: Enclosed spaces not connecting to open liquid surfaces, not subject to water vapor emissions, and not anticipating more than occasional, accidental water-based liquid contact; the following are considered "Indoor, Dry":
 1. Administration areas, offices, laboratories.
 2. Mechanical rooms and utility tunnels meeting this definition.
 3. Electrical rooms.

- E. Outdoors: Exposed to the outdoor ambient environment, whether under cover or not.
- F. Splash Zone: Surfaces less than 12 inches above normal liquid level in process tanks and channels.
- G. Submerged Zone: Below the surface of the liquid or solids process stream.

1.5 REFERENCE STANDARDS

- A. ABMA STD 9 - Load Ratings and Fatigue Life for Ball Bearings 2015.
- B. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014.
- C. ASME A13.1 - Scheme for the Identification of Piping Systems 2020.
- D. ASME B31.1 - Power Piping 2020.
- E. ASME BPVC-IX - Boiler and Pressure Vessel Code, Section IX - Qualification Standard for Welding, Brazing, and Fusing Procedures; Welders; Brazers; and Welding, Brazing, and Fusing Operators 2021.
- F. ASTM A36/A36M - Standard Specification for Carbon Structural Steel 2019.
- G. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings 1999, with Editorial Revision (2018).
- H. ASTM A48/A48M - Standard Specification for Gray Iron Castings 2003 (Reapproved 2021).
- I. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products 2017.
- J. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware 2016a.
- K. ASTM A780/A780M - Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings 2020.
- L. ASTM F402 - Standard Practice for Safe Handling of Solvent Cements, Primers, and Cleaners Used for Joining Thermoplastic Pipe and Fittings 2018.
- M. IEEE/ASTM SI 10 - American National Standard for Metric Practice 2016, with Errata (2017).
- N. IEEE C37.13 - IEEE Standard for Low-Voltage AC Power Circuit Breakers Used in Enclosures 2015.
- O. IEEE C57.13 - IEEE Standard Requirements for Instrument Transformers 2016.
- P. NACE No. 2 - Joint Surface Preparation Standard Near-White Metal Blast Cleaning 1994 (Reaffirmed 2006).
- Q. NEMA ICS 1 - Industrial Control and Systems General Requirements 2000 (Reaffirmed 2015).

- R. NEMA ICS 2 - Industrial Control and Systems Controllers, Contactors and Overload Relays Rated 600 Volts 2000, with Errata (2008).
- S. NEMA ICS 4 - Application Guideline for Terminal Blocks 2015.
- T. NEMA ICS 5 - Industrial Control and Systems: Control Circuit and Pilot Devices 2017.
- U. NEMA MG 1 - Motors and Generators 2018.
- V. NEMA ST 20 - Dry-Type Transformers for General Applications 2014.
- W. NFPA 704 - Standard System for the Identification of the Hazards of Materials for Emergency Response 2017.
- X. SSPC-SP 10 - Near-White Blast Cleaning 2007.
- Y. UL 508 - Industrial Control Equipment Current Edition, Including All Revisions.

1.6 SUBMITTALS - GENERAL

- A. See Section 01 3000 - Administrative Requirements, for submittal procedures.

1.7 SUBMITTALS - OTHER SECTIONS

- A. Product Data, Shop Drawings, and Design Data: Organize submittals by unit process so that equipment and interconnections of a process can be reviewed at the same time.
- B. Product Data: In addition to data specified in other sections, include:
 - 1. For Operating equipment: Evidence that product meets requirements of PART 2, GENERAL EQUIPMENT REQUIREMENTS, Operating Equipment.
 - 2. Factory- and shop-applied protective finishes.
- C. Design Data: Where equipment includes walkways, platforms, ladders, or railings, submit structural design data prepared by licensed professional structural engineer.
- D. Welder Qualifications: Where welding by certified welders is specified in other sections, submit a copy of qualified procedures and a list of names and identification symbols of qualified welders and welding operators.
- E. Operation and Maintenance Data: See Section 46 0106; submit for:
 - 1. Factory- and shop-applied protective finishes.

1.8 QUALITY ASSURANCE

- A. Welder Qualifications for Structural Welding: Where welding by certified welders is specified in other sections, provide welders qualified in accordance with AWS D1.1/D1.1M using procedures, materials, and equipment of the type required for the work.

- B. Welder Qualifications for Pipe Welding: Where welding by certified welders is specified in other sections, provide welders qualified in accordance with ASME BPVC-IX; welders and welding operators qualified by another employer may be accepted as permitted by ASME B31.1.

1.9 DELIVERY, STORAGE, AND HANDLING

- A. See Section 01 6000 - Product Requirements for additional requirements.
- B. Chemicals and Chemical Compounds: Deliver such products with attached Material Safety Data Sheet (MSDS) in conformance with 29 CFR 1910.
 - 1. This includes process feed chemicals and materials for construction, including solvents, solvent cements, glues, sealants, adhesives, and other materials that may contain hazardous compounds.
 - 2. Handle in accordance with ASTM F402.
 - 3. Provide storage facilities that comply with NFPA 704.
- C. Keep interior of pipes, conduits, and fittings free of dirt and debris.

1.10 TEMPORARY WATER

- A. Temporary water will be provided by Owner at no cost to Contractor.
- B. Water Source: Existing at wastewater treatment plant.
- C. Provide hoses, temporary pipes, ditches, and other items as required to properly dispose of water without damage to adjacent properties.
- D. Dispose of or discharge temporary water in accordance with applicable regulations.

PART 2 PRODUCTS

2.1 GENERAL EQUIPMENT REQUIREMENTS

- A. Unless otherwise indicated, provide products that are new and unused.
- B. Where components serve the same function and are the same size, provide identical units from same manufacturer.
- C. Provide components of a specific type by the same manufacturer.
- D. Operating Equipment: For equipment that is electrically, hydraulically, or pneumatically operated, or has moving parts or electronic components, provide products that:
 - 1. Are standard products of a manufacturer regularly engaged in manufacture of such products.
 - 2. Essentially duplicate items that have been in satisfactory use for at least 2 years.

3. Is capable of operating in outdoor ambient temperature range anticipated at project site, unless located in a climate-controlled space or enclosure.
- E. Provide necessary accessories, fittings, interconnections, services, and adjustments required for complete and operable system.

2.2 EQUIPMENT WITH MOVING PARTS

- A. Protection from Moving Parts: Locate and guard belts, chains, pulleys, gears, projecting setscrews, keys, couplings, and other rotating and moving parts in accordance with OSHA requirements.
1. Make guards removable or so arranged as to allow access for maintenance.
 2. A lockable housing without openings is considered a sufficient guard.
- B. Lubrication: Provide adequate means of lubrication for moving parts subject to wear.
1. Unless otherwise indicated, provide lubrication by either grease or oil.
 2. Grease Lubrication: Provide grease fittings; if grease fitting is not easily accessible, provide grease tubing to a convenient location.
 3. Oil Lubrication: Provide oil reservoirs of liberal size with opening for filling, overflow opening at proper location to prevent overfilling, and drain opening at the lowest point; vent reservoirs to prevent pressure build-up.
 4. Provide equipment that is fully lubricated at Startup.
- C. Bearings: Provide bearings complying with ABMA STD 9 or ABMA STD 11 as applicable to type of bearing.
1. Life Expectancy: Theoretical L-10 life expectancy.
 2. Relief Ports: Provide to prevent build-up of pressure that might damage bearings or seals.
- D. Locate drives, lubrication, and bearings that are accessible from walkways at or above ground level.

2.3 ELECTRICALLY OPERATED EQUIPMENT

- A. Provide electrical components necessary for proper functioning of equipment, including but not limited to, motors, motor starters, manual and automatic devices, electrical disconnecting means, conduit and raceways, and power and control wiring.
- B. Electrical Components: As follows, unless otherwise indicated.
- C. Electric Motors: Provide motors complying with, and selected in accordance with, NEMA MG 1; designed for continuous duty unless otherwise indicated; with following characteristics unless otherwise indicated:

1. Capacity and Power Rating: Sufficient to drive equipment at specified capacity without exceeding nameplate current, power, or rating, or starting characteristics or temperature limits, and non-overloading under any conditions under which driven equipment must function.
 2. Service Factor: 1.15, minimum.
 3. Electrical Characteristics: As indicated.
 4. Motor Enclosures: Totally enclosed fan-cooled.
 5. Type: Squirrel-cage induction.
 6. Induction Motors: Design B with normal torque and low starting current.
 7. Insulation: Class B or F.
 8. Windings: Nonhygroscopic, epoxy coated.
 9. Bearings: Steel ball bearings, shielded.
 10. Bearing Lubrication: Moisture resistant grease; lubricant changeable without disassembly of motor or housing by externally located easily accessible grease fittings and purge plugs.
 11. Interchangeability: Motors of same size, rating, mounting, and other characteristics interchangeable.
 12. Compatibility: Select motors for compatibility with their controllers and the equipment driven.
- D. Motor Controls: NEMA ICS 1, NEMA ICS 2, NEMA ICS 4, and UL 508.
- E. Motor Starters: Magnetic motor starter with thermal overload protection in each phase, short circuit protection, and other features required for the specified control function.
1. Overload Protective Devices: Thermal inverse-time-limit type giving adequate protection to motor windings, with manual-reset type pushbutton.
 2. For Manual Operation: Provide Start-Stop pushbutton in enclosure cover.
 3. For Automatic Operation: Provide Hand-Off-Automatic selector switch in enclosure cover.
- F. Control Circuit and Pilot Devices: NEMA ICS 5.
- G. Instrument and Control Transformers: Comply with IEEE C57.13 and NEMA ST 20.
- H. Circuit Breakers: Thermal magnetic type, complying with IEEE C37.13.
1. Main Circuit Breaker: External handle mechanism, with positive locking device, mounted outside enclosure to permit operation of breaker from outside enclosure.

2. Main Circuit Breaker Capacity: Maximum of 150 percent of electrical load.
 3. Branch Circuit Breakers: E-frame bolt-on type mounted on interior bus bar.
 - a. Provide a branch circuit breaker for each drive motor, control circuit, heating device, and receptacle.
 - b. Provide spaces for additional circuit breakers where indicated.
- I. Wiring:
1. Provide number tags on each end of wires.
 2. Secure wires with either plastic ties or wiring duct, or both.
 3. Secure wires going to components mounted on enclosure door in a cable-like bundle strapped to door and enclosure with sufficient slack to allow easy operation of door.
 4. Terminate circuits requiring field connection on panel terminals.

2.4 LANGUAGE AND UNITS OF MEASURE

- A. Language: Use English language for forms of identification and human-machine interfaces (HMIs).
- B. Units of Measure:
1. For human-machine interfaces (HMIs), provide operator-switchable setting for traditional or metric units display and data entry.
 2. Use the same units of measure in each device measuring or displaying the same characteristic.
 3. Metric Units of Measure: As defined in IEEE/ASTM SI 10, American National Standard for Metric Practice.

2.5 IDENTIFICATION OF EQUIPMENT, PIPING, AND ENCLOSURES

- A. Plant Item Identification Scheme (Plant ID): Identify each item of equipment, device, and enclosure using a unique alphanumeric identifier and use the same identifier in each submittal and other documentation.
- B. Plant Item Nameplates: For each item of equipment, device, and enclosure, provide a nameplate permanently secured in a prominent, easily readable location.
1. Include Plant ID number and the generic name of the item.
 - a. Valves: See Section 46 0916 for additional requirements.
 - b. Enclosures: Include both enclosure ID and internal device ID; where a single enclosure contains more than one device, show both enclosure ID and device IDs on outside nameplate with separate nameplates inside identifying each device.

- c. Motor Starters: Include both starter ID and name and ID of device controlled by starter.
- 2. Lettering: At least one inch high letters in color contrasting with background.
- 3. Nameplate Material: Engraved multicolor laminated plastic.
- 4. Attachment: Where exposed to weather or humid environment, use epoxy adhesive, other permanent adhesive, or screw attachment; other locations, permanent self-adhesive.
- C. Manufacturer Nameplates: For each valve, item of equipment, and device, provide a nameplate permanently secured in a conspicuous location.
 - 1. Nameplate Information: Manufacturer's name and address, type or style, model or serial number, and catalog number.
 - 2. Nameplate Material: Same as Plant Item nameplates, or stainless steel or other corrosion-resistant material; information cast integrally need not be repeated on nameplate; manufacturer's original nameplates may be used provided they are in an easily readable location.
- D. Piping Identification: Identify piping by its contents and flow direction every 20 feet of straight run.
 - 1. Provide additional identification at branch connections, inlets and outlets of equipment, upstream of valves, and within 3 feet of entrance to or exit from basins, foundation walls, and similar barriers.
 - 2. Identify contents by color coding and lettering in contrasting color.
 - 3. Lettering: At least 1 inch high; on horizontal piping, orient lettering horizontally; on vertical piping, orient lettering so it is readable when you tilt your head to the left.
 - 4. Identify flow by large arrows.
 - 5. For contents identification, use either painted stenciled lettering or self-adhesive plastic tape pre-printed with supplemental attachment by plastic tape banding around pipe; for small diameter piping use any method that will provide durable, easily readable identification.
 - 6. Colors: Comply with ASME A13.1.

2.6 PROTECTIVE FINISHES

- A. Surfaces related to unit processes are required to have a protective finish as specified, except that the following are not required to be separately finished unless otherwise specified:
 - 1. Stainless steel.
 - 2. Hot-dipped galvanized steel.

3. Fiberglass.
 4. Aluminum, if not located in submerged, splash, or corrosive atmosphere zones.
 5. Ductile iron.
 6. PVC and CPVC.
 7. Concrete, unless submerged or in splash zone.
- B. Architectural and Structural Components: Finish exposed surfaces of the following using the specified finish, unless the material is not required to have a protective finish:
1. Walls, ceilings, and exposed overhead structure in corrosive atmosphere zone and hazardous atmosphere zone.
 2. Walls in the splash zone.
 3. Inside of concrete basins and channels.
- C. Shop and Factory Finishes: Where finishing prior to delivery to project site is feasible, shop or factory-applied finishes are required, whether or not manufacturer's or fabricator's standard procedure; this requirement is non-negotiable, to achieve required corrosion resistance.
- D. Field Finishes: Field finishing is permitted for the following:
1. Architectural and structural components.
 2. Inside of concrete basins and channels.
 3. Metallic piping, before installation of insulation.
 4. Piping identification.
 5. Finish painting of designated equipment in addition to specified factory/shop painting.
- E. Finishes:
1. Test coatings with electric detector equipped with audible signal that operates when a flaw defect is detected, such as a 90-volt wet sponge type pinhole detector.
 2. Coating Repair: If welding is required after finishing or finish is otherwise damaged, prepare, re-coat, and test in the same manner as specified for original coating.
- F. Finish Applications:
1. Buried: Coal tar coating; field or shop applied unless otherwise indicated.
 2. Corrosive Atmosphere Zone: Coal tar epoxy polyamide or epoxy polyamide coating.
 3. Hazardous Atmosphere Zone: Coal tar epoxy polyamide or epoxy polyamide coating.

4. Splash and Submerged Zones - Concrete Surfaces: Chlorinated rubber coating.
 5. Splash and Submerged Zones - Not Concrete: Coal tar epoxy polyamide coating.
 6. Other Areas: Manufacturer's standard finish.
- G. Coal Tar Coating: Black, hot applied coal tar coating system.
1. Preparation: Blasting in accordance with SSPC-SP 10 near white blast cleaning.
 2. Total Dry Film Thickness: manufacturer recommended mils, minimum.
- H. Coal Tar Epoxy Polyamide Coating: High-build, black or dark red, VOC-compliant; shop or factory applied after fabrication.
1. Preparation: Blasting in accordance with SSPC-SP 10 near white blast cleaning.
 2. Top Coats: Two coats.
 3. Total Dry Film Thickness: 16 mils, minimum.
 4. Maximum Time Between Coats: 72 hours.
- I. Epoxy Polyamide Coating: VOC-compliant; shop or factory applied after fabrication.
1. Color: To be selected by Architect/Engineer from manufacturer's full color range.
 2. Preparation: Blasting in accordance with SSPC-SP 10 near white blast cleaning.
 3. Maximum Time Between Coats: 72 hours.
- J. Chlorinated Rubber Coating: Glossy.
1. Color: To be selected by Architect/Engineer from manufacturer's full color range.
 2. Preparation: Prepare surfaces using the methods recommended by the manufacturer for achieving the best result for the substrate under the project conditions.
 3. Top Coats: Two coats.
 4. Total Dry Film Thickness: manufacturer recommended mils, minimum.
- K. Galvanizing: Hot-dipped zinc-alloy coating complying with ASTM A123/A123M or ASTM A153/A153M as applicable to item galvanized; electro-galvanized coating not acceptable; inspect for defects in factory; where repair is permitted by standard, use one of the methods specified in ASTM A780/A780M.
1. Stainless steel may be substituted where galvanizing is specified.
- L. Galvanizing Repair Paint: ASTM A780/A780M.

2.7 METALS AND CONSTRUCTION MATERIALS USED IN EQUIPMENT

- A. Stainless Steel: Type 304, Type 304L, Type 316, or Type 316L, unless otherwise indicated.
- B. Steel Plates, Shapes, and Bars: ASTM A36/A36M and as specified in Section 05 1200.
- C. Galvanized Steel Assemblies: Design to be field assembled using bolts without any welding.
- D. Malleable Iron: ASTM A47/A47M, grade No. 32510, minimum.
- E. Cast Iron: ASTM A48/A48M Class 30, minimum.

END OF SECTION

SECTION 46 0509 - PIPING AND EQUIPMENT SUPPORTS AND ANCHORS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Supports, hangers, and guides.
- B. Vibration isolation and snubbers.
- C. Seismic restraints for suspended piping.
- D. Anchors and fasteners to supporting structures.
- E. Thrust blocking for buried piping.

1.2 REFERENCE STANDARDS

- A. ASCE 7 - Minimum Design Loads for Buildings and Other Structures; 2010, with 2013 Supplements and Errata.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A47/A47M - Standard Specification for Ferritic Malleable Iron Castings; 1999 (Reapproved 2014).
- D. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- E. ASTM A181/A181M - Standard Specification for Carbon Steel Forgings, for General - Purpose Piping; 2013.
- F. ASTM A194/A194M - Standard Specification for Carbon and Alloy Nuts for Bolts for High Pressure or High Temperature Service, or Both; 2015.
- G. ASTM A576 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality; 1990b (Reapproved 2012).
- H. MSS SP-58 - Pipe Hangers and Supports - Materials, Design, Manufacture, Selection, Application, and Installation; 2009.

1.3 ADMINISTRATIVE REQUIREMENTS

- A. Furnish support and anchorage items to be embedded in concrete to concrete form installer for installation in forms.

1.4 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000 - Administrative Requirements.~~
- B. Product Data: Manufacturer's published literature for each factory-fabricated item, showing size, materials of construction, and loading capacity.

- C. Shop Drawings: Detailed fabrication and installation drawings showing how each item of equipment, enclosure, and piping is supported and anchored.
 - 1. Identify item supported/anchored and loads on supports/anchors
 - 2. For supports, show member sizes, components, and connections.
 - 3. For vibration isolation, identify isolator type, base type, and loads on each isolator.
 - 4. For vibration isolation bases, show isolator and snubber orientation and attachments, slide rails, and accessories.
 - 5. For seismic restraints for suspended piping, identify design loads in all directions.
 - 6. For anchors, show anchor and fastener type, size, quantity, diameter, depth of penetration, edge distance, and spacing.
 - 7. Include the calculations and prescriptive design tables used for design, sizing, and selection.
 - 8. Include the stamp or seal of the design engineer.

1.5 QUALITY ASSURANCE

- A. Designer Qualifications: Perform design under direct supervision of a Professional Engineer experienced in design of this type of work and licensed in Virginia.
- B. Manufacturer Qualifications: Company specializing in manufacturing the types of products specified in this section with not less than three years documented experience.

PART 2 PRODUCTS

2.1 DESIGN REQUIREMENTS

- A. Drawings do not show all details of supports and anchors; design supports and anchors to resist all live and dead loads .
 - 1. Design Loads: As specified in ASCE 7.
 - 2. Comply with applicable requirements of authorities having jurisdiction.
 - 3. Select and design supports for piping in accordance with MSS SP-58.
 - 4. Design supports and anchors with factor of safety of 2.
- B. Anchor all equipment, enclosures, and piping, including fittings, valves, and other items attached to piping, to structure capable of supporting them, whether such anchorage is shown on the drawings or not.
- C. Provide vibration isolation for pumps, blowers, air compressors, and other equipment so indicated on the drawings.

1. Provide vibration isolation for piping connected to equipment provided with vibration isolation, for specified distances from equipment.
- D. Provide support for all piping not indicated to be direct-buried, whether such support is shown on the drawings or not; unless otherwise indicated, support piping from structure above.
- E. Provide thrust blocking for direct-buried piping whether shown on the drawings or not.
 1. At minimum, provide thrust blocking at pipeline tees, plugs, caps, bends, and other locations where unbalanced forces exist.
 2. Do not use thrust blocking for any plastic piping.
- F. Bracing: Brace hanging pipes against movement using longitudinal and lateral sway bracing and seismic restraints.
 1. Provide supports, braces, and anchors to resist gravity and seismic design forces.
 2. Brace vibration isolator-supported pipe with cable bracing or other means designed to prevent transmission of vibration to the structure.
 3. Brace every run 5 feet or more in length with at least two transverse and one longitudinal bracing locations.
 4. Piping of Ductile Iron or Steel, with Welded or Screwed Connections:
 - a. Provide transverse bracing at spacing not more than 40 feet on center.
 - b. Provide longitudinal bracing at spacing not more than 80 feet on center.
 5. Other Piping:
 - a. Provide transverse bracing at spacing not more than 20 feet on center.
 - b. Provide Longitudinal bracing at spacing not more than 40 feet on center.
 6. Provide lateral restraint for risers at not more than 30 feet on center or as required for horizontal runs, whichever is less.
- G. Do Not:
 1. Do not support piping connections to equipment by the equipment; provide separate pipe supports.
 2. Do not support large or heavy valves, fittings, or equipment by the piping; provide separate supports.
 3. Do not support pipes by other pipes.
 4. Do not use existing supports to support additional new piping unless it is shown that existing supports are adequate for the additional loads; provide reinforcement if necessary.

