

**Wastewater Treatment Plant Sludge
Dewatering Improvements**

City of Wheeling

August 2026



0000038009

CITY OF WHEELING OFFICIALS

ADMINISTRATION

Denny Magruder, Mayor

Robert Herron, City Manager

William Lanham II, Assistant City Manager

Chelsea Brown, Administrative Assistant

Nathan Greene, Finance Director

David Pesi, Utility Accounting

Marcia Embrey, Water Billing/Accounting

Rosemary Humway-Warmuth, City Solicitor

Travis Workman, Interim City Engineer

Mike Chiazza, Water Pollution Control Plant Superintendent

Lori Siburt, Water Department Superintendent

COUNCIL

Tony Assaro, Ward 1

Ben Seidler, Ward 2

Connie Cain, Ward 3

Jerry Skalvounakis, Ward 4

Ty Thorngate, Ward 5

Dave Palmer, Ward 6

Jessica Holloway, City Clerk

ADVERTISEMENT FOR BIDS/PUBLIC NOTICE TO BIDDERS

Sealed bids will be received by the City of Wheeling, WV at the office of the City Manager, 1500 Chapline Street, Wheeling, WV 26003 until 2:30 p.m. on September 3, 2026 and will be opened and read immediately thereafter for the

WASTEWATER TREATMENT PLANT SLUDGE DEWATERING IMPROVEMENTS

COMPLETION DATE: 270 DAYS FROM NOTICE TO PROCEED

The bid specifications, drawings, plan holders list, addenda, and other bid information (**but not the bid forms**) may be viewed and/or downloaded for free via the internet at <https://bids.verdantas.com>. The bidder shall be responsible to check for Addenda and obtain same from the web site.

Bids must be in accordance with drawings and specifications and on forms available from Verdantas LLC at a non-refundable cost of One Hundred Seventy-Five Dollars (\$175.00) for hard copies **and \$45.00 for electronic files**. Documents may be ordered by registering and paying online at <https://bids.