5. Do not block equipment access areas or bridge crane runs with pipe supports.

H. Piping Support Types:

1. Single Horizontal Suspended Piping: Use adjustable swivel-ring hangers.
2. Single Horizontal Wall Mounted Piping: Use wall brackets.
3. Multiple Horizontal Piping: Use racks for floor-supported piping and trapeze hangers for suspended piping.
4. Horizontal Pedestal Mounted Piping: Use saddle type supports.
5. Vertical Piping Adjacent to Walls: Use wall brackets as appropriate.
6. Insulated Piping: Provide oversized supports to fit insulation inserts, galvanized or stainless steel protection shields, and oversized rollers.
7. Attachments to Structural Steel: Use beam clamps attached to top flange.
8. Base Flanges Adjacent to Rotating Equipment: Provide pedestal type support under pipe.
9. Pipe Sizes 2.5 inch and Larger: Provide means of vertical adjustment after erection while supporting load.

I. Piping Support Locations:

1. Provide supports at spacings indicated by MSS SP-58.
2. Provide individual supports at piping changes in direction and changes in elevation, adjacent to flexible joints and couplings, and where otherwise shown on the drawings.

J. Piping Isolation Locations: Isolate piping supports for the following distances from equipment:

1. Where a flexible piping connector occurs within specified distance, pipe isolation is not required beyond the connector.
2. Up to 4 inch Pipe Size: First 3 supports.
3. 5 to 8 inch Pipe Size: First 4 supports.
4. 10 inch Pipe Size and Over: First 6 supports.
5. Select three hangers closest to vibration source for minimum 1.0 inch static deflection or static deflection of isolated equipment. Select remaining isolators for minimum 1.0 inch static deflection or 1/2 static deflection of isolated equipment.

2.2 MATERIALS

- A. Materials: Unless otherwise indicated, provide all support products made of one or more of the following:

1. Stainless steel, TP304, with No.1 finish.
 2. Carbon steel, ASTM A36/A36M, with hot-dipped galvanized finish, ASTM A153/A153M.
 3. Polyvinylchloride (PVC) or chlorinated polyvinylchloride (CPVC) plastic.
 4. Chloroprene rubber.
 5. Polyethylene.
- B. Structural Steel Shapes: Use carbon steel with shop primed finish.
- C. Seismic Restraints for Suspended Piping and Equipment: Cable and rigid types; arranged to resist seismic loads in all directions.
1. Cable Type: Steel wire strand cables, with protective thimbles to prevent cable wear.
 - a. Capacity: Based on the lesser of cable capacity or anchor load taking into account bracket geometry.
 - b. Connections: Use overlapping wire rope U clips, cable clamping bolts, swaged sleeves or seismically rated tool-less wedge insert lock connectors.
 2. Rigid Type: Steel elements capable of carrying compression and tension loads in addition to seismic loads.
 - a. Capacity: Based on the lesser of structural element capacity or anchor load taking into account bracket geometry.
 - b. Anchorage: Capable of carrying additional tension loads generated by the vertical component of the rigid brace compression which is additive to any static load requirements on the system.
 3. For Clevis Hangers: Internally brace clevis hanger bracket cross bolt to prevent deformation.
 4. For Vertical Suspension Rods: Provide bracing of sufficient strength to prevent rod buckling from vertical compression forces utilizing series of attachment clips.
- D. Racks and Trapeze Hangers: Fabricate of structural steel channel shapes, designed to suit conditions at points of installation.
1. Use clamps or clips to secure pipes to racks, while allowing sliding or rolling movement due to thermal expansion.
 2. At each support where an anchor is not provided, provide an intermediate pipe guide that allows movement but keeps pipe aligned.
- E. Hanger Rods:
1. Material: Carbon steel, ASTM A576.

- 2. Rod Diameter: 1/2 inch, minimum.
- F. Bracing: Structural steel angle or channel shapes, not rods or cables.
- G. Brackets: Welded, pre-punched with minimum of two fastener holes.

2.3 PIPE SUPPORTS, GUIDES, AND ANCHORS

A. Manufacturers - Factory-Fabricated Supports:

- 1. Provide all support products from a single manufacturer.
- 2. Anvil International: www.anvilintl.com.
- 3. Cooper B-Line: www.cooperindustries.com.
- 4. Empire Industries, Inc.: www.empireindustries.com.
- 5. Erico: www.erico.com.
- 6. Piping Technology and Products, Inc.: www.pipingtech.com.
- 7. PHD Manufacturing, Inc.: www.phd-mfg.com.
- 8. Substitutions: See Section 01 6000 - Product Requirements.

B. Pipe Supports:

- 1. Liquid Temperatures Up To 122 degrees F:
 - a. Overhead Support: MSS SP-58 Types 1, 3 through 12.
 - b. Support From Below: MSS SP-58 Types 35 through 38.

C. Beam Clamps: MSS SP-58 Types 19 through 23, 25 or 27 through 30 based on required load.

- 1. Material: ASTM A36/A36M carbon steel or ASTM A181/A181M forged steel.
- 2. Provide clamps with hardened steel cup-point set screws and lock-nuts for anchoring in place.

D. Offset Pipe Clamps: Double-leg design two-piece pipe clamp.

E. Pipe Hangers: For a given pipe run use hangers of the same type and material.

- 1. Material: Malleable iron, ASTM A47/A47M; or carbon steel, ASTM A36/A36M.
- 2. Provide coated or plated hangers to isolate steel hangers from dissimilar metal tube or pipe.

F. Intermediate Pipe Guides: Use pipe clamps with oversize pipe sleeve that provides clearance around pipe.

1. Pipe Diameter 6 inches and Smaller: Provide minimum clearance of 0.16 inch.
 2. Pipe Diameter 8 inches: Provide U-bolts with double nuts providing minimum clearance of 0.28 inch.
 3. Pipe Diameter 8 inches: 0.625 inch U-bolt.
 4. Pipe Diameter 10 inches: 0.75 inch U-bolt.
 5. Pipe Diameter 12 to 16 inches: 0.875 inch U-bolt.
 6. Pipe Diameter 18 to 30 inches: 1 inch U-bolt.
- G. Pipe Alignment Guides: Galvanized steel.
1. Pipe Diameter 8 inches and Smaller: Spider or sleeve type.
 2. Pipe Diameter 10 inches and Larger: Roller type.
- H. Dielectric Barriers: Provide between metallic supports and metallic piping and associated items of dissimilar type; acceptable dielectric barriers include rubber or plastic sheets or coatings attached securely to pipe or item.

2.4 VIBRATION ISOLATORS AND SNUBBERS

- A. Manufacturers:
1. Kinetics Noise Control, Inc.: www.kineticsnoise.com.
 2. Mason Industries: www.mason-industries.com.
 3. Vibration Eliminator Company, Inc.: www.veco-ny.com.
 4. Silex Innovations Inc.: www.silex.com.
 5. Substitutions: See Section 01 6000 - Product Requirements.
- B. Provide all products from a single manufacturer.
- C. Applications:
1. Pumps:
 - a. Base: Steel framed isolation base mounted on isolators.
 - b. Base Thickness: 1/2 inches.
 - c. Isolator Type: Open spring mounts.
 - d. Isolator Deflection: 1/2 inches.
 2. Blowers:

- a. Base: Steel frame type isolation base mounted on isolators.
 - b. Base Thickness: 1/2 inches.
 - c. Isolator Type: Open spring mounts.
 - d. Isolator Deflection: 1/2 inches.
3. Air Compressors:
- a. Base: Steel frame type isolation base mounted on isolators.
 - b. Base Thickness: 1/2 inches.
 - c. Isolator Type: Open spring mounts.
 - d. Isolator Deflection: 1/2 inches.
- D. Vibration Isolation - General: Maintain stability and uniform deflection under all operating loads.
- E. Steel Framed Isolation Bases: Engineered structural steel frames with welded brackets for side mounting of isolators.
- 1. Frames: Square, rectangular or T-shaped.
 - 2. Design: Sufficiently rigid to prevent misalignment or undue stress on equipment and to transmit design loads to isolators and snubbers.
 - 3. Provide anchoring devices for equipment.
- F. Isolator Hangers: Combination elastomeric/spring type.
- 1. Configuration: Steel construction containing stable steel spring with elastomeric element in series isolating upper connection of hanger box to building structure.
 - 2. Bottom Opening: Sized to allow plus/minus 15 degrees rod misalignment.
- G. Isolator Mounts, Pad Type: Non-seismic type.
- 1. Configuration: Flat or molded.
 - 2. Thickness: 0.25 inch minimum.
 - 3. Material: Elastomeric/glass fiber; single or multiple layers using bonded, galvanized sheet metal separation plate between each layer.
- H. Isolator Mounts, Open Spring Type: Non-seismic type.
- 1. Configuration: Freestanding, laterally stable without housing, with leveling device connected to equipment or frame.

2. Anchorage: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.
- I. Isolator Mounts, Restrained Spring Type: Non-seismic type.
1. Anchorage: Adequate means for fastening isolator top to equipment and isolator base plate to supporting structure.

2.5 ANCHORS AND FASTENERS

- A. Anchor and Fastener Applications:
1. Submerged and Splash Zone Locations: Use stainless steel TP304L or TP316L.
 2. Anchoring Steel To Concrete: Use Type 316 stainless steel.
 3. Anchoring or Connecting Fiberglass Reinforced Plastic to Anything: Use stainless steel machine bolts.
 4. Anchoring or Connecting Aluminum to Anything: Use stainless steel machine bolts.
 5. Anchoring or Connecting Steel to Steel: Use either galvanized steel, stainless steel, or wrought iron, unless otherwise indicated for corrosion zone.
- B. Anchors, Bolts, Nuts, and Washers:
1. Bolt Sizes and Locations: As shown on approved shop drawings, except as otherwise indicated.
 2. Anchor Bolts: Furnish templates for accurate positioning.
- C. Concrete Inserts: Dovetail or slot-and-twist type, with load rating not less than that of hangers or anchors they support.
- D. Expansion Anchors for Hollow Concrete Masonry and Brick Masonry, Hollow and Solid: Expansion shield and expander nut contained inside shield, to be placed in pre-drilled hole; designed to accept both machine bolts and threaded rods.
1. Shield Body: Four legs; inside of each tapered toward shield bottom or nut end, with end of one leg elongated and turned across shield bottom; outer surface of body ribbed for grip-action.
 2. Expander Nut: Square with sides tapered inward from bottom to top, designed to climb bolt or rod thread and simultaneously expand shield as soon as the threaded item, while being tightened, reaches, and bears against shield bottom.
 3. Material: Zinc plated steel of 43,541 psi minimum tensile strength.
 4. Threaded Fasteners: Machine bolts; steel nuts and washers, ASTM A194/A194M.

5. Select type, length, diameter, and embedment depth based on manufacturer's published maximum allowable working loads and application limitations.
- E. Expansion Anchors for Solid Concrete and Solid Concrete Masonry: UL listed; one-piece stud or bolt that has integral expansion wedges, nuts and washers, to be placed in pre-drilled hole.
 1. Stud/Bolt: Stainless steel, TP304.
 2. Nut and Washer: Stainless steel, TP304.
 3. Select type, length, diameter, and embedment depth based on manufacturer's published maximum allowable working loads and application limitations.
- F. Drilled-In Adhesive Anchors: Anchor rod assembly and anchor rod adhesive cartridge to be placed in pre-drilled hole.
 1. Do not use to anchor overhead hung supports.
 2. Anchor Rod Assembly: Chamfered and threaded stud rod of zinc plated steel, ASTM A36/A36M with nut and washer of ASTM A194/A194M alloy-steel.
 3. Adhesive Cartridge: Sealed capsule containing premeasured amount of resin, quartz sand aggregate, and hardener contained in separate vial within capsule; activated by insertion procedure of anchor rod assembly.
 4. Select type, length, diameter, and embedment depth based on manufacturer's published maximum allowable working loads and application limitations.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install manufactured products in accordance with manufacturers' instructions.
- B. Install supports, hangers, guides, anchors, and fasteners as specified, as indicated on the drawings, in accordance with approved shop drawings, and as specified.
- C. Do not use any of the following anchor or fastener types:
 1. Impact expansion hammer drive type.
 2. Explosive charge drive type.
 3. Lead shields.
 4. Plastic or fiber inserts.
 5. Drilled-in plastic sleeve and nail drive systems.
- D. Do not use drilled-in adhesive anchors for overhead hung supports.
- E. Do not make holes in structural steel for hanger supports.

- F. Vibration Isolation: Prior to making piping connections to equipment with operating weights substantially different from installed weights, block up equipment with temporary shims to final height; when full load is applied, adjust isolators to load and remove shims.

3.2 THRUST BLOCKING FOR DIRECT-BURIED PIPING

- A. Provide thrust blocks, whether or not shown on the drawings.
 - 1. Place blocking between solid ground and fitting, so that fitting is securely anchored but with fitting joints accessible for repair.
 - 2. For vertical down bends, use steel rods and clamps, hot-dipped galvanized or coated with bituminous paint, to anchor into gravity thrust blocks.
 - 3. Size the area of bearing as indicated or as directed.
- B. Concrete for Thrust Blocks:
 - 1. Mix: Not leaner than 1 part cement, 2.5 parts sand and 5 parts gravel.
 - 2. Compressive Strength: 2000 psi at 28 days.
- C. Pour base and thrust bearing sides against undisturbed earth; sides of thrust blocks not subject to thrusts may be poured against forms.

END OF SECTION

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SECTION 46 0550 - WASTEWATER SAMPLING SYSTEM

PART 1 GENERAL

1.1 SUMMARY

- A. Related Requirements:
 - 1. Section 40 7000 - Instrumentation.

1.2 SUBMITTALS

- A. Submittals shall include shop drawings and Operation and Maintenance Manuals.

PART 2 PRODUCTS

2.1 WASTE SAMPLING DEVICE

- A. Furnish and Install waste sampling devices, complete with sample and refrigerator, as shown on Drawings.
- B. Waste sampling device shall be of the electromechanical pump-type Isco Sampler-Refrigerator Combination Model 5800, Hach AS950, or approved equal. It shall contain a standard-type sampling unit with a pump and suction piping and capable of taking samples based on either time or flow proportioning. The unit shall be equipped with provision for discharging waste samples by gravity into the refrigerator below the sampling unit. The unit shall be suitable for corrosive environments and outdoor operation with an ambient temperature range of 110°F to -20°F.
- C. Controls:
 - 1. All controls for the sampler shall be mounted on the refrigerator. Control panel shall contain a key-lock and be side-hinged to provide for inspection.
- D. Sampler:
 - 1. The programming module shall be designed to automatically deliver samples on the basis of flow. Sampler shall be capable of proportioning a sample based on a 4-20 mA DC signal derived from a flowmeter. Provide a manual override sampling activator which does not alter preset cycling sequence. Provide panel light to indicate if unit is in operation and stage of sampling cycle.
 - 2. Samples shall be collected using a peristaltic pump typically producing a line velocity of 5.1 feet per second in a 1/4-inch I.D. suction line or 2.5 feet per second in a 3/8-inch I.D. suction line at three feet of head. The body of the peristaltic pump shall be made of high strength plastic for corrosion resistance. The pump shall be capable of producing at least 26 feet of lift.
 - 3. Liquid discharge spout shall be of a size capable of accepting standard 1" I.D. plastic transfer tubing and designed so as not to obstruct gravity flow of the discharged sample.

4. The sampler shall utilize a non-wetted detector to sense the presence of the liquid at the pump. The sensor shall not be dependent on, or affected by any compositional, chemical, or physical property of the liquid.
5. The materials in contact with the flow stream shall be limited to medical grade silicone rubber, vinyl, or Teflon, and stainless steel. The suction line shall be made of 3/8-inch I.D. vinyl with a length of 10 feet and shall have a weighted polypropylene strainer.

E. Refrigerator:

1. The refrigerator composite sampler shall be capable of collecting repeated sample increments and depositing them into a 5-1/2 gallon polyethylene sample container. The collected sample shall be stored in a refrigerated enclosure capable of maintaining a sample temperature of 39°F + 1.8°F (4°C + 1°C) in ambient temperatures from -20°F TO 120°F (-29°C TO 49°C).
2. The exterior and base of the refrigerator shall be constructed of fiberglass-reinforced plastic with a UV-resistant gel-coat. The interior of the refrigerator shall be food grade ABS plastic for easy cleaning and to inhibit bacterial growth. The refrigerator shall include 1-1/2 inches of rigid foamed-in-place insulation to aid in sample preservation. The refrigerator shall have a hinged, reinforced fiberglass plastic controller enclosure which is capable of being locked. The temperature control knob shall be located under this enclosure. The refrigerator's door shall also have hasps capable of accepting a padlock to prevent unauthorized tampering with the sample compartment contents. A magnetic gasket shall be used to seal the refrigerator door. The refrigerator power supply and solid state thermostat shall be contained in a sealed, NEMA 4 equivalent, aluminum enclosure inside the refrigerator base. All other exposed metal components shall be either anodized or irradiated (TM) aluminum, stainless steel, or galvanized steel.
3. The refrigerator shall be provided with an adjustable, weight-activated mechanism to automatically terminate sampling at a predetermined level; no contact with the sample liquid shall be acceptable in determining the shut-off level. An exterior indicator light shall be provided to indicate when the container is full.
4. Equip the refrigerator with a 5-1/2 gallon capacity, polyethylene sample container.
5. Power supply shall be 120-volt, 60-cycle, 4-amp, total load. Provide a 3-wire, 8' grounded cord and plug.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Contractor shall install the samplers in accordance with the manufacturer's written instructions.

END OF SECTION

SECTION 46 1010 - WASTEWATER PUMPS

PART 1 GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown on the Drawings, as specified herein, and as required to furnish and install complete wastewater pumping systems.
 - a. System components generally include pump, motor, piping connections, controls and all appurtenances required for a complete and operational system.

B. Related Sections:

1. Section 40 9200 - Process Control Descriptions.
2. Division 26 - Electrical.

1.2 REFERENCES

- A. American Iron and Steel Institute (AISI).
- B. American National Standards Institute (ANSI).
- C. National Electrical Manufacturers Association (NEMA).
- D. Virginia Department of Environmental Quality (VDEQ).
 1. Sewage Collection and Treatment Regulations.

1.3 SUBMITTALS

- A. ~~Section 01 3000 - Administrative Requirements:~~ Requirements for submittals.

McGill Section 013300
- B. Product Data: Submit manufacturer's product data for system materials and component equipment, including electrical characteristics and connection requirements.
- C. Shop Drawings:
 1. Indicate system materials and component equipment.
 2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.
 3. Pump performance data including pump characteristic curves, pump efficiency curves, and brake horsepower curves.
- D. Manufacturer's Certificate:
 1. Submit Certificate of Proper Use.

- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

- A. Section 01 7800 - Closeout Submittals: Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of equipment.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.
- D. Submit Certificate of Proper Installation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 7000 - Execution and Closeout Requirements: Requirements for maintenance materials.
- B. Spare Parts:
 - 1. Furnish the following spare parts, where applicable to pump type, for each pump model/size:
 - a. One set of mechanical seals for each pump model.
 - b. One cover plate O-ring.
 - c. One rotating assembly O-ring.
 - d. One set of impeller clearance adjustment shims.
 - e. One set of double row lower and single row upper ball bearings.
 - 2. Spare parts shall be packed in sturdy containers with identifying text. Protect spare parts from water and wet weather until transferred to the Owner at closeout.
- C. Tools: Furnish special wrenches and other devices required for Owner to maintain equipment components.

1.6 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section, regardless of component manufacture, from one single manufacturer.

2. The single manufacturer supplying the equipment required by this Section shall review and approve, or prepare, all Shop Drawings and other submittals for components required under this Section.
3. No equipment with less than 3 years of proven reliability shall be provided under this section. The manufacturer shall be capable of producing a list of 5 successful installations along with shop drawing, date of installation, contact person and contact number for each installation.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' verifiable experience.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. ~~Section 01 6000—Product Requirements:~~ Requirements for transporting, handling, storing, and protecting products.

McGill Section 011200
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept equipment on-Site in original packaging. Inspect for damage.
- D. Store equipment according to manufacturer's instructions.
- E. Protect equipment from water and wet weather.

1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

- A. ~~Section 01 7000—Execution and Closeout Requirements:~~ Requirements for warranties.

McGill Section 017700
- B. Furnish one-year manufacturer's warranty for complete pump system.

PART2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Manufacturer List:
 1. The basis of design for equipment in this Section is Hydromatic for submersible pumps and Flygt for dry pit submersible pumps.
 2. Pre-approved equipment manufacturers also include ABS, KSB, and Smith & Loveless.
 3. Additional manufacturers may be added to the pre-approved manufacturer's list by Addendum.

4. Substitutions: Section 01 6000 - Product Requirements.

- B. The naming of a manufacturer and model number is not an indication that the manufacturer's standard equipment offering is acceptable in lieu of the specified features. Naming of a manufacturer is instead an indication that the manufacturer may have the capability of providing the system as specified. Manufacturer shall make any necessary modifications to meet all the requirements of the Contract Documents.
- C. Dimensions and locations shown on the Drawings for the equipment and accessories in this section are based on the equipment named as the basis of design. Any change to dimensions or locations of equipment and accessories required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner.
- D. Any costs or modifications incurred by using equipment other than the basis of design, if any, including building construction, structural, piping, electrical, mechanical, plumbing and instrumentation systems, shall be made by the Contractor at no additional expense to the Owner.

2.2 COMMON PUMP REQUIREMENTS

- A. Pump manufacturers shall supply pumps as complete units including drivers. Assembly by the contractor of pumps, shafting, motors, and the like supplied by various independent manufacturers will not be allowed.
- B. The pump requirements, where applicable, shall be as scheduled on the Drawings.
- C. Pumps and motors shall be designed to operate continuously at the conditions shown on the pump schedule.
- D. Other motor requirements shall be as shown on the drawings and as specified in Division 26 - Electrical.
- E. Wastewater treatment process pumps shall be equipped with suction (non-submersible installations) and discharge pressure gages graduated in psi and feet of water for the operating range of the pump. Gages shall be protected by diaphragms.
- F. Furnish non-floating displacement type liquid level regulators, each provided with watertight electric cable necessary for proper pump operation as shown on the electric schematics.
- G. Lifting chains, slide rail mounting brackets, discharge pipe mounting brackets and hardware shall be constructed of galvanized steel.

2.3 NON-CLOG SUBMERSIBLE AND DRY PIT SUBMERSIBLE SEWAGE PUMPS

- A. Pump Construction
 - 1. The pumps shall be designed and constructed to pump sewage, storm water, heavy sludge, and other fibrous materials without injurious damage during operation. Lifting cover, stator housing, volute casing, and impeller shall be constructed of ASTM A48, Class 30 gray cast iron. The volute shall be of the center discharge design and shall be fitted with ANSI 125 lb. flanges and tested to hydraulic institute standards at 150% of shut-off

head. The interfaces between the major castings shall be machined and fitted with Buna-N O-rings. All nuts, bolts, washers, and other fastening devices coming into contact with the sewage shall be constructed of 316 stainless steel.

2. The A536 cast iron impeller shall be of Non-Clog design, double shrouded with a smooth, long thoroughfare having no acute angles. The wear ring system shall be constructed of Series 400 stainless steel with a Brinnell hardness of 200-310. The system shall provide efficient sealing between the volute and impeller.
 3. Each pump shall be provided with an enclosed block seal consisting of cartridge containing both the upper and lower sets of mechanical seal faces. Regular tandem mechanical seal running in an oil bath shall also be acceptable provided the designs utilize AL stainless steel springs, mounting hardware, and seal face retention components. The seal face housing and spring system shall be constructed of 316 stainless steel. Both sets of faces (both upper and lower sets) shall be silicon carbide. Conventional double mechanical seals with a spring assembly between the rotating faces, requiring constant differential pressure to effect sealing and subject to penetration and opening by pumping forces shall not be considered equal to the enclosed block seal design or the tandem seal specified. Seal designs that use springs or housing materials other than Type 316 stainless shall not be provided or accepted. Seal face materials other than silicon carbide shall not be accepted.
 4. The pump and motor shaft shall be of series 400 stainless steel with a Brinnell hardness of 200. The shaft shall be designed such that the diameter of the shaft where it passes through the lower seal shall be adequate to limit shaft deflection due to axial and radial thrust loads to 0.16 mm. The shaft shall not extend more than 2-1/2 times its diameter below the nearest support bearing and shall be supported by double row lower and single row upper ball bearings with a B-10 life of 50,000 hours minimum at any point on the flow versus head curve.
- B. The pump motor shall be integral to the pump. The squirrel cage induction type motor shall be utilize Class F insulation, NEMA B inverter duty rated design, Class H slot liners with a service factor of 1.25. The dual voltage copper wound stator, which will allow field changeability of voltage, shall withstand a heat rise to 155°C as defined in NEMA standard MG-1. The NEMA starting code shall be G or less. The rotor shall be constructed of laminated steel plates with poured aluminum shorting bars. The rotor shall be both statically and dynamically balanced. All castings shall be machine fit utilizing metal to metal contact. All machine fits shall be additionally protected with Buna-N O-rings. Motors utilizing jackets to be cooled by passage of the pumped fluid (sewage) shall not be permitted. Motors shall have thermal sensors for overload protection built into motor casing.
1. The motor power cable shall consist of the SJO type insulated cable with a double jacketed protection system, neoprene outside, synthetic rubber inside, exceeding industry standards for oil, gas, and sewage resistance. Individual conductors shall be of the Type RUW.
 2. The power cable will enter the pump through a vellums type cable entry constructed of cast iron alloy metal and galvanized for corrosion resistance. The heavy duty cable entry with strain relief shall be provided with an integral rubber grommet to protect against

leakage once the cable is secured. The power cable leads shall be connected to terminals on an isolated terminal board. The terminal board shall be connected to terminals on an isolated terminal board. The terminal board shall be constructed of Bake-O-Lite and will include individually O-ringed brass lugs on both upper and lower side of the terminal board. The terminal board shall be totally isolated from the motor using Buna-N O-rings fitted to the terminal board and mating with the machined terminal board housing in the motor. This system will prevent moisture from entering the motor should leakage occur through the cable entry. Motors shall be equipped with moisture sensors to stop pump operation if moisture is detected in the seal cavity.

- C. The following minimum spare parts shall be furnished with each set of pumps:
 - 1. One spare pump mechanical seal cartridge.
 - 2. One cover plate O-Ring.
 - 3. One rotating assembly O-ring.
 - 4. One set of impeller clearance adjustment shims.
 - 5. One set of double row lower and single row upper ball bearings.
- D. The pump manufacturer shall warrant the pumping equipment to be supplied to the Owner for a period of one year from date of substantial completion. The warranty shall be non-prorated and cover 100% of the cost of parts and labor, including wearing parts and freight.

2.4 GRIT SLURRY PUMPS

- A. The requirements for non-clog dry-pit submersibles shall apply to grit slurry pumps except as superceded in this paragraph.
- B. The shaft shall be solid stainless steel through the mechanical seal.
- C. Pump shall be of Ni-Hard construction with Ni-Hard impeller.
- D. Impellers shall be vortex type.

PART 3 EXECUTION

3.1 EXAMINATION

- A. Section 01 7000 - Execution ~~and Closeout Requirements~~: Requirements for installation examination.
- B. Verify that equipment is ready for installation.

3.2 INSTALLATION

- A. Install equipment according to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 7000 - Execution ~~and Closeout Requirements~~: Requirements for testing, adjusting, and balancing.
- B. Manufacturer Services: Furnish services of manufacturer's representative experienced in installation of products furnished under this Section for not less than two days on-Site for installation, inspection, field testing, and instructing Owner's personnel in maintenance of equipment.
 - 1. One representative for each pump manufacturer shall be required as above.

3.4 TESTING

- A. Commercial testing shall be required and include the following:
 - 1. The pump shall be visually inspected to confirm that it is built in accordance with the specification as to hp, voltage, phase and hertz.
 - 2. The motor seal and housing chambers shall be meggered for infinity to test for moisture content or insulation defects.
 - 3. Pump shall be allowed to run dry to check for proper rotation.
 - 4. Discharge piping shall be attached, the pump submerged in water and amp readings shall be taken in each leg to check for an imbalanced stator winding. If there is a significant difference in readings, the stator windings shall be checked with a bridge to determine if an unbalanced resistance exists. If so, the stator shall be replaced.
 - 5. The pump shall be removed from the water, meggered again, dried and the motor housing filled with oil.
- B. A non-witnessed hydraulic institute performance test shall be performed for pumps with motors rated at 20 or more horsepower. This shall include the following:
 - 1. The pump shall be tested at the design point as well as at least 4 other points to develop a curve. Data shall be collected to plot the head-capacity curve as well as a kW input and amperage curve.
 - 2. In making these tests, no minus tolerance or margin shall be allowed with respect to capacity, total head or efficiency at the specified design condition. Pump shall be held within a tolerance of 10% of rated capacity or at rated capacity with a tolerance of 5% of rated head. The pump shall be tested at shut-off, but not be plotted, and only used as a reference point when plotting the performance curve.
 - 3. Complete records shall be kept of all information relevant to the test, as well as the manufacturer's serial number, type and size of pump, as well as any impeller modifications made to meet the design conditions.
 - 4. A written test report shall be prepared, signed and dated by the test engineer incorporating 3 curves (head-capacity, kW input, and amperage) along with the pump serial number, test number, date, speed, volts, phase, impeller diameter, and certification number. This report shall then be submitted to the Engineer.

3.5 DEMONSTRATION

- A. Section 01 7900 - Demonstration and Training: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

SECTION 46 2020 - MECHANICALLY CLEANED BAR SCREEN

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Contractor shall furnish all labor, equipment, materials, tools, and incidental items required to install and place into proper operation one (1) mechanically cleaned bar screen(s) and one (1) screenings washer/compactor(s) specified in Section xxx. All equipment shall be installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, state, and federal codes and regulations.
- B. Each screen shall be furnished complete with bar rack, dead plate, discharge chute, side frames, covers, rake blades, drive chains, sprockets and bearings, scraper assembly, drive motor, gear reducer, anchor bolts, controls for operation of the screen and associated screenings washer/compactor and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.
- C. Screen(s), Washer/compactor(s) and Controls shall be supplied by a single manufacturer to ensure compatibility and proper operation of the system.
- D. Contractor shall be responsible for coordination of all related parts of the work. The contractor shall verify all structures, piping, wiring, and components are compatible. Contractor shall be responsible for all structural and other alterations required to accommodate equipment differing in dimensions or other characteristics from these specifications and drawings.
- E. All equipment to be installed shall be rated for Class I, Division 1, Hazardous locations. Equipment main control panel will be located in a non-classified indoor area.

1.2 RELATED SECTIONS

- A. ~~Section 01 3000 – Administrative Requirements: Submittals~~

McGill Section 013300
- B. Section 03 3000 – Cast-in-Place Concrete
- C. Section 05 5010 – Miscellaneous Metal
- D. Section 09 9110 – Painting
- E. Division 16 – Electrical
- F. Section 46 0103 – Startup and Commissioning Procedures: Equipment Installation Inspection and Start Up
- G. Section 46 0106 – Operation and Maintenance Manuals
- H. Section 462025 – Screenings Washer/Compactor

1.3 SUBMITTALS

- A. Provide shop drawings and product data in accordance with ~~section 01-3000~~ for the equipment being furnished, to include at minimum the following:
1. Certified shop drawings showing the details of construction, dimensions and anchor bolt requirements.
 2. Complete wiring diagrams detailing all required field connections.
 3. Descriptive literature, brochures, and/or catalogs of submitted equipment.
 4. Headloss calculations showing the ability of the screen to meet the flow and headloss requirements as specified in Table 2.2.B.
 5. Complete bill of materials for the equipment.
 6. List of Manufacturer's supplied spare parts.
 7. Manufacturer's ISO 9001:2015 certificate of registration
 8. Equipment weights.
 9. A copy of Manufacturer's 3-year factory warranty.
- B. The manufacturer shall furnish operation and maintenance manuals in accordance with the requirements of section 46 0106 – Operation and Maintenance Manuals, to include at minimum the following:
1. Short and long term storage requirements.
 2. Manufacturers unloading instructions.
 3. Manufacturer's installation instructions
 4. Equipment weights and lifting points.
 5. Complete wiring diagrams detailing all required field connections.
 6. Assembly drawings
 7. Maintenance schedule
 8. Maintenance instructions

1.4 REFERENCE STANDARDS

- A. American Iron and Steel Institute (AISI).
- B. American National Standards Institute (ANSI).
- C. American Society for Testing Materials (ASTM).
- D. American Bearing Manufacturers Association (ABMA).

- E. American Gear Manufacturers Association (AGMA).
- F. National Electrical Manufacturers Association (NEMA).
- G. Underwriters Laboratory (UL).

1.5 QUALITY ASSURANCE

- A. Qualifications: Qualified Manufacturers shall have a minimum 15 years' experience manufacturing screens, with no fewer than 20 operating installations of the type specified herein located in the USA. Manufacturer shall provide a list of 20 names and dates of installations for verification by the Engineer or Owner's Representative.
- B. A single manufacturer shall provide all components including but not limited to the screen, motors, gear reducers and control panels as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.
- C. Screen shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions. Equipment manufactured outside the United States, or by third parties, shall not be permitted for this project. The equipment manufacturer shall supply a certificate of origin and letter of compliance confirming both requirements.
- D. All welding shall be performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code.
- E. Screen shall undergo a passivation process to ensure maximum resistance to corrosion. All stainless steel surfaces shall be thoroughly cleaned and glass bead-blasted to a minimum SSPC-SP-6 finish. The use of nitric and hydrofluoric acid passivation is not acceptable due to the negative impact these chemicals have on the environment.
- F. Manufacturer shall warranty all equipment against faulty or inadequate design, improper assembly, defective workmanship or materials. Materials shall be suitable for the service conditions.
- G. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. The fabrication shall be performed by the equipment manufacturer at the manufacturer's facility located within the continental USA; all welding and assembly shall be performed by direct employees of the manufacturer; each welder shall be certified in accordance with AWS or ASME. Welder certificates shall be provided to the Engineer upon request.
- H. All structural members of the equipment shall be designed for shock and vibratory loads. Additionally, the screen shall be designed to withstand the forces generated by maximum operating head without damage to the screen or its components.
- I. Each screen shall have the Manufacturer's name, address, and product identification information on a corrosion resistant nameplate securely affixed to the equipment.

- J. Screen manufacturer shall be ISO 9001:2015 certified and provide the Engineer with a copy of a valid certificate of registration. Equipment suppliers not utilizing ISO 9001 manufacturing facilities shall not be considered or approved for this project.
- K. All control panels shall be fabricated and tested in the manufacturer's UL Authorized control panel shop. The equipment manufacturer shall supply a certificate of conformance confirming this requirement.

1.6 WARRANTY

- A. The equipment shall be warranted by the manufacturer for a period of three (3) years from the date of shipment. Additionally, the lower sprocket bearings shall include a (5) year warranty period from the date of shipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Shipping
 - 1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
 - 2. Pack spare parts in containers bearing labels clearly designating contents and equipment for which they are intended.
- B. Receiving and Storage:
 - 1. Store and safeguard equipment, material, and spare parts. All spare parts must be stored in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Screen shall be in compliance with these specifications and plans and shall be supplied by the following manufacturer:
 - 1. Kusters Water, ProTechtor® Multirake Screen (Model MRS-C)
 - 2. Pre-Approved equal
 - 3. Any request for pre-approval must be submitted at least 21 calendar days prior to the bid date. Pre-Approved equals must meet these specifications without exception. The pre-approval information shall include a copy of this specification with a line by line check confirming 100% compliance with every item, a letter of compliance signed by a corporate officer for section 1.5, and customer references for no fewer than 10 installations which shall include:
 - a. Jobsite address
 - b. Customer name
 - c. Customer phone number

- d. Customer email address
 - e. Date of installation
 - f. Peak flow capacity for each screen
 - g. Bar spacing
 - h. Headloss calculations at peak flow
4. Suppliers not meeting the experience clause identified in section 1.5.A shall provide a performance and payment bond for 100% of the contract amount. The bond shall be issued by a surety with an FSR rating of no less than "A". A letter of surety shall be provided with the pre-approval to confirm bondability. The owner and/or engineer reserves the right to reject any manufacturer should insufficient or incomplete data be provided to determine an approved equal manufacturer status.

2.2 BAR SCREEN UNITS

A. GENERAL DESIGN REQUIREMENTS

1. The mechanically cleaned bar screen shall be a self-contained screening system designed to positively clean and remove debris from the influent flow stream and transport the retained debris to the discharge point. The screen system shall be fully automated and controlled by the manufacturer supplied control system.
2. The bar rack shall extend from the invert of the channel to a minimum of 12" above the maximum water level where it shall be connected to the screen dead plate on which the screenings will be transported to the discharge apex. The screenings will then be carried into the discharge chute by a passive reciprocating scraper.
3. The screenings shall be mechanically cleaned from the bar rack by a series of engaging rakes carried by two (2) endless roller chains mounted on each side of the screen. The screen frame superstructure shall be constructed such that it forms a strong and rigid internal structure that spans the width of the chamber.
4. The chains shall run over stainless steel drive sprockets keyed to a main, solid, stainless steel drive shaft which shall be mounted in externally mounted bearings and driven by a shaft mounted motor-driven gear unit.
5. The Contractor shall be required to make any necessary modifications to the existing concrete channel walls and floor, and to the operating floor curb, to accommodate the equipment furnished. The manufacturer shall ensure the manufacturer furnished seals at the channel walls and floor are properly mounted to redirect influent flow into the bar rack and prevent screenings from passing between the concrete walls and screen side frames.

B. DESIGN CRITERIA

Maximum Flow:	6.0 MGD

Channel Width:	2.5 ft.
Channel Depth:	4.16 ft.
Bar Spacing:	12 mm
Downstream Water Level at Maximum Flow:	1.5 ft.
Headloss at Maximum Flow:	2.01 in.
Headloss at Maximum Flow and 30% Blinding:	4.42 in.
Maximum Upstream Water Level:	1.87 ft.
Channel Invert to Operating Floor Depth:	33.50 ft.
Screen Discharge Height:	4.0 ft.
Screen Incline from Horizontal:	90 degrees
Screen Motor Horsepower:	Minimum 3 HP
Rake Speed:	15 - 30 ft/min.
Side Frame Material / Thickness:	304 Stainless Steel/3/16 in.
Roller Track Material / Thickness:	304 Stainless Steel/3/16 in.
Sprocket/Guide Material:	304 Stainless Steel
Chain material:	304 Stainless Steel
Bar Material:	304 Stainless Steel
Bar Dimensions:	8 mm x 4 mm x 40 mm
Fastener Material:	304 Stainless Steel
Operational Environment:	Class I, Div. I
Operational Voltage:	460V/3ph/60Hz
Control Panel NEMA Rating:	NEMA 4X, Stainless Steel
Local Station NEMA Rating:	NEMA 7, Cast Aluminum

C. PERFORMANCE AND DESIGN REQUIREMENTS

1. Each screen shall be capable of processing the specified peak flow of municipal wastewater with the specified amount of freeboard when installed in the channel at a screen inclination as noted in Table 2.2.B. The screen shall lift and discharge screenings at an elevation as specified in Table 2.2.B into the discharge chute without use of brushes or spray washes.
2. The maximum upstream water level shall not exceed that specified in Table 2.2.B. The screen shall be capable of processing the peak flow without exceeding the maximum upstream water level based on a 30% reduction (blinding) of the screens free open area.
3. The travel speed of the cleaning rakes shall be as specified in Table 2.2.B. The bar rack must be continually cleaned by the travelling rakes with an elapsed time between cleaning of 5 -10 seconds.
4. All parts shall be designed and manufactured so the screen structure and bar rack can withstand the hydraulic force exerted by the maximum water depth. All structural and

functional parts shall be adequately sized to prevent deflection and vibration which could impair raking operation.

5. All components shall be so designed that jamming at any point will not result in structural failure but will cause the drive motor to stall. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor and/or the maximum differential head at any water depth.

D. SCREEN COMPONENTS

1. Screen Frame Assembly

- a. The screen frame shall be provided and designed to support all required static and dynamic loads.
- b. Screen frame side plates shall be made of the material and thickness specified in Table 2.2.B.
- c. The side plates shall be connected with each other through u-channel and angle support members made of minimum 3/16" thick material.
- d. Each side frame shall include a separate chain guard/roller track to guide the rake chains. The roller tracks must support both the upstream and downstream chain lengths and be bolted to the side frames so they can be easily replaced. The roller tracks shall be made of material as specified in Table 2.2.B.
- e. Neoprene sealing strips shall be fastened to the side frames to seal the lateral gaps between the side frames and the channel walls.

2. Bar Rack

- a. The bar rack shall consist of equally spaced, vertically aligned trapezoidal bars, inclined at the angle specified. The bars shall be spaced and of the material and thickness as specified in Table 2.2.B.
- b. The bars shall be located by a positive retaining plate at the top and bottom of the bar rack. The retaining plates will guarantee the specified bar spacing. The bars must be bolted and singularly replaceable without any welding, cutting, or further disassembly of the bar rack.
- c. The lower portion of the bar rack shall be curved to optimize the bar rack flow area. The curve of the bars shall match the path of screen rakes such that the rakes positively remove all captured screenings.
- d. A curved lower plate in lieu of curved bars shall not be accepted.

3. Dead Plate

- a. The dead plate will extend fully from the bar rack to the discharge point of the screen. The dead plate shall be made using minimum 3/16" thick material as specified.

- b. The dead plate shall be properly stiffened by structural members to ensure it remains flat and true such that the clearance between the dead plate and the rake teeth is a maximum of 1/8".
- 4. Chains
 - a. Drive chains for the rakes shall be roller type chains manufactured using the material specified in Table 2.2.B. Each chain shall have a minimum breaking load of 20,000 lbf. Chain rollers and pins shall be made of material specified in Table 2.2.B.
 - b. Chain with non-stainless steel components will not be accepted.
 - c. The drive chains shall not require lubrication.
 - d. The use of non-roller chain shall not be acceptable.
 - e. The chain shall be guided by the guide tracks mounted on each side frame.
- 5. Upper Bearings and Drive Sprockets
 - a. The screen shall be provided with upper drive sprockets with 8 teeth and a nominal pitch diameter of 13". The sprockets shall have a minimum plate thickness of 1".
 - b. Sprockets shall be fabricated from material as specified in Table 2.2.B.
 - c. The drive shaft shall be supported on each side by an externally mounted, grease lubricated bearings.
 - d. Upper bearings shall be ball bearings, greased, and protected by double seals. The bearing diameter shall be a minimum of 2-3/4" and mounted in oil-resistant, enamel coated casings supported by a stainless steel take-up frame.
- 6. Lower Chain Guides
 - a. The screen shall be provided with lower revolving sprockets/guides with 8 teeth and a nominal pitch diameter of 13". The sprockets shall have a minimum plate thickness of 1".
 - b. The lower revolving sprocket/guide bearings shall consist of a life sealed bushing system. The system shall consist of a stainless steel stub shaft supporting a ceramic sleeve. The ceramic collar will interface with a high lubricity, low friction composite bushing surface to ensure zero metal to metal contact. This composite bushing must be designed for extreme wear life in highly abrasive, high impact environments. Lower bushings that require any maintenance or have metal to metal wear shall not be accepted.
 - c. Machined lower guides shall be provided for each chain.
 - d. Each guide shall include a fixed circular stainless steel disc, no less than 23 mm in thickness and 275 mm in diameter.

- e. All materials of construction shall be as specified in Table 2.2.B.
- f. The guide assembly shall be maintenance free, lubrication free and bolted to the main frame assembly. Welding of the guide to the frame is not permitted.
- g. UHMW or plastic guides are not acceptable materials of construction.

7. Screen Rakes

- a. Rakes shall be designed to lift screenings collected on the bar screen and in the openings between the bars the entire length of the screen to the discharge point. To ensure screenings removal, the rakes must project a minimum of 3/8" into the bar field.
- b. Rake frames shall be made of minimum 3/16" thick channel having a cross section of 4 1/4" by 2 3/8". Frame material shall be stainless steel.
- c. Rake blades shall be made using minimum combined thickness 1/2" stainless steel plates with a minimum width of 6 1/4". Rake blades shall be laser cut to provide a precision tooth profile that matches and engages the bars of the bar rack.

8. Discharge Chute

- a. A discharge chute shall be provided that fully encloses the discharge section of the screen. The discharge chute shall be made of minimum 3/16" thick stainless steel plate.
- b. The height of the discharge chute shall be as specified in Table 2.2.B and shall allow proper discharge into the screenings receptacle.

9. Scraper Mechanism

- a. A pivoting scraper mechanism shall be provided to clean each rake of collected screenings as it passes and deposit the screenings in the discharge chute without requiring any manual cleaning of the scraper mechanism.
- b. The scraper must be aligned so that no screenings are allowed to carry over and fall back into the flow on the downstream side of the screen.
- c. The scraper frame shall be made of stainless steel and be mounted on a pivot attached to the side frames. The frame shall be fitted with a replaceable UHMWPE scraper blade.
- d. The scraper shall be designed to follow the rotational path of the rakes and return to the resting position with minimal shock.
- e. Scrapers that require a spring or other mechanical damper will not be permitted.
- f. The scraper mechanism shall be mounted integral to the chain take up plates so that when the chain tension is adjusted via the take up assemblies, the wiper mechanism position will move automatically to maintain its adjustment with the rakes. Take up

designs which require chain tensioning and then a second step to re-adjust the wiper contact point shall not be permitted.

10. Guards and Covers

- a. The portion of the screen above the operating floor level shall be provided with easily removable, properly stiffened stainless steel covers.
- b. The covers shall fully enclose the screen to provide safety and to contain odors. The covers will allow ready access for maintenance to the equipment.
- c. The covers shall be removable to facilitate visual observation by maintenance personnel when required.

11. Drive Assembly

- a. The screen shall be driven by a heavy-duty, shaft-mounted helical worm gear reducer. The gear reducer shall be sized to provide the proper input power and torque to operate the screen and be rated for greater than the nominal horsepower of the drive motor.
- b. The gear reducer shall be capable of providing a rake travel speed as specified in Table 2.2.B during continuous operation.
- c. The gear reducer shall be driven by an inverter duty electric motor. The motor shall be UL rated for the operational environment as specified in Table 2.2.B. The motor shall be rated for a minimum horsepower and voltage as specified in Table 2.2.B, with a minimum service factor of 1.0.
- d. The drive unit shall be affixed with a rotating torque arm connected to a forward and reverse over-torque device. The device shall consist of a spring loaded carrier that is attached to the rotating torque arm and a stationary point on the screen frame. During normal operation the torque device will maintain standard operating position. If any screen rake experiences a jam, the force will cause the torque arm to rotate with the drive shaft, compressing one of the torque tension springs. This motion will cause activation of a proximity sensor which will signal the control system to initiate the clearing mode. If the clearing mode proves unsuccessful then the system shall initiate an alarm signal and lockout the screen unit.
- e. Overload protection systems activated solely by current-sensing detection systems will not be permitted.
- f. Torque monitoring devices that do not monitor both forward and reverse over-torque will not be permitted.
- g. Screens that do not offer an automatic reversing feature shall not be permitted.

2.3 CONTROLS AND INSTRUMENTATION

A. GENERAL

1. Each control panel shall be the supplier's standard UL listed enclosure and wired for the voltage as specified in Table 2.2.B. The enclosure shall be furnished completely pre-wired and tested, requiring only mounting and connection to field mounted electrical devices. The control panel shall include all equipment required to control the equipment specified herein and the washer/compactor specified in Section 11xxx.
2. The control panel enclosure shall be as specified in Table 2.2.B and suitable for wall mounting. The enclosure shall house all control devices required for a complete and operable system. All hinges and latches shall be corrosion resistant.
3. A separate local control station in an enclosure as specified in Table 2.2.B shall be provided. The local control station shall include an emergency stop, red, mushroom head pushbutton, Hand/Off/Auto switches and all other operators as required for proper operation of the equipment specified.

B. CONTROL DEVICES

1. Main power fusible disconnect switch with through door lockable handle.
2. Pilot devices shall be mounted on the front of the enclosure door.
3. Indicator lights shall be LED type.
4. Selector switches shall be heavy duty NEMA type.
5. Control transformer shall be protected by two (2) primary fuses and one (1) secondary circuit breaker. The 120-volt secondary shall have one leg grounded.
6. Auxiliary relay contacts shall be included for signal outputs. The contacts shall be rated 10 amp, 240 VAC, resistive load.

C. SAFETY FEATURES

1. If a power failure occurs while the equipment is running, operation shall resume when power is restored.
2. If a power failure occurs while the equipment is in a fault condition, the fault indicator shall reactivate when power is restored.
3. Short-circuit protection requires that a properly sized circuit breaker be provided by the Electrical Contractor.
4. Control reset shall be from the main control panel only.

D. COMPONENTS

1. Controller
 - a. Allen Bradley MicroLogix 1400 PLC.
 - b. Allen-Bradley PanelView 800, 7" color flat panel touch screen.

2. Operation Controls
 - a. Control Power: OFF/ON switch
 - b. Alarm reset: Pushbutton
 - c. Emergency Stop: Push to stop, pull to run pushbutton
 3. Indicator Lights
 - a. Control power on: White pilot light
 4. Dry Contacts
 - a. Screen In-Auto
 - b. Screen Running
 - c. Screen Fault
 - d. High Level
 - e. E-Stop
- E. Local Station
1. Screen
 - a. Screen: HAND/OFF/AUTO selector switch
 - b. Screen: REVERSE/OFF/FORWARD selector switch
 - c. Screen: FAST/SLOW selector switch
 - d. Emergency Stop: Push to stop, pull to run pushbutton
- F. FIELD MOUNTED DEVICES
1. Level Control
 - a. Two (2) Siemens Sitrans LU Ultrasonic level controllers and Mounts
 - b. One (1) Siemens HydroRanger 200 level controller with Two (2) ultrasonic Level transducers and Mounts
 - c. Two (2) Siemens Micropilot FMR20 Radar level controllers and Mounts
 - d. One (1) High level alarm float switch
- G. OPERATION
1. When in Automatic mode, the screen shall be started by the level sensors, a high water level float switch, or a screen idle timer.

2. Screen operation shall begin in slow speed when the level sensors detect a start differential water level. The screen will continue to run until the differential drops below the start differential. Once below this level the screen will continue to run for the duration set in its off-delay timer and then stop.
 - a. If the water differential continues to increase while the screen is running the screen will increase to high speed operation. The screen will continue to run in high speed until the water differential decreases to the slow speed (start) differential level. The screen will then decelerate to slow speed until the differential is below the start differential. Once below this level the screen will continue to run for the duration set in its off-delay timer and then stop.
3. If the high level float switch starts the screen, the screen will start in high speed and an alarm signal will be sent by the control system. The screen will continue to run in high speed until the float switch no longer detects a level. Once below this level the screen will continue to run for the duration set in its off-delay timer and then stop.
4. If the screen has not been started by a differential or float signal and the screen idle timer elapses, the screen will start in slow speed and run for the duration set in its off-delay timer and then stop.
5. If the over-torque sensor for the screen is activated during screen operation, indicating a jam, the screen will reverse in an attempt to clear the jam. The screen will reverse for a set period of time, then run forward again. If the jam has been cleared, the screen will return to normal operation. If the jam still exists, the screen will make additional attempts to clear the jam, (3 attempts, maximum). If the jam is not cleared after the final attempt, the screen will stop, and an alarm signal will be sent by the control system.
 - a. A jam (over-torque) condition in HAND mode immediately stops the screen and the control system will send an alarm signal.

2.4 SOURCE QUALITY CONTROL

- A. Screen system and control panel shall be factory assembled and tested to ensure proper design and satisfactory operation. Equipment shall be shipped in the minimal practical number of pieces for minimal field assembly by the Contractor.

2.5 SHOP PAINTING

- A. Stainless steel and other corrosion-resistant surfaces shall not be painted. Gearboxes, Motors, and other manufactured components will receive the manufacturer's standard weather and corrosion-resistant coating.

2.6 SPARE PARTS

- A. The following spare parts shall be provided:
 1. Two (2) Replacement rake blades
 2. Two (2) Replacement bolt-in screen bars

3. One (1) UHMW Scraper blade
4. Three (3) Fuses of each size and type used in the control panel

PART 3 EXECUTION

3.1 INSTALLATION AND TESTING

- A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of any significant deviations.
- B. Installation of the equipment shall be in strict accordance with the contract documents and the Manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the Manufacturer's recommendations.
- C. Supplier shall furnish the services of a factory-trained Service Engineer for two (2) trips. One (1) trip of one (1) day for installation inspection services. One (1) trip of two (2) days for start-up, commissioning, and to provide operator training.
 1. Equipment shall not be energized, or "bumped", to check the electrical connection for motor rotation without installation inspection and the Service Engineer present.
 2. The Service Engineer shall make all necessary adjustments and settings to the controls.
 3. The Service Engineer shall demonstrate proper and sequential operation of the screen. The screen shall be operated in both Automatic and Hand mode by the Service Engineer during the start-up and commissioning to demonstrate proper operation of the screen system.
 4. The screen must undergo a full scale site test during which the screen will be subjected to the maximum differential head condition.
 - a. This test will consist of fully blinding the front of the screen using plywood and plastic sheeting to allow for the maximum differential head level to be built on the front face of the screen.
 - b. Should the screen fail this test, for example there is bending, bowing, buckling or other significant signs of mechanical damage, then the screen shall be repaired or replaced at the manufacturer's cost.

END OF SECTION

SECTION 46 2025 - SCREENINGS WASHER/COMPACTOR

PART 1 GENERAL

1.1 SCOPE OF WORK

- A. Contractor shall furnish all labor, equipment, materials, tools, and incidental items required to install and place into proper operation one (1) screenings washer/compactor(s) and one (1) mechanically cleaned bar screen(s) specified in Section 46 2020. All equipment shall be installed as shown on the plans, as recommended by the supplier, and in compliance with all OSHA, local, state, and federal codes and regulations.
- B. Each washer/compactor shall be furnished complete with inlet hopper, discharge pipe, shafted screw, drive motor, gear reducer, anchor bolts, controls for operation of the washer/compactor and all accessories and appurtenances specified or otherwise required for a complete and properly operating installation.
- C. Washer/compactor(s), Screen(s) and Controls shall be supplied by a single manufacturer to ensure compatibility and proper operation of the system.
- D. Contractor shall be responsible for coordination of all related parts of the work. Contractor shall verify all structures, piping, wiring, and components are compatible. Contractor shall be responsible for all structural and other alterations required to accommodate equipment differing in dimensions or other characteristics from these specifications and drawings.
- E. All equipment to be installed and shall be rated for Class I, Division 1, Hazardous locations. Equipment main control panel will be located in a non-classified indoor area.

1.2 RELATED SECTIONS

- A. ~~Section 01 3000 – Administrative Requirements: Submittals~~
McGill Section 013300
- B. Section 03 3000 – Cast-in-Place Concrete
- C. Section 05 5010 – Miscellaneous Metal
- D. Section 09 9110 – Painting
- E. Division 16 – Electrical
- F. Section 46 0103 – Startup and Commissioning Procedures: Equipment Installation Inspection and Start Up
- G. Section 46 0106 – Operation and Maintenance Manuals
- H. Section 46 2020 - Mechanically Cleaned Bar Screen

1.3 SUBMITTALS

- A. Provide shop drawings and product data in accordance with ~~Section 01 3000~~ for the equipment being furnished and Section 46 0500 for submittal procedures, to include at minimum the following:

McGill Section 013300

1. Certified shop drawings showing the details of construction, dimensions and anchor bolt requirements.
 2. Complete wiring diagrams detailing all required field connections.
 3. Descriptive literature, brochures, and/or catalogs of submitted equipment.
 4. Complete bill of materials for the equipment.
 5. List of Manufacturer's supplied spare parts.
 6. Manufacturer's ISO 9001:2015 certificate of registration
 7. Equipment weights.
 8. A copy of Manufacturer's 3-year factory warranty.
- B. The manufacturer shall furnish operation and maintenance manuals in accordance with the requirements of section 46 0106 – Operation and Maintenance Manuals, to include at minimum the following:
1. Short and long term storage requirements.
 2. Manufacturers unloading instructions.
 3. Manufacturer's installation instructions
 4. Equipment weights and lifting points.
 5. Complete wiring diagrams detailing all required field connections.
 6. Assembly drawings
 7. Maintenance schedule
 8. Maintenance instructions

1.4 REFERENCE STANDARDS

- A. American Iron and Steel Institute (AISI).
- B. American National Standards Institute (ANSI).
- C. American Society for Testing Materials (ASTM).
- D. American Bearing Manufacturers Association (ABMA).
- E. American Gear Manufacturers Association (AGMA).
- F. National Electrical Manufacturers Association (NEMA).
- G. Underwriters Laboratory (UL).

1.5 QUALITY ASSURANCE

- A. Qualifications: Qualified Manufacturers shall have a minimum 15 years' experience manufacturing screenings washer/compactors, with no fewer than 100 operating installations of the type specified herein located in the USA. Manufacturer shall provide a list of 25 names and dates of installations for verification by the Engineer or Owner's Representative.
- B. A single manufacturer shall provide all components including but not limited to the motors, gear reducers, inlet hopper and control panels as a complete integrated package to ensure proper coordination, compatibility, and operation of the system.
- C. Washer/compactor shall be Manufacturer's standard product and only modified as necessary to comply with the drawings, specifications, and specified service conditions. Equipment manufactured outside the United States, or by third parties, shall not be permitted for this project. The equipment manufacturer shall supply a certificate of origin and letter of compliance confirming both requirements.
- D. All welding shall be performed in accordance with American Welding Society (AWS) D1.1 Structural Welding Code.
- E. Washer/compactor shall undergo a passivation process to ensure maximum resistance to corrosion. All stainless steel surfaces shall be thoroughly cleaned and glass bead-blasted to a minimum SSPC-SP-6 finish. The use of nitric and hydrofluoric acid passivation is not acceptable due to the negative impact these chemicals have on the environment.
- F. Manufacturer shall warranty all equipment against faulty or inadequate design, improper assembly, defective workmanship or materials. Materials shall be suitable for the service conditions.
- G. All equipment shall be designed, fabricated, and assembled in accordance with recognized and acceptable engineering and shop practices. The fabrication shall be performed by the equipment manufacturer at the manufacturer's facility located within the continental USA; all welding and assembly shall be performed by direct employees of the manufacturer; each welder shall be certified in accordance with AWS or ASME. Welder certificates shall be provided to the Engineer upon request.
- H. All structural members of the equipment shall be designed for shock and vibratory loads.
- I. Each washer/compactor shall have the Manufacturer's name, address, and product identification information on a corrosion resistant nameplate securely affixed to the equipment.
- J. Washer/compactor manufacturer shall be ISO 9001:2015 certified and provide the Engineer with a copy of a valid certificate of registration. Equipment suppliers not utilizing ISO 9001 manufacturing facilities shall not be considered or approved for this project.
- K. All control panels shall be fabricated and tested in the manufacturer's UL Authorized control panel shop. The equipment manufacturer shall supply a certificate of conformance confirming this requirement.

1.6 WARRANTY

- A. The equipment shall be warranted by the manufacturer for a period of three (3) years from the date of shipment.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Shipping
 - 1. Ship equipment, material, and spare parts complete except where partial disassembly is required by transportation regulations or for protection of components.
 - 2. Pack spare parts in containers bearing labels clearly designating contents and equipment for which they are intended.
- B. Receiving and Storage:
 - 1. Store and safeguard equipment, material, and spare parts. All spare parts must be stored in accordance with manufacturer's recommendations.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Washer/compactor shall be in compliance with these specifications and plans and shall be supplied by the following manufacturer:
 - 1. Kusters Water, ProTechtor® Screenings Washer/Compactor (Model SWP)
 - 2. Pre-Approved equal
 - 3. Any request for pre-approval must be submitted at least 21 calendar days prior to the bid date. Pre-Approved equals must meet these specifications without exception. The pre-approval information shall include a copy of this specification with a line by line check confirming 100% compliance with every item, a letter of compliance signed by a corporate officer for section 1.5, and customer references for no fewer than 10 installations which shall include:
 - a. Jobsite address
 - b. Customer name
 - c. Customer phone number
 - d. Customer email address
 - e. Date of installation
 - f. Maximum capacity for each washer/compactor
 - 4. Suppliers not meeting the experience clause identified in section 1.5.A shall provide a performance and payment bond for 100% of the contract amount. The bond shall be

issued by a surety with an FSR rating of no less than “A”. A letter of surety shall be provided with the pre-approval to confirm bondability. The owner and/or engineer reserves the right to reject any manufacturer should insufficient or incomplete data be provided to determine an approved equal manufacturer status.

2.2 SCREENINGS WASHER/COMPACTOR

A. GENERAL DESIGN REQUIREMENTS

1. The screenings washer/compactor system shall be designed to wash, compress and transport screenings to the screenings receptacle. The equipment shall be of the latest design and shall be fabricated of materials and in a fashion that will fully perform the functions described below.
2. Wet screening shall enter the screenings washer inlet hopper through an enclosed connecting chute. The solids shall be washed and agitated to liquefy fecal matter and to facilitate its return to the influent channel. The connecting chute shall provide a completely closed system to protect operating personnel from exposure to wastes.
3. Wet screenings with a minimum dry solids content of 5–10 percent shall enter the washer/compactor through the inlet hopper. Excess liquid shall exit through the perforated drainage holes in the bottom of the trough. Drainage of free flowing liquid shall be provided through the integral overflow outlet located beneath the trough. The rolling action provided by the Archimedean screw and the wash water system shall provide additional cleaning of the screenings before the compaction stage and an integral brush attached to the screw shall continuously clean the trough perforations. The screw shall transport all collected, washed and compacted screenings into the discharge pipe for conveyance to the drop off point.
4. The Contractor shall be required to make any necessary modifications to the existing concrete channel walls, operating floor, operating floor curb and building walls to accommodate the equipment furnished as shown on the Contract Drawings.

B. DESIGN CRITERIA

Peak Throughput Volume:	70 ft ³ /hr.
Fecal Matter Reduction:	>95%
Weight Reduction:	60 – 70%
Volume Reduction:	60 – 70%
Dryness After Compaction:	40 - 50%
Screw Diameter:	200 mm
Screw Material:	Hardox 400, 400 BHN
Anti-Rotation/Wear Bar Material:	Alloy steel, 340 BHN
Inlet Hopper Material:	14 ga., 304 Stainless Steel
Housing Material:	304 Stainless Steel
Discharge Pipe:	8 in. expanding to 12 in.
Discharge Pipe Material:	11 ga., 304 Stainless Steel

Screenings Discharge Height:	4.0 ft.
Trough Perforation Size:	5 mm
Drain Connection Size:	6" plain ended pipe
Drain Location:	Bottom
Motor Horsepower:	2 HP
Wash Water Connection Size:	1" NPT
Wash Water Flow Rate:	10 – 20 gpm @ 40 psig
Ball Valve Material:	Bronze Body, Stainless Steel Ball
Solenoid Valve Material:	Bronze
Strainer Material:	Bronze Body, Stainless Steel Screen
Operational Environment:	Class I, Div. I
Operational Voltage:	460V/3ph/60Hz
Control Panel NEMA Rating:	NEMA 4X, Stainless Steel
Local Station NEMA Rating:	NEMA 7, Cast Aluminum

C. PERFORMANCE AND DESIGN REQUIREMENTS

1. Each washer/compactor shall be capable of processing the peak throughput volume of screenings as noted in Table 2.2.B. The washer/compactor shall lift and discharge the washed and compacted screenings to the elevation as specified in Table 2.2.B.
2. All parts shall be designed and manufactured so the washer/compactor structure can withstand the forces exerted compacting and transporting the screenings volume specified. All structural and functional parts shall be adequately sized to prevent deflection and vibration which could impair operation.
3. All components shall be designed so that jamming at any point will not result in structural failure but will cause the drive motor to stall. All components, including the gear reducer, shall be designed to withstand, without damage or permanent distortion, the full stalling torque of the drive motor.

D. WASHER/COMPACTOR COMPONENTS

1. Inlet Hopper
 - a. Each washer/compactor shall be equipped with an inlet hopper to receive screenings as shown on the Drawings.
 - b. The hopper shall be flanged, gasketed, and bolted to the washer/compactor housing to provide a watertight connection.
 - c. The hopper shall be equipped with a stainless steel spray bar with nozzles to provide wash water to the walls of the inlet hopper and trough. The spray bar shall include a ball valve to regulate the spray water flow supplied from the wash zone solenoid valve.
2. Screw Housing

- a. The screw housing and associated components shall be constructed from material as specified in Table 2.2.B. The outlet flange shall incorporate an ANSI 150 lb. bolt pattern for connection to the discharge pipe. DIN pattern flanges shall not be acceptable.
 - b. The compaction/washing section shall incorporate dewatering zones to allow the removal of the filtrate during compaction. Dual wash water inlets shall be provided in the washing zone.
 - c. To prevent screenings rotation and housing wear, the washing zone and compaction zone shall be fitted with a minimum of six (6) anti-rotation/wear bars to provide the washboard/friction contact points for the screenings and to prevent screw contact with the cylindrical wall.
 - d. Each anti-rotation/wear bar shall be secured to the cylindrical housing with M10 stainless steel hex head cap screws and shall be replaceable without removing the screw from the compactor. Each anti-rotation/wear bar shall be made from material as specified in Table 2.2.B.
 - e. The bottom of the housing below the inlet hopper shall contain a replaceable perforated section for drainage. The perforated section shall have round openings as specified in Table 2.2.B on staggered centers. Slotted holes or wedge wire sections in the drainage area are not acceptable as an alternate.
 - f. A drain pan shall be mounted to the bottom of the screw housing and shall be easily removeable. The drain pan shall incorporate a drain as specified in Table 2.2.B. to return the wash water and liquefied fecal matter to the screening channel as shown on the Contract Drawings.
3. Drain Pan Flush System
- a. The drain pan of the washer/compactor shall be supplied with a flush water system to periodically flush any accumulated organic debris from the pan.
 - b. The flush connection shall be a minimum 1/4" NPT.
 - c. A control solenoid valve, flow adjustment ball valve and incoming plant water strainer shall be supplied for installation by the Contractor.
 - d. Solenoid valves shall be 1/2-inch, minimum, suitable for 120 VAC operation and shall be UL rated for the operational environment as specified in Table 2.2.B. Solenoid valves shall be normally closed and rated for up to 100 psig.
 - e. Ball valves shall be 1/2-inch, minimum, with stainless steel ball, stem and Teflon seats.
 - f. A Y-strainer with replaceable stainless steel internals shall be provided for the incoming plant water supply. Y-strainer shall be 1/2-inch, minimum.
4. Wash Water System

- a. A screenings wash water system shall be provided to continuously clean the screenings during operation. Wash water will be introduced into the washing zone in two places to dissolve and remove organic material.
 - b. The wash water system shall be furnished with two stainless steel nozzles piped together to a single inlet connection point. Nozzle orifice diameter shall be 5/8" minimum to prevent plugging of the nozzles.
 - c. A control solenoid valve, flow adjustment ball valve and incoming plant water strainer shall be supplied for installation by the Contractor.
 - d. Piping, fittings and valves shall be 1-inch diameter, minimum.
 - e. The wash water flow and minimum pressure requirements shall be as noted in Table 2.2.B.
 - f. Solenoid valves shall be 1-inch, minimum, suitable for 120 VAC operation and shall be UL rated for the operational environment as specified in Table 2.2.B. Solenoid valves shall be normally closed and rated for up to 100 psig.
 - g. Ball valves shall be 1-inch, minimum, with stainless steel ball, stem and Teflon seats.
 - h. A Y-strainer with replaceable stainless steel internals shall be provided for the incoming plant water supply. Y-strainer shall be 1-inch, minimum.
5. Solid Shaft Screw
- a. The solid shaft screw shall be of the material and diameter as specified in Table 2.2.B. The shaft where the flights are attached shall be a minimum of 2-1/2 inches in diameter. Designs incorporating hollow shaft screws for introduction of wash water are not acceptable as an alternate.
 - b. The solid shaft screw shall be designed to transport and dewater the screened material. The distance between the flights shall be arranged to allow transportation into the compaction/washing section.
 - c. The screw flights shall be of decreasing pitch approaching the compaction zone to provide a pre-dewatering stage and shall have a minimum thickness of 1/2 inch. The last flight shall be double thickness and have a minimum hardness of 400 BHN to handle the higher stress of compaction and prevent premature wear.
 - d. After fabrication the screw shall be precision machined to ensure that it is concentric to within 1.5 mm along its length.
 - e. A stainless steel reinforced brush shall be attached to the flights of the solid shaft screw in the drainage area to clean the trough and prevent debris from blinding the drain holes. The brush shall be attached to the flights using stainless steel hardware.
 - f. To reduce wear on the brush and screw flights, the design shall be such that the screw shall not be allowed to rest in the washer/compactor housing. The screw shall be fully supported and cantilevered from the thrust bearing.

6. Thrust Bearing

- a. An independent thrust bearing shall be mounted between the drive and the washer/compactor body to fully support the screw and handle the axial load created during compaction and reversal of the screw.
- b. The thrust bearing shall be mounted in a substantial fabricated steel housing and shall utilize tapered roller bearings located between two seals. The screw will be cantilevered from the thrust bearing to prevent the screw from resting inside the screw housing.
- c. Units submitted without an axial thrust bearing to fully support the cantilevered screw will not be accepted.

7. Support Structure

- a. The washer/compactor shall be supplied with a minimum of two support legs to hold the unit in a horizontal position. Support legs shall attach to the housing using stainless steel hardware.
- b. The support legs shall be fabricated from material as specified in Table 2.2.B and have a minimum thickness of 3/8 in.
- c. Support legs shall be designed to handle the forces and loads of the unit such that in the event of a jam in the unit they will not distort or structurally fail.

8. Mobile Cart

- a. The washer/compactor shall be mounted to a mobile cart to allow the unit to be readily moveable for maintenance or repair.
- b. The frame shall be fabricated from tubular steel with sufficient bracing to provide for a rigid structure. Material shall be the same as specified for the housing in Table 2.2.B.
- c. Four (4) castor wheels shall be mounted to the frame. Castor wheels shall be sized for the weight of the unit including a fully loaded hopper. Castors shall be of a 360 degree swivel design with stainless steel frames. The wheels shall be a minimum of 5 in. in diameter and made from phenolic material with stainless steel roller bearings. Castor wheels shall be rated for wash down duty.
- d. Threaded support rods and attachment bases shall be provided at the castor wheel locations to allow rigid support of the washer/compactor. The castor wheels shall not fully support the unit when in operation.

9. Discharge Pipe

- a. The discharge pipe shall be mounted to the discharge flange of the washer/compactor body and be designed to transport the washed, dewatered and compacted screenings to the appropriate receiving device.

- b. The discharge pipe shall be constructed of the material as specified in Table 2.2.B and shall be of the configuration as shown on the Contract Drawings.
- c. The discharge pipe shall have a minimum inside diameter and expand to a minimum diameter as specified in Table 2.2.B.
- d. The discharge pipe shall be supplied with a bagging device to contain and encase dewatered screenings.
- e. The screenings bagger shall be designed to be fitted with replaceable plastic bags.

10. Cold Weather Protection

- a. The discharge pipe shall be heat traced, insulated and cladded to prevent freezing.
- b. Heating cable shall be rated at 5 watts per foot, be self - regulating and rated for the operating environment as specified in Table 2.2.B.
- c. Insulation shall be minimum 1" thick closed cell neoprene foam.
- d. Cladding shall be minimum 20 gauge stainless steel as specified in Table 2.2.B.
- e. An ambient sensing control thermostat shall be supplied for mounting by the contractor. The thermostat housing shall be rated for the operating environment as specified in Table 2.2.B but not less than NEMA 4.
- f. Electrical power shall be 120V/1ph and will be supplied from a local power panel separate from the unit control panel.

11. Drive Assembly

- a. The washer/compactor shall be driven by a heavy-duty, shaft-mounted parallel helical or helical bevel gear reducer. The gear reducer shall be sized to provide the proper input power and torque to operate the washer/compactor and be rated for greater than the nominal horsepower of the drive motor.
- b. The gear reducer shall have a cast iron housing with a minimum service factor of 1.2.
- c. Gear reducers shall have ball or roller bearings throughout with all moving parts immersed in oil. Gears shall be of alloy steel with teeth precision ground and polished after casehardening. Shafts shall be of high strength alloy steel ground to required tolerances.
- d. The gear reducer shall be driven by an inverter duty electric motor. The motor shall be UL rated for the operational environment as specified in Table 2.2.B. The motor shall be rated for a minimum horsepower and voltage as specified in Table 2.2.B, with a minimum service factor of 1.0.
- e. The motors shall be rated at 40°C ambient with Class F insulation and shall have a Class B temperature rise at full load.

2.3 CONTROLS AND INSTRUMENTATION

A. GENERAL

1. Controls for the washer/compactor shall be incorporated in the control panel supplied for the mechanically cleaned bar screen specified in Section 46 2020 - Mechanically Cleaned Bar Screen.
2. Each control panel shall be the supplier's standard UL listed enclosure and wired for the voltage as specified in Table 2.2.B. The enclosure shall be furnished completely pre-wired and tested, requiring only mounting and connection to field mounted electrical devices. The control panel shall include all equipment required to control the equipment specified herein.
3. The control panel enclosure shall be as specified in Table 2.2.B and suitable for wall mounting. The enclosure shall house all control devices required for a complete and operable system. All hinges and latches shall be corrosion resistant.
4. A separate local control station in an enclosure as specified in Table 2.2.B shall be provided. The local control station shall include an emergency stop, red, mushroom head pushbutton, Hand/Off/Auto switches and all other operators as required for proper operation of the equipment specified.

B. CONTROL DEVICES

1. Main power fusible disconnect switch with through door lockable handle.
2. Pilot devices shall be mounted on the front of the enclosure door.
3. Indicator lights shall be LED type.
4. Selector switches shall be heavy duty NEMA type.
5. Control transformer shall be protected by two (2) primary fuses and one (1) secondary circuit breaker. The 120-volt secondary shall have one leg grounded.
6. Auxiliary relay contacts shall be included for signal outputs. The contacts shall be rated 10 amp, 240 VAC, resistive load.

C. SAFETY FEATURES

1. If a power failure occurs while the equipment is running, operation shall resume when power is restored.
2. If a power failure occurs while the equipment is in a fault condition, the fault indicator shall reactivate when power is restored.
3. Short-circuit protection requires that a properly sized circuit breaker be provided by the Electrical Contractor.
4. Control reset shall be from the main control panel only.

D. COMPONENTS

1. Controller
 - a. Allen Bradley MicroLogix 1400 PLC.
 - b. Allen-Bradley PanelView 800, 7" color flat panel touch screen.
2. Over Torque Protection
 - a. Tsubaki Shock Relay Model TSBSS
3. Operation Controls
 - a. Control Power: OFF/ON switch
 - b. Alarm reset: Pushbutton
 - c. Emergency Stop: Push to stop, pull to run pushbutton
4. Indicator Lights
 - a. Control power on: White pilot light
5. Dry Contacts
 - a. Compactor In-Auto
 - b. Compactor Running
 - c. Compactor Fault
 - d. E-Stop

E. Local Station

1. Washer/compactor
 - a. Compactor: HAND/OFF/AUTO selector switch
 - b. Compactor: REVERSE/OFF/FORWARD selector switch
 - c. Pan Flush: OPEN/CLOSED/AUTO
 - d. Emergency Stop: Push to stop, pull to run pushbutton

F. OPERATION

1. When in Automatic mode, the washer/compactor shall be started when a call to run signal is received from the mechanical screen.
2. The washer/compactor will run in the forward direction when the call to run signal is received. Periodically the washer/compactor will stop and run in the reverse direction,

for no more than 8 seconds, and then return to forward operation. This intermittent scrub sequence enhances the washing capability of the unit and resets the spiral brush bristles, ensuring proper cleaning of the drain perforations.

3. The wash water solenoid valve will open whenever the washer/compactor is running in the forward direction.
4. The pan flush solenoid shall operate intermittently based on the operator settable pan flush cycle and duration timers.
5. The washer/compactor will continue to run until the call to run signal is removed. Once this occurs the washer/compactor will continue to run for the time set in the its off delay timer and then stop.
6. The wash water solenoid valve will close once the washer/compactor stops.
7. The pan flush cycle shall stop once the washer/compactor stops.
8. If the jam (over-torque) sensor for the washer/compactor is activated during operation, indicating a jam, the washer/compactor will reverse in an attempt to clear the jam. The washer/compactor will reverse for a set period of time, then run forward again. If the jam has been cleared, the washer/compactor will return to normal operation. If the jam still exists, the washer/compactor will make additional attempts to clear the jam, (3 attempts, maximum). If the jam is not cleared after the final attempt, the washer/compactor will stop, and an alarm signal will be sent by the control system.
 - a. A jam (over-torque) condition in HAND mode immediately stops the washer/compactor and the control system will send an alarm signal.

2.4 SOURCE QUALITY CONTROL

- A. The washer/compactor system and control panel shall be factory assembled and tested to ensure proper design and satisfactory operation. Equipment shall be shipped in the minimal practical number of pieces for minimal field assembly by the Contractor.

2.5 SHOP PAINTING

- A. Stainless steel and other corrosion-resistant surfaces shall not be painted. Gearboxes, Motors, and other manufactured components will receive the manufacturer's standard weather and corrosion-resistant coating.

2.6 SPARE PARTS

- A. The following spare parts shall be provided:
 1. One (1) Brush with mounting clips and attaching hardware
 2. One (1) Set of Anti rotation/wear bars with attaching hardware
 3. Three (3) Fuses of each size and type used in the control panel
 4. Two (2) Boxes of screenings bags.

PART 3 EXECUTION

3.1 INSTALLATION AND TESTING

- A. Contractor shall verify all dimensions in the field to ensure compliance of equipment dimensions with the drawings. Contractor shall notify Engineer of any significant deviations.
- B. Installation of the equipment shall be in strict accordance with the contract documents and the Manufacturer's instructions and shop drawings. Manufacturer shall supply anchor bolts for the equipment. Contractors shall install the anchor bolts in accordance with the Manufacturer's recommendations.
- C. Supplier shall furnish the services of a factory-trained Service Engineer for two (2) trips. One (1) trip of one (1) day for installation inspection services. One (1) trip of one (1) day for start-up, commissioning, and to provide operator training.
 - 1. Equipment shall not be energized, or "bumped", to check the electrical connection for motor rotation without installation inspection and the Service Engineer present.
 - 2. The Service Engineer shall make all necessary adjustments and settings to the controls.
 - 3. The Service Engineer shall demonstrate proper and sequential operation of the washer/compactor. The washer/compactor shall be operated in both Automatic and Hand mode by the Service Engineer during the start-up and commissioning to demonstrate proper operation of the system.

END OF SECTION

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SECTION 46 2300 - GRIT REMOVAL AND HANDLING EQUIPMENT

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Cyclone classifier.
- B. Screw type classifiers.

1.2 RELATED REQUIREMENTS

- A. Section 46 0106 - Operation and Maintenance Manual.
- B. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Requirements applicable to all equipment.
- C. Section 46 0923 - Monitoring and Control Instrumentation: Moving equipment overload detection and alarm.

1.3 REFERENCE STANDARDS

- A. AASHTO T 11 - Standard Method of Test for Materials Finer Than 75 Micrometer (No.200) Sieve in Mineral Aggregates by Washing 2005 (Reapproved 2018).
- B. AASHTO T 27 - Standard Method of Test for Sieve Analysis of Fine and Coarse Aggregates 2014 (Reapproved 2018).
- C. ABMA STD 11 - Load Ratings and Fatigue Life for Roller Bearings 2014.
- D. AIST PB-229 - Stainless Steels: A Steel Products Manual 2008.
- E. ASME B17.1 - Keys and Keyseats 1998 (Reaffirmed 2017).
- F. ASME B17.2 - Woodruff Keys and Keyseats 1998 (Reaffirmed 2017).
- G. ASTM A27/A27M - Standard Specification for Steel Castings, Carbon, for General Application 2020.
- H. ASTM A53/A53M - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless 2020.
- I. ASTM A108 - Standard Specification for Steel Bar, Carbon and Alloy, Cold-Finished 2018.
- J. ASTM B26/B26M - Standard Specification for Aluminum-Alloy Sand Castings 2018, with Editorial Revision.
- K. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate 2014.
- L. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric) 2014.

- M. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes 2021.
- N. ASTM B221M - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes (Metric) 2021.

1.4 SUBMITTALS

- A. See ~~Section 01 3000 - Administrative Requirements~~, and Section 46 0500 for submittal procedures.
- B. Product Data: Manufacturer's literature for standard manufactured units.
- C. Shop Drawings: Submit drawings showing layout of equipment, construction and erection details, and piping to connection with plant piping.
 - 1. If proposed equipment requires modification to structural concrete, submit drawings showing changes required and concrete design calculations.
- D. Field Quality Control Reports:
- E. Operating and Maintenance Data: ~~Section 01 3000-~~ McGill Section 017823.
- F. Maintenance Materials:
 - 1. Furnish spare parts, identical and interchangeable with original parts.
 - 2. Furnish in wooden containers clearly marked with contents on two sides and top.
 - 3. Where the number of spare part units required by the schedule results in a fractional number of units, round number up.

1.5 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Minimum of two years experience manufacturing products of the type specified.
 - 2. Minimum of three similar systems installed, with documented evidence of satisfactory operation for each installation.

1.6 WARRANTY

- A. See ~~Section 01 7800 - Closeout Submittals~~, for additional warranty requirements.

McGill Section 017700

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Enviro-Care..
- B. Envirodyne.

- C. Jim Myers & Sons.
- D. Lakeside..
- E. Substitutions: See Section 01 6000 - Product Requirements.

2.2 SYSTEM DESCRIPTION

- A. Grit Classifying: Screw type classifier with cyclone..
- B. Deposit grit at indicated point of discharge, within area and at elevations indicated.

2.3 CYCLONE CLASSIFIERS

- A. Cyclone Classifiers: Cylindrical-conical unit with cast aluminum housing, designed to centrifugally separate grit from organics, return water and organics to effluent stream, and discharge grit separately; electric motor driven; capable of intermittent and continuous operation without overheating or excessive vibration or noise.
 - 1. Capacity: 230 gallons per minute at maximum feed pressure.
 - 2. Maximum Feed Pressure: 7.5 psi.
 - 3. Capable of making a separation at approximately 150 mesh predicated on feed solids concentration of not more than one percent solids for grit pumped from point of removal from grit chamber.
 - 4. Connections: Flanged ANSI Standard 125 pound feed connections; flanged transition fittings for both feed and overflow connections.
- B. Feed Chamber: Cast steel or cast iron; rubber lined steel or unlined cast iron alloy, 28-percent chromium, with Brinell hardness of 550 to 600.
 - 1. Lining: Replaceable, high-density gum rubber or synthetic rubber with durometer hardness of 79, minimum 5/8 inch thickness.
- C. Inlet Head Casing: Cast steel, ASTM A27/A27M; or cast aluminum, ASTM B26/B26M.
- D. Cylindrical Sections: Fabricated from structural steel plate or cast aluminum, ASTM B26/B26M.
- E. Apex Valve: Provide cast aluminum housing with pivoted, quick opening, toggle-clamp operator or a four-bolt flange with cast iron alloy (28-percent chromium) apex section.

2.4 SCREW TYPE CLASSIFIERS

- A. Screw-Type Classifiers: Washing and settling tank, inclined screw conveyor for discharge, screw drive unit, and supports; designed to separate grit from organics, return water and organics to effluent stream, and discharge grit separately; capable of intermittent and continuous operation without overheating or excessive vibration or noise.

- B. Screw: Half pitch helicoid screw, with support on tail shaft bearing and thrust taken by drive end bearings taking thrust.
1. Grit Capacity: 55 cubic feet per hour.
 2. Diameter: 12 inches.
 3. Pipe Shaft: 4 inches diameter Standard.
 4. Solid Shaft: 2 inches or 2-7/16 inches diameter.
 5. Power: 1.0 horsepower.
 6. Flights: 3/8 inch thick, butt or fillet welded both sides to shaft.
 - a. Outer leading edges of flights protected with coating of weldment, minimum of one inch wide, 1/8 inch thick.
 - b. Carbon steel flights without coating are acceptable provided steel has minimum Brinell hardness of 500 or flights are equipped with abrasion resistant wearing shoes attached with counter sunk AIST PB-229, Type 304 stainless steel bolts.
 7. Pipe Shafts: ASTM A53/A53M steel pipe, Schedule 80, bushed for solid shaft.
 8. Solid Shafts: Cold rolled steel complying with ASTM A108.
 9. Coupling Bolts: AIST PB-229, Type 316 stainless steel.
 10. Driven Sprocket (Chain Drive): High-test cast iron with minimum tensile strength of 20,000 psi cast in a chill, and Brinell hardness of not less than 360 with a chill depth at least 3/16 inch; stress relieved before machining; teeth accurately ground to fit chain; split construction assembled with cadmium-plated nuts and bolts; key seated on screw drive shaft with keys and keyseats complying with ASME B17.1 or ASME B17.2.
 11. Screw Lengths: Manufacturer's standard modular lengths with coupling flight connection for ease of installation and removal.
- C. Bearings:
1. Tail Shaft Bearings: Grease lubricated, with cast iron, high carbon or heat treated alloy steel bushings, rated for minimum of 5 years on continuous service basis.
 2. Drive End Bearings: Extra heavy roller bearing pillow blocks, or grease lubricated ball bearings, with minimum rated life expectancy (L-10) of 40,000 hours based on American Bearing Manufacturers Association Standards on continuous service basis.
- D. Housing: Steel plate, 1/4 inch thick, forming settling compartment.
1. Overflow Weir: Control depth of liquid in settling compartment by adjustable weir located at end of tank that provides pool depth of minimum of 150 percent of spiral diameter; fabricated of structural steel, or aluminum complying with ASTM B209 (ASTM

B209M) or ASTM B221 (ASTM B221M), Alloy 6061, Temper T6.

2. Supporting Structure: Steel; provide mounting brackets and anchor bolts.
- E. Drive Unit: Mechanical variable speed drive, manually adjustable in infinite steps over entire range.

2.5 MOTORS AND DRIVES

- A. Variable Speed Drives: Mechanical variable speed drive with ratio indicated, manually adjustable in infinite steps over entire range, using motor sheave, speed reduction sheave, and multiple V-belts to transmit power.
 1. Service Factor: 1.5, minimum.
 2. Suitable for mounting with motor provided.
 3. Sheaves: Cast iron or cast steel complying with ASTM A27/A27M, keyed to shaft with keys and key seats complying with ASME B17.1 or ASME B17.2.
 4. Shafts: Solid, cold finished steel complying with ASTM A108, of sufficient size to transmit maximum force developed by drive assembly; areas in contact with bearings polished.
 5. V-belts: Heavy-duty type, rayon corded, with oil- and heat-resistant and heat-dissipating rubber cover.
 6. Bearings: Anti-friction type, running in oil, with minimum rated life expectancy (L-10) of 50,000 hours based on ABMA STD 11 when operating under normal continuous operating load.

2.6 PLC BASED CONTROL SYSTEM

- A. The grit system control equipment shall be mounted in a NEMA Type 4 steel enclosure with hinged, lockable doors.
- B. All components within the control panel shall be UL listed or recognized, and the complete grit system control panel itself shall be labeled as a UL 508A General Use Industrial Control Panel.
- C. To facilitate wire tracing and servicing, the control wiring shall be run in enclosed wireways, with removable covers, rather than tied up in bundles.
- D. Control relays up to 6-amp capacity shall be the modular, plug-in type, with integral LED indicating lights to show activation. Larger control relays shall be enclosed to be "finger safe".
- E. A duplex GFI protected convenience outlet shall be provided in the panel for operation of 120-Volt AC devices.
- F. Thermal magnetic air circuit breakers shall be provided for branch disconnect service and short-circuit protection of all auxiliary circuits, and thermal magnetic circuit breakers with lockout capability shall be provided for each drive and pump motor, matched to the motor inrush current.

- G. Magnetic across-the-line starters with 24-Volt coils and solid-state overload protection for each phase shall be provided for each motor to give positive protection against phase unbalance, thermal overload, phase loss and ground fault. To provide the fastest trip speed and for ground fault protection, only solid-state overload protection will be used, and motor starters using heater coils will not be acceptable. Each single-phase auxiliary motor shall be equipped with an over-current protection device in addition to the branch circuit breaker, or shall be impedance protected. Circuit breakers shall be used in lieu of fuses, to eliminate the need for stocking spare fuses. All switches shall be labeled and a coded wiring diagram shall be provided.
- H. Individual NEMA 4 oil-tight Hand-Off-Automatic selector switches shall be provided for the pump and dewatering device drives.
- I. To control the operation of the grit removal and dewatering system, and monitor the control, environmental and alarm functions, a specially preprogrammed, dedicated microprocessor-based control system shall be provided. The controller shall interface with the panel display unit, motor starters, flush water, accessories and alarm functions through digital and analog input and output ports as required. The digital controls shall operate on 24 volts or less, to eliminate shock hazard.
- J. The 24-volt DC power supply shall be overload protected to be "crowbar safe" and will return to operation when a short is removed. Program integrity shall be maintained by battery-backed RAM. A surge suppressor with power filter shall be provided for the control circuits.
- K. A NEMA 4 rated display unit shall be mounted through the front of the panel to provide operator input to and visual output from the microprocessor controller. For exterior mounted locations, an aluminum hood to shade the HMI display from direct sunlight shall be mounted on the face of the control panel. The metal shade shall cover the entire display, shield the top and sides of the display, and shall be hinged to fold over the display and stow against the front of the panel. Display shall be as per Section 40 9516 - Control Panels.
- L. 1Display Functions
 - 1. "Run – Off" indication for drives and pump.
 - 2. Grit removal cycle time settings and indication of remaining run time.
 - 3. Set time intervals for pump run time, prime fail alarm, dewatering device run time.
 - 4. View current status.
 - 5. Alarm list/status and diagnostics.
- M. Provisions shall be made to allow interfacing the grit system PLC with a plant SCADA system, using an Ethernet IP connection.
- N. To control the operation of the grit pump, a manual Hand-Off-Automatic selector switch shall be provided. In the Automatic position, control shall be from the PLC program, with a manual push button to override the timed program and initiate a pumping cycle. A manual push button shall also be provided to reset the grit removal cycle. The program shall be capable of

initiating grit pumping cycles at adjustable intervals throughout the day. The pumping cycle and dewatering device cycle lengths shall also be programmable.

- O. For each unit of equipment, provide moving equipment overload detection and alarm.

2.7 INSTRUMENTATION

- A. For each group of automatically operating equipment provide one control panel.
- B. Control Panel: Mount instrumentation and control devices in enclosure as specified in Section 40 9513, mounted near equipment. Provide the following, at minimum, mounted on or in panel door:
 - 1. On-Off-Alarm indication.
 - 2. Hand-Off-Auto switch.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install equipment in accordance with manufacturer's instructions.

3.2 FIELD QUALITY CONTROL - PRIOR TO STARTUP

- A. Demonstrate proper operation without sewage flow, using manual controls.

3.3 OWNER PERSONNEL TRAINING

- A. See Section 46 0500 for additional requirements.
- B. Instructor: Equipment manufacturer's technical representative.
- C. Operating Personnel Training:
 - 1. Sessions: One.
 - 2. Trainees: Two.
 - 3. Training Hours: 2.

3.4 FIELD QUALITY CONTROL - AFTER STARTUP

- A. Capacity and Performance Testing: Obtain Owner's approval of test methods, including type, size, and volume of grit that would be considered an adequate test.
- B. Classifiers: Operate equipment continuously for 24 hours at design flow specified.
 - 1. Sample overflow periodically, not less than once every four hours.
 - 2. Dry and test samples as specified by AASHTO T 27 and AASHTO T 11.

- 3. If particles average more than 5 percent larger in size than specified size, adjust equipment to comply.
- C. If test results are unsatisfactory, adjust, modify, repair, or replace, and retest.
- D. Owner reserves the right to reject the installed equipment if performance appears to be unachievable with installed equipment.

END OF SECTION

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SECTION 46 4322 - CLARIFIER AND THICKENER RESTORATION

PART 1 GENERAL

1.1 SUMMARY

A. Description of Work:

1. Contractor shall provide all labor, material and equipment to furnish and install OEM components for rehab of clarifiers and thickeners as specified herein.
2. This specification covers the general requirements for the design, fabrication and installation of components for two (2) existing preliminary clarifiers, two (2) existing secondary clarifiers ~~and one (1) existing gravity thickener.~~

B. Work and Components Included (but not limited to):

1. The Equipment Manufacturer shall furnish the items listed below:
 - a. Factory rebuild of drive mechanism.
 - b. Center support pier, anchor bolt template, and grout shield.
 - c. Unitube sludge removal header and supports and manifold.
 - d. Manifold seal plate.
 - e. Heavy solid scraper blades
 - f. One (1) surface skimmer with skimmer blade.
 - g. One (1) scum trough and ramp with flushing device.
 - h. Anti-Rotation Scum Baffle.
 - i. Influent channel target baffles.
 - j. Associated attachment bolts and anchor bolts for above.
2. Like items of equipment specified herein shall be the end products of one manufacturer in order to achieve standardization for operation, maintenance, spare parts and manufacturer's service.

C. Related sections include but are not necessarily limited to:

1. The following items are specified under other sections of these specifications:
 - a. Section 03 3000 - Cast-in-Place Concrete
 - b. Section 05 5000 - Metal Fabrications
 - c. Section 09 9110 - Painting

d. Electrical - Division 16.

1.2 QUALITY ASSURANCE

A. Manufacturer:

1. It is the intention of this specification to cover minimum acceptable quality for a complete installation with the exception of the motor controls, electrical work and piping requirements.

B. Manufacturer's Experience:

1. The equipment Manufacturer shall have not less than five (5) successful years experience in the design, construction and operation of the type specified at ten (10) different plants.
2. The Engineer may require evidence, in the form of operating records, from these plants to substantiate any claims concerning the ability of the equipment to perform as required.

1.3 SUBMITTALS

A. Shop Drawings:

1. ~~See Section 01 3000.~~ McGill Section 013300
2. Product technical data including:
 - a. Include as a minimum with submittal, complete construction details, materials of construction, complete detailed drawings of all equipment furnished, electrical diagrams, and other pertinent information.
 - b. Provide Owner with written statement that manufacturer's equipment has been installed properly and started up, and is ready for operation by Owner's personnel.

1.4 EQUIPMENT MANUFACTURER'S SERVICE REPRESENTATIVE

A. Installation Assistance:

1. Provide for installation assistance as required for the equipment supplied.

B. Operating Instructions and/or Operator Training:

1. Provide for one (1) 4-hour working period total to instruct plant Operators for the equipment supplied. The training period will be integrated by the Owner with overall training.

1.5 GUARANTEE AND WARRANTY

- ### **A.**
1. The equipment shall be guaranteed to meet or exceed the design criteria detailed in Part 2 of this specification.

1. See Section 11005 - Equipment: Basic Requirements for other requirements.

PART 2 PRODUCTS

2.1 GENERAL

- A. The design and layout shown on the drawings are based on the manufacturer shown in Section 2.2.
- B. Changes in architectural, structural, electrical, mechanical and plumbing requirements for the substitution shall be the responsibility of the Bidder wishing to make the substitution. This shall include the cost of redesign by affected designers. Any additional cost incurred by affected subcontractors shall be the responsibility of the Bidder and not the Owner.
- C. See Section 01640 - *Product Substitutions*.

2.2 ACCEPTABLE MANUFACTURERS

- A. Siemens Industry, Inc. - Waukesha, WI.

2.3 EQUIPMENT

- A. General:
 1. Furnish and deliver suction type sludge collector components for installation in two (2) existing concrete settling tanks.
 - a. Tank diameter to be 80 feet.
 - b. Tank side water depth to be 11 feet.
 - c. Tank freeboard to be 2 feet.
 - d. Floor slope to be 1/16 inch per foot.
 2. Sludge Collector Mechanism:
 - a. Provide components for a center pier supported, peripheral feed design with peripheral overflow.
 - b. The center drive mechanism supports and rotates a structural steel cage to which is attached a Unitube sludge collection header and manifold.
 - c. The header shall be parallel to the tank floor and have a series of inlet orifices such that the entire tank bottom is swept clean in a single revolution.
 - d. The header shall be designed to uniformly remove sludge in proportion to the area swept with the removal of a larger volume of sludge at greater distances from the tank center.
 - e. Sludge shall be transported through the header to the center manifold, with removal being accomplished by hydrostatic pressure.

- f. Fabricated steel structures shall be shipped in the largest sub-assemblies permitted by carrier regulations, properly match-marked and identified for ease of field erection.

B. Design Criteria:

1. Hydraulics shall be designed to handle (per basin):

	MIN.	AVE.	MAX.	PEAK
Effluent Flow (MGD)	3.00	3.25	6	10.0
Return Flow (MGD)	3.00	3.25	3.25	0
Mixed Liquor Flow (MGD)	6.00	6.50	9.25	10.0

2. Maximum headloss for header: 0.88 ft.
3. Minimum flow velocity in header: 0.98 lps.
4. Minimum header orifice diameter: 2.25 inch.
5. Manifold diameter: 5.00 ft.
6. Center Pier diameter: 24 inch.
7. Drive:
 - a. Internal gear pitch diameter: 38".
 - b. Ball race diameter: 42".
 - c. Motor Horsepower: 0.50 HP.
 - d. AGMA rated torque: 21,900 ft-lbs. with 1.25 S.F.
 - e. Speed: 0.04 RPM.

C. Structural Members:

1. Structural steel to conform to ASTM A36.

D. Structural steel components shall have minimum thickness of 1/4".

1. All welding to conform to American Welding Society Standard AWS D1.1. Structural support members shall be shop welded for bolted field assembly. Field welding shall be limited to bridge splices and tack welding of skimmer connections after final positioning.
2. Design components so that stresses developed do not exceed allowable stresses, as defined by current AISC standards when designed for the AGMA rated torque.
3. Panel lengths and member sizes shall be selected such that slenderness ratios do not exceed 200 for compression and 240 for tension. For strength, the controlling member

force shall be used to determine member size.

4. Maximum deflection in a span under combined live and dead loads shall not exceed $L/360$.

E. Drive Mechanism:

1. Existing center drive mechanism to be returned to original manufacturer for disassembly, cleaning and inspection. The rebuilding of the drive units shall include the following items:
 - a. The drive unit shall be completely disassemble and inspected.
 - b. All castings shall be blasted cleaned and repainted.
 - c. All bearings and shafting shall be solvent cleaned and inspected. If deemed dependable, shall be reassembled.
 - d. All bearings, raceways, shaft seals, gaskets, neoprene dust shield, overload spring plate, micro switches and actuators, chains, sprockets, shear pin hub, chain guard, gear reducer mounting base, primary gear reducer and motor shall be replaced.
 - e. Any gear, housing or shaft whose service life is deemed exhausted shall be replaced at additional cost.

F. Center Pier:

1. A cylindrical 1/4" thick steel plate center pier shall support the drive, collector mechanism and access bridge.
2. Top of pier to have a drive mounting plate set plumb with the centerline.
3. Drive to be positioned, leveled and grouted in place on top of pier with a non-shrink grout.
4. Manufacturer to provide minimum eight (8) 1" diameter drill-in adhesive anchors and steel template/grout shield to accurately locate anchors. Pier template and base plate will be double punched to allow the re-use of existing or new anchors.

G. Sludge Collection Header:

1. Provide a fully tapered, rectangular-shaped Unitube header varying in cross section from a maximum near the tank center to a minimum at the outer wall.
2. Fabricate header from 1/4" thick steel plate and hot-dip galvanized after fabrication. Provide steel plate counterweights not exceeding 50# each as necessary for proper equipment balance. Field welding of galvanized header or supports will not be allowed.
3. Longitudinal cross sectional axis to be mounted at an angle of 45 degrees to tank bottom to trap sludge.
4. Provide a 2" fluidizing vane as an integral part of header.

5. Attach flexible squeegee to fluidizing vane provided with 1" vertical adjustment.
6. Manufacturer to size and space header inlet orifices at regular intervals not exceeding 30".
7. Orifice design to be proportionate to the volume of sludge withdrawn from the entire tank floor at all flows.
8. Provide header flange with silicone seal for bolted connection to center manifold. Provide horizontal header support from cage through steel tie-bars with adjustable galvanized clevis assembly and locknuts.
9. Alternate Manufacturers shall submit header verification field data in accordance with the Substitute Equipment Section of this specification.

H. Center Cage, Truss Arm and Manifold:

1. Existing center cage to be re-used.
2. Existing truss arm opposite the Unitube header to be re-used.
3. Provide a cylindrical manifold with two (2) neoprene seals for bolted connection to the sludge collection header and bottom of cage. A bottom seal plate shall be furnished by the equipment Manufacturer and will be securely anchored to the floor and grouted in place after final adjustment.
4. Provide heavy solid plow blades consisting of a 3" deep 1/4" steel blade, spaced such that the entire floor is scraped once per revolution.

I. Target Baffle and Skirt baffle:

1. Provide a specially configured target baffle with stainless steel drill in anchors to be installed at each existing inlet orifice. Locate target baffles as shown on the manufacturer drawings.
2. Blast clean and repaint existing skirt baffle as directed by the onsite engineer.
3. Add steel plate skirt baffle extension as shown on the Drawings. Blast and paint once installed.

J. Access Bridge:

1. Existing access bridge to be re-used, blast cleaned, and painted.

K. Surface Skimmer, Main Basin and Influent Raceway:

1. Provide one (1) "full radius" skimmer consisting of scum blade, hinged wiper assembly and scum trough.
2. Support the scum blade along its length with structural "A" frames bolted to the truss arm at 12' maximum spacing.

3. Mount the hinged wiper assembly on the outer end of the scum blade to form a pocket for trapping scum.
4. The wiper assembly shall maintain continual contact and proper alignment between scum blade, outer scum baffle and scum trough.
5. The wiper blade shall have a wearing strip on its outer end which contacts the scum baffle and neoprene strip on its inner and lower edges which contact the scum trough.
6. All springs, pivot points and threaded fasteners shall be constructed of 18-8 stainless steel.
7. The scum trough and beach shall be fabricated of 1/4" thick steel plate, supported from the tank wall.
8. Scum trough shall be 6'-0" wide with an overall length of 4'-9" along the scum baffle consisting of beach plate, inner radius baffle, hopper and 6" discharge pipe.
9. Beach plate to slope at a nominal incline of 1-3/4" per foot to a point 5" below the maximum water elevation.
10. The submerged trough shall continue on a horizontal run for an additional 4' along the scum baffle. An inner radius baffle extending 9" below and 3" above maximum water level shall run from the trough to the end of the submerged shelf.
11. Provide a counterweighted flushing device actuated by the main tank skimmer arm. Actuator arm shall pivot on a 3/4" minimum diameter stainless steel pin riding in an oil impregnated sintered bronze bushing. The actuator arm shall be counterweighted by steel plates to assure positive valve closure. The flapper valve shall be held open to allow 15 to 20 gallons of flushing water per trip.
12. Influent raceway skimmer is to consist of a 12" wide paddle type which will prevent scum bridging and assist moving scum in the narrow portion of channel to existing weir gate.

L. Anti-Rotation Scum baffle:

1. A stationary anti-rotational scum baffle shall be provided to trap scum as the rotating skimmer blade approaches and wedges the trapped scum outward toward the scum trough. The baffle shall consist of a structural steel support angle hung from the access bridge or a support beam, 3/16" thick, Duro 60 2-ply reinforced "hay bailer" belting and a 1" thick steel backing bar. The belting shall extend a minimum of 3-inches below water level and shall run from the center cage to the entry point of the scum trough submerged shelf.

M. Materials and Coatings:

1. All components shall be fabricated from A36 carbon steel.
2. All components shall be blast cleaned and prime painted in the shop

3. Finish coats shall be applied in the field by installing Contractor.
 4. Reference Section 09905 - Painting and Protective Coatings.
- N. New Effluent Weirs and Scum Baffles (supplied by Installing Contractor):
1. Fabricate weirs from 3/16" thick x 9" FRP.
 2. Weir shall have 90 degree, 2.5 inch deep "V" notches spaced 6" on centers.
 3. Fabricate scum baffle from 1/4" thick x 12" FRP.
- O. Anchor Bolts:
1. All equipment anchor bolts shall be stainless steel.
 2. Equipment Manufacturer shall furnish steel template and grout shield to accurately locate center pier anchors and allow for grouting beneath the pier and manifold seal plate after final plumbing.

PART 3 EXECUTION

3.1 INSTALLATION

- A. The Contractor shall install the clarifier components as shown on the drawings.
- B. Equipment shall be installed in accordance with the Manufacturer's recommendations to provide a complete installation.
- C. The Contractor shall plumb, adjust for true plane of rotation, grout beneath center pier, manifold seal plate and drive unit and grout the floor in accordance with the Manufacturer's recommendations.

3.2 ELECTRICAL CONNECTIONS AND WIRING

- A. Wiring and conduits for electrical power, control, and instrumentation will be provided by the Electrical Contractor under Division 16 - Electrical.
- B. Reconnect new torque overload switches to properly de-energize equipment when high torque conditions are encountered.

END OF SECTION

SECTION 46 5103 - AIR DIFFUSERS

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Air distribution and diffusion for:
 - 1. Aerated grit tanks.
 - 2. Post aeration tanks.
- B. Air diffusers.
- C. Air headers, supports, and accessories.

1.2 RELATED REQUIREMENTS

- A. Section 46 0006 - Wastewater Treatment System.
- B. Section 46 0106 - Operation and Maintenance Manual.
- C. Section 46 0500 - Common Work Results For Water and Wastewater Equipment: Requirements applicable to all equipment.
- D. Section 46 0506 - Wastewater Treatment Piping: Air supply main to air headers.

1.3 SUBMITTALS

- A. See McGill Section 013300 ~~Section 01 3000 - Administrative Requirements~~, and Section 46 0500 for submittal procedures.
- B. Product Data: Manufacturer's technical literature showing compliance with requirements.
- C. Shop Drawings: Submit drawings showing layout and anchorage of diffusers and piping.
- D. Field Quality Control Reports.
- E. Operation and Maintenance Data: Section 46 0106.
- F. Maintenance Materials:
 - 1. Spare Diffusers: 5 percent of installed quantity of each diffusers type; complete with all parts required for installation.
 - 2. One set of any special tools, calibration devices, and instruments required for operation, calibration, and maintenance.

1.4 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Minimum of three years experience manufacturing products of the type specified.

2. Minimum of three similar systems installed, with documented evidence of satisfactory operation for each installation.

1.5 WARRANTY

McGill Section 017700

- A. See ~~Section 01 7800 – Closeout Submittals~~, for additional warranty requirements.

PART 2 PRODUCTS

2.1 MATERIALS - GENERAL

- A. Header Pipe Type: As specified in Section 46 0506.
- B. Anchors and Fasteners: TP304L stainless steel.
- C. Other Non-Submerged and Partially Submerged Components: Stainless steel or PVC.
- D. Other Submerged Components: PVC.

2.2 AERATED GRIT AND POST AERATION TANK AIR DISTRIBUTION

- A. System Configuration: As indicated on drawings, consisting of assembly for connection to air main, a single fixed header, and supports.
- B. Air Header:
 1. Inside Diameter: 2 inches nominal.
 2. Header Supports: Adjustable supports that allow free longitudinal movement with little or no lateral or vertical movement.
- C. Air Diffusers: Coarse bubble diffusers.
 1. Submergence: As shown on the drawings..
 2. Pattern: As indicated, along one long side.

2.3 AIR DIFFUSERS

- A. Coarse Bubble Diffusers:
 1. Air Flow Rate:
 - a. Aerated Grit Tanks: 125 SCFM, each tank.
 - b. Post Aeration Tanks: 100 SCFM, each tank.
 2. Maximum Allowable Head loss: 4 inch of water, excluding submergence.
 3. Configuration: Non-valved orifice type; stainless steel; balancing nozzle, inverted air reservoir, air exit ports located on horizontal planes on two levels, and deflector that directs liquid along diffuser outer walls.

a. Products:

- 1) Aqua-Aerobic: www.aqua-aerobic.com/#sle.
- 2) Environmental Dynamics: www.wastewater.com/#sle.
- 3) Approved equal.

PART 3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the manufacturer's written instructions.
- B. Provide the services of manufacturer's technical representative to supervise installation, adjustment, and testing, and startup.
- C. Adjust diffuser mountings so that all diffusers on a header are within 1/8 inch of common horizontal plane.

3.2 FIELD QUALITY CONTROL - PRIOR TO STARTUP

- A. In-Tank Diffusers: Test by filling tank with water to depth of approximately two feet above top of diffusers, and:
 1. Apply air at design pressure.
 2. Inspect diffusers for proper operation and uniformity of diffusion.
 3. Adjust diffusers as required for uniform diffusion.
- B. Replace diffusers that cannot be sufficiently adjusted.

3.3 OWNER PERSONNEL TRAINING

- A. See Section 46 0500 for additional requirements.
- B. Operating Personnel Training:
 1. Sessions: One.
 2. Trainees: Two.
 3. Training Hours: 2.
- C. Maintenance Personnel Training:
 1. Sessions: One.
 2. Trainees: Two.
 3. Training Hours: 4.

3.4 FIELD QUALITY CONTROL - AFTER STARTUP

- A. Replace diffusers that cannot be sufficiently adjusted.

END OF SECTION

SECTION 46 7621 - BELT FILTER PRESSES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Contractor shall provide all labor, materials, equipment and incidentals as shown on the Drawings, as specified herein, and as required to furnish and install a complete skid mounted belt press for blended primary and secondary sludge dewatering.
2. System components generally include the skid base assembly, positive displacement sludge feed pump with VFD drive, electromagnetic sludge flow meter, polymer system, sludge mixing system, belt press, hydraulic power unit, belt washwater booster pump, NEMA 4X control panel with touch screen HMI, PLC based process control system, and all other components required for a complete installation.

B. Related Sections :

1. Section 05 5010 - Miscellaneous Metal: Miscellaneous metalwork and fasteners as required by this Section.
2. Section 40 9200 - Process Control Descriptions: Additional control descriptions for equipment specified in this Section.
3. Division 26 - Electrical.

1.2 REFERENCES

- A. American Gear Manufacturers Association (AGMA)
- B. ASTM International (ASTM)
- C. National Electrical Manufacturers Association (NEMA)
- D. Virginia Department of Environmental Quality (VDEQ)
1. Sewage Collection and Treatment Regulations.

1.3 SUBMITTALS

- A. Section 01 3300 - Submittal Procedures: Requirements for submittals.
- B. Product Data: Submit manufacturer's product data for system materials and component equipment, including electrical characteristics and connection requirements.
- C. Shop Drawings:
1. Indicate system materials and component equipment.
 2. Submit wiring and control diagrams, installation and anchoring requirements, fasteners, and other details.

- D. Manufacturer's Certificate:
 - 1. Submit Certificate of Proper Use.
 - 2. Submit Certificate of Proper Installation.
- E. Manufacturer's Instructions: Submit detailed instructions on installation requirements, including storage and handling procedures.
- F. Source Quality-Control Submittals: Indicate results of factory tests and inspections.
- G. Field Quality-Control Submittals: Indicate results of Contractor-furnished tests and inspections.

1.4 CLOSEOUT SUBMITTALS

McGill Section 017823.

- A. ~~Section 01 70 00 - Execution and Closeout Requirements:~~ Requirements for closeout procedures.
- B. Project Record Documents: Record actual locations and final orientation of equipment.
- C. Operation and Maintenance Data: Submit maintenance instructions for equipment and accessories.
- D. Submit Certificate of Proper Installation.

1.5 MAINTENANCE MATERIAL SUBMITTALS

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Requirements for maintenance materials.
- B. Furnish the following Spare Parts:
 - 1. One complete set of dewatering belts.
 - 2. One complete set of discharge blades.
 - 3. One complete set of sludge containment seals.
 - 4. One press roller bearing of each different size used.
 - 5. One oil filter for the hydraulic power unit.
- C. Tools: Furnish special wrenches and other devices required for Owner to maintain equipment components.

1.6 QUALITY ASSURANCE

- A. Component Supply and Compatibility:
 - 1. Obtain all equipment included in this Section, regardless of component manufacture, from one single manufacturer.

2. The single manufacturer supplying the equipment required by this Section shall review and approve, or prepare, all Shop Drawings and other submittals for components required under this Section.

1.7 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum five years' verifiable experience.
- B. The manufacturer shall have a belt filter press of the type specified herein successfully operating for a minimum of five years in each of at least ten wastewater treatment plants in the USA, along with shop drawing, date of installation, contact person and contact number for each installation.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Section 01 6000 - Product Requirements: Requirements for transporting, handling, storing, and protecting products.
- B. Deliver materials in manufacturer's packaging, including application instructions.
- C. Inspection: Accept equipment on-Site in original packaging. Inspect for damage.
- D. Store equipment according to manufacturer's instructions.
- E. Protect equipment from water and wet weather.

1.9 EXISTING CONDITIONS

- A. Field Measurements: Verify field measurements prior to fabrication. Indicate field measurements on Shop Drawings.

1.10 WARRANTY

McGill Section 017700

- A. ~~Section 01 7000 - Execution and Closeout Requirements:~~ Requirements for warranties.
- B. The equipment shall be guaranteed against defects in material and workmanship under normal use and service for a period of one year after start up during which time replacement parts shall be provided without charge. Further, an additional four year warranty (total of five years) shall be provided for the belt press frame and its coating, the belt press rollers and their coatings and the belt press roll bearings.

PART 2 - PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS:

- A. Manufacturer List:
 1. The basis of design for equipment in this Section is Komline Sanderson's Model GRS-2.0 Series III Kompress two-belt extended length press with galvanized steel frame and appurtenances.

2. Other Pre-approved equipment manufacturers include Alfa Laval. Additional manufacturers may be added to the Pre-approved manufacturer's list by Addendum.
 3. Substitutions: Section 01 2500 - Substitution Procedures.
- B. The naming of a manufacturer and model number is not an indication that the manufacturer's standard equipment offering is acceptable in lieu of the specified features. Naming of a manufacturer is instead an indication that the manufacturer may have the capability of providing the system as specified. Manufacturer shall make any necessary modifications to meet all the requirements of the Contract Documents.
 - C. Dimensions and locations shown on the Drawings for the equipment and accessories in this section are based on the equipment named as the basis of design. Any change to dimensions or locations of equipment and accessories required to accommodate equipment other than the basis of design shall be provided by the Contractor at no additional expense to the Owner.
 - D. Any costs or modifications incurred by using equipment other than the basis of design, if any, including building construction, structural, piping, electrical, mechanical, plumbing and instrumentation systems, shall be made by the Contractor at no additional expense to the Owner.

2.2 GENERAL:

- A. Each belt filter press shall be of the continuous belt design with three distinct dewatering zones including a gravity dewatering zone, an adjustable wedge or low pressure zone and a shear/pressure zone and shall consist of a galvanized steel frame, dewatering belts, an inlet flocculation/distributor, belt support/wiper bars, drainage elements, drums, rollers, bearings, discharge blades, a belt drive unit, belt tracking and tensioning systems, a belt wash system and a filtrate/belt washwater drainage system. Each belt filter press shall be factory assembled including all internal piping, valving, wiring and control devices and shall be shipped as a complete assembly except that the dewatering belts shall be shipped separately in suitable containers to prevent accidental damage.
- B. Compliance with the performance requirements of the specifications will not relieve the contractor of his responsibilities of supplying equipment having the specified structural, mechanical, corrosion resistant and operational features. Deviations from the requirements specified shall not be permitted.

2.3 EQUIPMENT DESIGN:

- A. Feed Sludge Characteristics.
 1. Feed Sludge Type: Primary sludge blended with aerobically digested secondary sludge.
 2. Design Daily Sludge Production: 852 lbs. dry solids per day, average daily flow basis.
 3. Total Solids Concentration: 1 to 3%.
 4. Sludge age: 30 days (design SRT of aerobic digester).
 5. Volatile Solids/Total Solids: 50 - 60%.

B. Required Performance Criteria:

1. Hours of Operation: maximum of 6 hours per day, 5 days per week at design daily sludge production.
2. Minimum sludge feed rate at average dry solids concentration: 20 gallons per minute.
3. Minimum solids capture rate: 88%.
4. Discharge Cake solids, minimum: 15%.
5. Maximum Polymer Usage: 20 dry lbs per ton dry solids in feed sludge.

C. Equipment Characteristics:

1. Effective belt width: 2.0 meters with overall belt width approximately 2.2 meters
2. Number of Press Units: As shown on the Drawings.
3. Power Supply: 480V, 3 Phase, 60 Hz, 20.55 FLA (15.38 KW)

D. Water Requirements:

1. Wash water: 80 gpm @ 85 psi pressure
2. Polymer Blending System: 25 gpm @ 45 psi.

2.4 EQUIPMENT SCOPE

- A. After proper flocculation of the sludge with polymer, initial dewatering shall occur by gravity drainage through the gravity section filter belt, traveling horizontally along the press. Further dewatering shall occur by squeezing the sludge between two tensioned pressure belts, first through a wedge zone then over and under a minimum of eight drums forcing entrained water from the sludge through both pressure and shear action. Dry cake discharge shall be assisted by doctor blades at each belt. Each belt shall be subsequently washed with high pressure, low volume water from spray headers before it returns to the head of its section of the press. Washwater and filtrate shall be collected in drain pans for direction to a curbed concrete drainage basin surrounding the press.

1. The overall dimensions of each fully assembled belt filter press shall not exceed 23'-0" long by 11'-0" wide by 8'-0" high.

- B. The equipment furnished shall be designed and constructed in accordance with the best practices and methods and for continuous service at maximum conditions. All parts shall be so designed and proportioned as to have liberal strength, stability and stiffness and to be fully suitable for the intended conditions of service. Provisions shall be made for easy lubrication, adjustment or replacement of all parts. Corresponding parts of multiple units shall be interchangeable. Except as otherwise specified, steel plates and shapes shall have a minimum thickness of 3/8 inch, sheet metal shall be 14 gauge minimum and bolts shall be 1/2 inch diameter minimum. All welding shall be in accordance with the latest applicable codes of the American Welding Society. All materials used shall be of the best quality and fully suitable in

every respect for the service intended. Unless otherwise specified, all materials in direct contact with sludge, polymer or filtrate shall be type 316 stainless steel or plastic. All fasteners shall be type 316 stainless steel.

- C. All materials used in the construction of the sludge dewatering equipment shall be of the best quality and entirely suitable in every respect for the service required. All structural steel shall conform to the ASTM Standard Specification for Structural Steel. All iron castings shall conform to the ASTM Standard Specifications of Gray Iron Castings and shall be of a class suitable for the purpose intended. Other materials shall conform to the ASTM Specifications where such specifications exist and the use of such materials shall be based on continuous and successful use under similar conditions of service.

2.5 SLUDGE CONDITIONING SYSTEM

- A. Each sludge conditioning system shall consist of an in-line polymer injection ring, a variable orifice venturi type mixing valve and a press mounted flocculation tank/ feed distributor to provide even distribution of sludge across the full width of the press.
- B. The polymer injection ring shall be of the multiport type to assure optimum polymer usage, shall be of polyethylene construction and shall be supplied with a polyethylene injection manifold complete with tubing and fittings for distributing polymer to the injection points on the ring. The mixing valve shall be of cast type 316 stainless steel construction and shall include provisions to vary the throat area through an external adjustably weighted lever arm for most effective instantaneous polymer/sludge mixing. The mixing valve shall also include a removable inspection cover.
- C. Each injection ring and mixing valve shall form a sludge/polymer mixing assembly which shall be located directly in the sludge feed line. The contractor shall provide spool pieces to simulate the mixing assembly at two additional locations in each sludge feed line to allow for repositioning the mixing assembly for most effective floc formation. The contractor shall also provide the necessary polymer piping and valving to accommodate the alternate mixing assembly locations.
- D. The flocculation tank/feed distributor shall be mounted on the feed end of the press and shall be sized to provide an adequate residence time for effective floc formation. The system shall consist of a lower inlet section or feed hopper and an upper distribution and exit section. All parts of the system shall be constructed of type 316 stainless steel. Sludge shall directly overflow the hopper onto the full width of the distribution section. The sludge inlet line to the tank shall incorporate a means of draining the feed hopper. The hopper shall also be provided with a drain connection. The contractor shall provide a quick opening valve and PVC piping to the drain basin below. No mechanical or static mixing devices shall be included in the hopper or distributor as such devices become fouled and require frequent cleaning.

2.6 PRESS FRAME

- A. Each side frame shall be constructed of welded members formed from 3/8 inch thick ASTM A36 structural steel plate. A minimum of five cross members shall be bolted to the side frames to form a rigid structure, properly stiffened for supporting the belt press rollers and other components and to withstand the applied loading without deflection, deformation or vibration during operation. All mainframe members shall be 7 inch channel shapes with

minimum moment of inertia of 44 inches. Channel flanges shall be turned out to allow for convenient and thorough washdown. Frame construction shall allow easy access to and visual contact with all internal press components.

- B. The frame shall have minimum safety factors of nine times the allowable yield strength in bending and ten times the allowable shear stress at an applied belt tension of 50 pounds per linear inch. Frame deflection shall not exceed 0.002 inch under the same belt tension load. Design calculations shall be submitted to substantiate the required frame safety factors and deflection limit.
- C. After fabrication all frame members shall be hot dipped galvanized per ASTM A123 to a thickness of 5 to 7 mils to assure complete and thorough corrosion protection. Painted or flame sprayed coatings are not acceptable since adequate surface protection at boltholes, slots and inaccessible areas is not assured. Stainless steel local side panels shall be provided where necessary to contain spray mist and provide operator protection from moving parts.

2.7 GRAVITY DRAINAGE SECTION

- A. Each belt filter press shall contain a gravity drainage section consisting of an inlet flocculation/distributor, a filter belt, belt supports, sludge containment seals, drainage elements, a discharge chute and a filtrate collection pan.
- B. Conditioned sludge shall be fed to the press by gravity overflow from the flocculation tank onto a sludge distributor constructed of type 316 stainless steel. Even distribution of the sludge across the entire belt width shall be achieved without the use of a driven spreader mechanism.
- C. Gravity dewatering shall occur on a horizontal traveling belt section with a minimum active dewatering length of 10 feet and a minimum active dewatering area of 53 square feet through which free water drainage shall occur. Inclined gravity drainage areas shall not be allowed due to the cloth blinding effect caused by pooling of fragile sludges. The belt shall be supported in this section by full width ultra high density molecular weight polyethylene support/ wiper bars 1-3/4 inches in diameter with minimum 3-1/2 inch spacing. The bars shall assure maximum free water drainage by repeatedly breaking the surface tension of the water on the underside of the belt. The bars shall be mounted in type 316 stainless steel support brackets. The bars shall be fabricated with square type 316 stainless steel plugs on each end which shall allow each bar to be rotated in 90 degree increments for extended life and reduced maintenance cost. The gravity drainage zone shall be so designed that the filter belt does not have to be removed to rotate or replace support bars. Replaceable rubber side seals with type 316 stainless steel holders shall be provided to contain the sludge on the belt. These seals shall not require bolted connections so that they may be easily and quickly replaced. A type 316 stainless steel discharge chute shall be provided at the discharge end of the gravity section to provide a gentle transition to the wedge zone to prevent floc shear of the thickened sludge at this point.
- D. In order to minimize polymer use, maximize hydraulic and solids loading rates and promote more rapid drainage of free water from the sludge, a combination of plows shall be located in the gravity drainage zone. A minimum of six rows of plows shall be furnished at least three rows of which shall be high rate drainage elements with the balance being plows for thorough

sludge dispersion along the entire length of the gravity zone. To facilitate convenient operator cleaning and to provide flexibility of operation, the plows shall be mounted on crossbars with lifting handles to raise and lock each row in an upright, out of service position. The crossbars shall be type 304 stainless steel; associated mounting and lifting hardware shall be hot dipped galvanized malleable iron. Each plow shall be of ultra high density molecular weight polyethylene and shall be mounted on a type 316 stainless steel holder which in turn shall be mounted on the crossbar and spaced on 6 inch centers. The plows shall be individually adjustable on the crossbars to allow for more flexibility. A total of 53 plows shall be provided in the gravity drainage zone. Plows shall be cylindrical and flare shaped at the bottom and elements shall be 6 inch diameter. Low profile cones which shall allow the sludge to keep both types of plows in constant and uniform contact with the belt. They shall also be designed to be self-cleaning by being mounted to allow them to freely and independently rotate and/or raise to prevent solids build-up.

- E. 14 gauge type 316 stainless steel drain pan shall be provided beneath the gravity drainage section to collect the filtrate and to direct it to the collection sump beneath the press through rigid PVC pipes of sufficient size to handle the drainage from the combined sludge and polymer feed streams. Other drain pan materials of construction are not acceptable due to possible cracking or breaking or failure of any applied corrosion resistant coating.

2.8 WEDGE SECTION

- A. Each press shall contain a wedge or low pressure section consisting of a pair of converging pressure belts, belt supports, troughing seals, a filtrate collection pan and provisions to adjust the angle of convergence of the belts.
- B. The wedge section shall receive thickened sludge discharged from the gravity zone, shall be horizontal and shall provide a zone wherein the two pressure belts gradually converge and begin to apply pressure to the sludge contained between the two tensioned belts. The wedge section shall have a minimum dewatering length of 6 feet and a minimum dewatering area of 31 square feet figured on the basis of one belt. The carrying belt shall be supported in this section by full width ultra high density molecular weight polyethylene support/wiper bars 1-3/4 inches in diameter spaced on 3-1/2 inch centers. The bars shall be mounted in type 316 stainless steel support brackets, shall have square type 316 stainless steel end plugs, shall be rotatable in 90° increments for extended life and shall be rotated or replaced without removing the belts.
- C. For process flexibility a manually adjustable roller shall be provided above the upper belt at the entrance to the wedge section to adjust the angle of convergence of the two belts to provide a means for adjusting the amount of pressure exerted on the sludge before entering the shear/pressure section of the press. Adjustable troughing seals shall be provided under both sides of the lower belt to prevent sludge migration beyond the belt edges and allow the application of mild pressure without process upset.
- D. A 14 gauge type 316 stainless steel drain pan shall be provided beneath the wedge section to collect the filtrate and to direct it to the collection sump beneath the press through rigid PVC pipes. Other drain pan materials of construction are not acceptable.

2.9 SHEAR/PRESSURE SECTION

- A. Each press shall include a shear/pressure section containing a minimum of eight dewatering drums in a horizontal plane which shall apply compression and shear reversals to the sludge by passing the sludge cake sandwiched between the two tensioned belts alternately over one drum and under the next. Designs that include the pressure roll profile in a vertical plane are not acceptable. The shear/pressure section shall begin with a 30 inch diameter perforated drum which shall be self-bailing to provide unimpeded filtrate drainage without rewetting of downstream cake and provide a gradual transition into the shear/pressure section. The remainder of the dewatering drums shall be solid surface drums and shall vary from 20 to 10 inches in diameter to provide the proper combination of dewatering area, applied pressure profile and time under pressure. The shear/pressure section configuration shall provide a minimum belt length in actual contact with the drums of 17 feet and a minimum dewatering area in actual contact with the drums of 99 square feet figured on the basis of one belt. Inactive belt runs between dewatering drums shall be kept to a minimum.

2.10 BELTS

- A. Each press shall be provided with two dewatering belts which shall be seamed and shall be fabricated of wear-resistant monofilament polyester. The mesh design, porosity and tensile properties shall be selected for optimum dewatering of the specific sludge to be processed and for a minimum life of 2000 hours of continuous failure-free operation. Each belt shall be a minimum of 67 inches wide, providing an effective 1.5 meter operating belt width in contact with the sludge.
- B. Belt edges shall be heat sealed and bonded for stability. A low profile type 316L stainless steel clipper seam shall be used to join the belt ends. Multiple coats of polyurethane adhesive shall be applied to the belt/clipper seam joint to provide a full and uniform bond at the joint, to reinforce the joint and to provide a smooth transition from belt to seam for proper doctor blade and drainage system element interface.
- C. Belts shall be designed for ease of replacement with a minimum of press downtime. Belt replacement shall be such that disassembly of the equipment is not required.

2.11 BELT WASH SYSTEM

- A. Each press shall be furnished with a belt wash system consisting of a spray header, a spray containment housing and a washwater collection box for each belt to thoroughly clean both belts after cake discharge. The belt wash system shall be suitable for use with plant effluent water furnished at a line pressure of 40 psig at the belt press locale. A washwater booster pump shall be furnished with each press to provide the required operating pressure to the belt wash system when adequate line pressure is not available. The system demand for each press shall be 62 gpm at 85 psig.
- B. A Self-cleaning spray header shall be furnished for each belt consisting of a schedule 10 type 316 stainless steel header, a series of replaceable type 317LM stainless steel spray nozzles providing an overlapping spray pattern on each belt, a replaceable stainless steel nozzle cleaning brush inside the header and an external handwheel operator which shall make the header self-cleaning. A full turn of the handwheel shall cause the brush to clean the nozzle orifices and shall allow the flushing water to pass through the header for discharge directly to

the collection basin beneath the press through a rigid PVC pipe. Presses without this or similar direct individual nozzle cleaning provisions shall not be acceptable.

- C. A 14 gauge type 316 stainless steel enclosure shall surround each wash header both to contain spray mist and to collect and discharge the spent washwater. The wash header enclosures shall include a housing above and below the filter belt to contain all mist and spray water and shall include easily replaceable brush type seals above and below the belt at both the entry and exit of the enclosures to prevent the escape of spray mist. Seal replacement shall be convenient and quick and shall not involve the use of bolted connections. Spent washwater shall be directed to the collection sump under the press through rigid PVC piping. Other enclosure materials of construction shall not be acceptable due to possible cracking or breaking or failure of any applied corrosion resistant coating.
- D. The spray headers shall be piped to a common washwater inlet connection on the press. A NEMA 4X pressure switch shall be provided in the water inlet manifold to provide an alarm signal in the event of low washwater pressure. Each spray header shall have a 150 psi Victaulic clamp connection to the water inlet manifold to allow for belt spray direction adjustment. A NEMA 4X solenoid valve for on-off control shall be provided and installed by the contractor at the inlet manifold and wired to the control panel.
- E. Washwater booster pump shall be furnished for each press to raise the system water pressure to the required operating level. The pump shall be a horizontal end suction centrifugal pump in type 316L stainless steel construction with mechanical shaft sealing. The pump shall be driven by a direct coupled 5 hp, 3600 rpm, TEFC motor and shall be furnished with a common steel channel base for the motor, pump and a coupling guard.

2.12 BELT TRACKING SYSTEM

- A. Each press shall be furnished with a continuous automatic belt tracking system consisting of a belt edge location sensor, a proportional tracking valve, a steering roller and a hydraulic cylinder for steering roller control for each of the belts along with a common hydraulic control system. Electro-mechanical belt tracking systems and belt tracking systems that are non-continuous shall not be permitted. The system shall constantly monitor belt location and through the proportional sensor, continuously adjust each belt path as necessary to maintain a central location on the rollers thereby preventing over-steering and belt wrinkling and providing longer belt life.
- B. A stainless steel sensing arm shall be in continuous contact with each belt edge and its location shall govern the position of a proportional pilot valve which in turn shall affect the position of a hydraulic cylinder which shall be connected to a pivotable belt steering roller. The cylinder shall cause the roller to skew from its transverse position and cause the belt to track centrally on the press rollers. The alignment system shall operate with smooth and slow motions resulting in a minimum of belt travel from side to side. Limit switches in NEMA 4X enclosures shall be furnished on both sides of each belt to sense gross belt misalignment and provide a signal to immediately shut the entire system down and sound an alarm in the event of a tracking system failure of either of the belts.
- C. A hydraulic control system shall be provided. For maximum corrosion resistance each hydraulic cylinder shall have heads, a fiberglass body, a chrome plated rod and stainless steel

hardware. Belt tracking and tension controls shall be located on the hydraulic power unit. All hydraulic lines shall be stainless steel tubing, neatly arranged and run along and across the press framing.

- D. A hydraulic power unit shall be furnished for each press consisting of a 2 hp, 1800 rpm, TEFC motor, a variable volume pressure compensated pump, a system pressure gauge, a tension control/relieving valve, a tension system pressure gauge, a breather type filler cap, a return filter with bypass, a level sight gauge and a thermometer all mounted on a 5 gallon type 316 stainless steel reservoir. The power unit shall be mounted on the press frame. All system hydraulic piping and tubing shall be factory furnished and installed. A NEMA 4X pressure switch shall be included to sense low system pressure and provide a signal to shut the entire system down and sound an alarm in the event of the loss of system pressure. The hydraulic unit is a completely sealed stainless steel unit designed for direct wash down in a WWTP including the wash down severe duty AC motor.

2.13 BELT TENSIONING SYSTEM

- A. Each press shall be furnished with a belt tensioning system for each of its belts consisting of a tension roller, hydraulic cylinders to apply tension to the belt, a rack and pinion mechanism to synchronize the hydraulic cylinder motions and a hydraulic control system. The tensioning system shall be such that dewatering pressure is directly proportional to belt tension and that adjustments in belt tension shall result in immediate changes in dewatering pressure.
- B. A tension roller shall be provided for each belt and it shall be powered by a hydraulic cylinder on each end of the roller. The motion of each cylinder shall be synchronized with its opposite side cylinder. This cylinder synchronization arrangement shall consist of a frame mounted rack and a tension assembly mounted pinion on each side of the press. The pinions, rigidly connected to a cross-shaft, shall provide parallel movement of the tension roll ends thereby preventing belt tracking and alignment problems. For maximum corrosion resistance the pinions and racks shall be nylon; the hydraulic cylinders shall be furnished with heads and fiberglass bodies, chrome plated rods and stainless steel hardware.
- C. Belt tension shall be controlled at the hydraulic power unit by means of a tension control valve as previously described. A common control shall be furnished such that both belts are tensioned equally preventing operational difficulties due to unequal belt tensions. Once set, the dewatering pressure shall be maintained automatically regardless of process changes. The belt tension system shall be designed to provide belt tensions varying from 0 to 50 pounds per linear inch throughout the shear/pressure section of the press. A directional control valve shall also be provided on the press for retraction of the tension cylinders when required.

2.14 BELT DRIVE SYSTEM

- A. Each press shall be provided with a belt drive system consisting of a rubber covered belt drive roll, a gear reducer with an AC drive motor for variable frequency control of the two belts. Hydraulic belt drive motors shall not be permitted.
- B. The belt drive motor shall be a 3 hp, 1800 rpm, TEFC, severe duty energy-efficient AC motor. The motor shall be C-face mounted to a hollow shaft, torque arm helical-bevel reducer, AGMA Class II rated, which shall be shaft mounted on the drive roll. The belt speed range shall be adjustable over a range of 2 to 20 feet per minute. For positive belt traction the belt

drive roll shall be rubber covered. The drive roll body shall be a minimum of 9-1/2 inches in diameter with a 1/4 inch thick minimum rubber covering on top of that.

- C. Each drive motor shall contain a thermal sensor imbedded in the windings which shall provide a signal for alarm and system shutdown if excessive motor temperature develops. Loss of motion detectors shall be provided on the press to sense belt drive failure or a broken belt condition and provide signals for system shutdown and sound an alarm in the event that either of these conditions occur. The drive motor shall be located above the discharge rolls and away from high moisture areas. A variable frequency controller shall be furnished in the belt press electrical control panel to provide power and speed control for the belt drive motor.

2.15 DISCHARGE BLADES

- A. Each press shall contain two discharge blades to assist in removing dewatered sludge cake from the belts at the discharge end of the press. The lower blade shall also direct the sludge cake to the receiving device (conveyor, container, chute, etc.). The discharge blades shall be replaceable and shall be made from high density polyethylene and each shall have two beveled edges for doubling the life of the blade. The blades shall be mounted on 316 stainless steel constructed, stiffened, pivotable support members with arms at each end for mounting adjustable counterweights for maintaining the proper pressure between the blades and the discharge rolls thereby reducing belt and closure wear. Lockable handles shall be provided so that the blades can be easily positioned away from the belts for cleaning.

2.16 DRUMS AND ROLLERS

- A. Each press shall be furnished with the necessary drums and rollers to provide gravity dewatering, shear/pressure dewatering, belt drive, belt tension, belt tracking and general belt support. A minimum of one perforated drum shall be furnished, all others shall be solid surface drums and rollers.
- B. Type 316 stainless steel shall be used for the perforated drum body and its end plates. The body shall be 3/16 inch thick and end plates 1/2 inch thick. Perforated drum shaft journals shall be type 17-4 PH stainless steel. All other drums and rollers shall be constructed of ASTM A-53, A-106 or A-500 Grade B carbon steel with wall thicknesses of 1/2 inch minimum. Larger diameter major load carrying drums shall have forged or one piece shaft and end plate machined from single bar stock using AISI 4140 material. The rubber covered drive roll shall have 17-4 PH stainless steel shafts. Smaller diameter nominal load carrying rollers shall have AISI 1045 steel shafts deep bored shrink fit and welded solid journal construction on each end. Shaft diameters through the support bearings shall be 2-13/16 inches diameter minimum for pressure drums and 2-11/16 inches diameter minimum for rollers.
- C. Belt drive rollers shall have a 1/4 inch thick 80 durometer vulcanized rubber covering for gripping the belts and for corrosion protection and shall have type 316 stainless steel end plates. All other solid surface drums and rollers shall have a 30 mil thick black fusion bonded applied nylon coating for corrosion protection which shall cover the roll body, ends and shafts up to the point of insertion into the bearings.
- D. All drums and rollers shall be designed to withstand the stress reversals inherent in rotating elements and shall be designed with a minimum factor of safety of 2 over fatigue failure of the material for shafts and 5 over fatigue failure for drum and roller bodies. Drum and roller

design shall be based on operating at rated belt speed, a belt tension of 50 pounds per linear inch on each belt and rated drive horsepower. Shaft stress concentration shall be minimized by the use of generous, well polished radii. Deflection of all drums and rollers whether major load carrying or not, shall be limited to 0.015 inch over the full width of the drum or roll body when operating at a belt tension of 50 pounds per linear inch per belt at rated drive horsepower. Calculations shall be furnished substantiating shaft sizing, drum and roll construction design, fatigue failure safety factors and drum and roller deflection.

2.17 BEARINGS

- A. The shafts of all drums and rollers on each press shall contain heavy duty self-aligning double row spherical roller bearings in split case four bolt base cast iron pillow block housings. Self-alignment shall occur within the housing. The housings shall permit the changing of bearings without disturbing the factory-set alignment of the rollers.
- B. Bearings shall be arranged for tapered adapter mounting to the drum and roller shafts. Bearings shall contain contact seals and shaft mounted splashguards on the shaft side to provide adequate sealing from moisture and grime. Non-shaft sides of bearing housings shall be solid. Bearing housings shall have a factory applied 12 mil thick black fusion bonded applied nylon coating for added corrosion resistance. All bearing hardware shall be stainless steel. All roller bearings shall be main frame mounted and shall be greaseable while the press is in operation.
- C. All roller bearings shall have an L-10 bearing life in excess of 1,800,000 hours with belts tensioned at 50 pounds per linear inch and with belts traveling at rated speed. Calculations shall be furnished demonstrating compliance with these provisions.

2.18 MISCELLANEOUS

- A. Each press shall be provided with two orange safety trip cords at each side of the press, one at a lower elevation and one at a higher elevation. Each cord shall be connected to a NEMA 4X dual actuated emergency stop switch which shall immediately stop the belt drives and shut down the entire system upon pulling or breaking of the trip cord. These switches shall be independent of the gross belt misalignment switches and shall require resetting at the press before the equipment can be restarted.
- B. Each press shall be complete with all intra-unit power and control wiring terminating in a single press mounted NEMA 4X stainless steel junction box. All wiring shall be run in rigid PVC conduit for added corrosion resistance.
- C. Each press shall be complete with all intra-unit hydraulic system and washwater piping as well as all filtrate and washwater drain lines directed to the collection basin beneath the press, all washwater supply piping terminating at a single washwater inlet connection. All interconnecting stainless steel hydraulic piping and tubing is included.
- D. For maximum corrosion resistance, all miscellaneous steel parts such as brackets, guards, spacers, etc. shall be fabricated from 304 stainless steel or UHMW plastic material.

2.19 ELECTRICAL CONTROL PANEL

- A. An electrical control panel shall be furnished with each belt filter press to control the belt press functions and those of the related auxiliary equipment specified herein. The panel shall be preassembled and prewired and shall include all controls necessary for semi-automatic system operation with provisions also for manual control of individual items when desired. The panel shall be suitably wired for connection to a 480 volt, 3 phase, 60 Hertz power source.
- B. The enclosure shall be fabricated from 14 gauge type 304 stainless steel, shall be floorstand-mounted and constructed to NEMA 4X standards. Instruments and control devices mounted on the enclosure door shall be rated for or installed in such a manner as to maintain the NEMA 4X integrity. Nameplates shall be engraved laminated phenolic with black background and white letters to identify each component mounted on the panel face. Letter height shall not be less than 3/16 inch. Additionally, the complete panel, as an assembly, shall be built in accordance with UL 508A and shall have a UL serialized label.
- C. Wiring shall be accomplished in a neat workmanlike manner and run in PVC wiring duct where practical. Where not practical it shall be supported and tied in position with nylon cable ties. All wiring shall be identified with a number code and all wiring for external connection shall be brought to a numbered terminal strip. Wiring shall comply with the applicable requirements of the latest edition of the National Electrical Code. Interconnecting wiring between this panel and the press and other related equipment shall be the responsibility of the contractor.
- D. The enclosure shall house a flange mounted dead front main disconnect, all motor starters, variable frequency controls, a programmable logic controller, interlocks, alarms, indicating lights and operator controls required for the operation of the belt filter press and auxiliary equipment described in this specification section. Each AC motor, contactor and wiring shall be protected by a properly sized motor starter protector and overload relays. Variable frequency drives shall be protected by properly sized fuses. Indicating lights and operator controls only as required shall be included in this panel for other system auxiliary equipment items described in other sections of the specifications. Starters, variable speed drives, controllers, etc. for such other items shall be furnished by others and shall be located elsewhere. The following control interfaces shall be provided for this auxiliary equipment: dry contacts rated at 10A 125V for start/stop control, PLC inputs to accept dry contact 'on' status and motor overload/fail signals, 4-20 ma DC signals or high/low speed switch contact closures as required for speed command signals. System interlocking and logic shall be provided by an industrial grade programmable logic controller meeting the following minimum requirements:
1. Total input/output: As required, expandable I/O
 2. Memory: EEPROM or FLASH
 3. Allen Bradley Micrologix Series
 4. CPU to have integrated Ethernet Communications
- E. Components shall be selected and the enclosure sized to limit the enclosure internal heat rise to 10°C while operating in a 40°C ambient. Calculations or method of determining compliance shall be submitted to the Engineer with the initial drawing submittal. A minimum of 20% spare

terminal blocks shall be provided. The control panel shall be completely tested under simulated field conditions by the press manufacturer prior to shipment. The Operation and Maintenance Manual shall contain complete as-built drawings including schematics, physical layout and terminal connections. It shall also contain tabulated maintenance procedures.

- F. The control panel shall include an Allen-Bradley PanelView Plus 1000 touch screen HMI with Ethernet Communications to provide the following controls and indicators:
1. Main disconnect switch.
 2. System automatic cycle start/stop control with on status light.
 3. Hydraulic power unit start/stop control with on status/motor fail light.
 4. Belt washwater booster pump start/stop control with on status/motor fail light and/or washwater solenoid valve to open/close appropriately.
 5. Belt drive start/stop control with on status/motor overtemperature light, speed control potentiometer and speed indicator.
 6. Sludge feed pump start/stop control with on status/motor fail light, speed control and speed indicator.
 7. Sludge meter flow rate indicator.
 8. Polymer feed pump start/stop control with on status/motor fail light, speed control and speed indicator as required.
 9. Sludge cake conveyor start/stop control with on status/motor fail light if required.
 10. Start/stop controls with on status/motor fail lights for any other auxiliary equipment items if required.
 11. Belt prewet and post wash cycle indicator lights.
 12. Motor run/jog selector switch.
 13. Emergency stop pushbutton with alarm/emergency trip light.
 14. Gross belt misalignment alarm light.
 15. Low system hydraulic pressure alarm light.
 16. Low system washwater pressure alarm light.
 17. Belt drive fail/broken belt alarm light.
 18. Alarm lights as required for other specified alarm conditions.
 19. Audible alarm horn.
 20. Alarm acknowledge pushbutton.

21. Alarm reset/lamp test pushbutton.

- G. Each press shall be provided with a belt drive system consisting of a rubber covered belt drive roll, a gear reducer with an AC drive motor for variable frequency control of the two belts. Hydraulic belt drive motors shall not be permitted.
- H. Semi-automatic operation of the entire system shall be controlled by a single start/stop cycle control. This control along with status and alarm contacts shall provide inputs to the programmable controller (PLC). The controller shall continuously scan the inputs and according to a logic program stored in its memory shall develop the appropriate run, stop, status or alarm signals for devices connected to its output. The PLC shall cause specific functions to be interlocked, timed, started or stopped as required during the start up, run and shutdown modes of operation. These modes of operation may be operator initiated or caused by one of the inputs. Essentially, the PLC shall initiate and monitor each step of the cycle, check that all interlocks are satisfied and drive start-ups are confirmed before proceeding to the next step, provide for prewetting the belts before sludge is introduced to the press on start-up and provide for the proper timed intervals for complete discharge of sludge cake and thorough belt washdown during the shutdown cycle. The control system shall allow unattended operation in the semi-automatic mode. In the manual mode of operation, the system shall be started and stopped by the actuation of each individual component control.
- I. During operation in either mode, any of the following alarm conditions shall activate the alarm horn and respective alarm causing the entire system to shut down, either instantaneously or in the normal programmed sequence as appropriate:
- J. Gross misalignment of any belt, low system hydraulic pressure, low washwater pressure, emergency stop at the press, belt drive failure, any broken belt, belt drive motor overheats, active feed pump or polymer system failure, AC motors overloaded or emergency stop at the control panel.
- K. Alarm annunciation shall follow ISA sequence AM. If the operator can correct an alarm condition during programmed shutdown, the PLC shall allow continuation of full operation by reactivation of the cycle control.
- L. Each press shall be provided with a belt drive system consisting of a rubber covered belt drive roll, a gear reducer with an AC drive motor for variable frequency control of the two belts. Hydraulic belt drive motors shall not be permitted.
- M. For either semi-automatic system operation where the programmable logic controller assumes control or manual control where an operator assumes control, the sequence of operation shall be as follows:
 - 1. Start-up Sequence:
 - a. Start the hydraulic power unit.
 - b. Start the belt washwater booster pump and/or open the washwater solenoid valve.

- c. Start the belt drive.
 - d. Start the conveyor.
 - e. After allowing the belts to become wet, start the polymer feed pump and the sludge feed pump.
 - f. Start any other auxiliary equipment item at the appropriate time during the sequence.
 - g. Adjust belt speed and/or sludge and polymer feed rates if required.
2. Shutdown Sequence:
- a. Stop the sludge and polymer pumps.
 - b. After allowing sludge to discharge completely from the belts and allowing for complete belt washdown, stop the washwater booster pump and/or close the solenoid valve.
 - c. Stop the belt drive.
 - d. Stop the hydraulic power unit.
 - e. Stop the conveyor.
 - f. Stop any other auxiliary equipment at the appropriate time during the sequence.

2.20 SLUDGE FLOW METER

A. General:

- 1. Each sludge feed system shall provide an in-line electromagnetic flowmeter manufactured by Foxboro corporation, or approved equal. Meters that use probes or paddle wheels that protrude into the sludge flow are not acceptable.
- 2. The sludge flowmeter shall be of rugged construction, rated for wet corrosive environments and sized adequately not to restrict sludge flow or sludge conditioning.

B. Performance:

- 1. The sludge flowmeter function shall not be affected by uneven flow or affected by low-frequency noise (slurry noise).
 - a. The flowmeters detector tube shall be highly resistant to abrasive fluid.

C. Construction:

- 1. The entire unit shall be NEMA 4X (IP67) watertight rated.

D. Controls:

1. The unit shall be integrated with the main touch screen control in the main belt press control panel. The controls shall be as follows:
 - a. Master non resettable gallon counter
 - b. Reset able gallon counter
 - c. GPM indicator
- E. Mounting:
 1. The sludge flowmeter shall be wafer type, for mounting between two ANSI class 150 pound flanges.
 2. The sludge flowmeter shall be mounted and pre-wired to Belt Filter Press main skid if provided.
 3. It shall be the responsibility of the contractor for the proper mounting, wiring and plumbing, if the location is different than specified as above.

2.21 SURFACE PROTECTION

- A. Belt filter press materials of construction (stainless steel, fiberglass, plastic, etc.) and protective coatings and coverings (hot dipped galvanizing, fusion bonded nylon, rubber, etc.) shall be completely corrosion resistant such that shop or field applied paint coating is not required.
- B. Miscellaneous parts such as brackets, spacers, guards, etc. shall be fabricated from type 304 stainless steel, galvanized steel or plastic and shall not require shop or field applied paint coating.
- C. Items such as motors, gear reducers, pumps, hydraulic power units and the like shall receive standard manufacturer's finish coatings.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Requirements for installation examination.
- B. Verify that equipment is ready for installation.

3.2 INSTALLATION

- A. Install equipment according to manufacturer's instructions.

3.3 FIELD QUALITY CONTROL

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Requirements for testing, adjusting, and balancing.

- B. **Manufacturer Services:** The belt press manufacturer shall furnish the services of a competent and experienced person for a period of eight days to be covered in two trips to job site to check the installation, supervise the start up, supervise the performance testing and provide operator instruction for the equipment furnished. Additional service, if requested, shall be available at the manufacturer's portal to portal per diem rate in effect at the time of service delivery, plus all travel and living expenses.

3.4 PERFORMANCE TESTING

- A. The equipment manufacturer shall conduct a performance test to demonstrate that the installed equipment can meet the specified performance requirements. One press shall be selected for testing. The test shall occur as soon as possible after successful equipment start up and process and system stabilization has been accomplished.
- B. The test period shall consist of one five hour steady state test run with sludge feed, sludge cake and effluent (combined filtrate and washwater) samples taken at the start of each run and every hour thereafter resulting in a total of six samples of each type. The sludge feed and effluent samples shall be analyzed for total suspended solids content; the cake samples shall be analyzed for total solids content. The resulting solids contents shall be averaged and the average value of each type shall be used to judge satisfactory performance. Polymer solution strength and flow rate shall be recorded. Sludge feed rate shall be recorded.
- C. The press manufacturer's representative shall operate the equipment during the test. The owner shall furnish personnel to assist in the operation and to take samples. The owner shall also furnish sludge, water, polymer, utilities, sludge cake disposal, routine test equipment and laboratory services for analyzing the samples. The belt press manufacturer shall recommend the most suitable polymer which shall be furnished by the owner. The contractor shall provide any special instrumentation for measuring sludge feed or polymer feed rates.
- D. The equipment shall have passed the performance test if the specified cake solids, solids capture and polymer use requirements are met with the press operating at the specified hydraulic and solids loading rates.
- E. Should the installed equipment fail to meet the specified performance requirements, the manufacturer shall within 30 days make changes in the equipment or method of operation as necessary and the equipment shall be retested. If after a second 30 day period, the equipment still does not meet the performance criteria, the equipment shall have failed the performance test and the owner shall require its removal and replacement with the specified equipment at no additional cost to the owner.

3.5 DEMONSTRATION

- A. Section 01 7000 - Execution ~~and Closeout~~ Requirements: Requirements for demonstration and training.
- B. Demonstrate equipment startup, shutdown, routine maintenance, and emergency repair procedures to Owner's personnel.

END OF SECTION

APPENDICES

APPENDIX B

PERMITS

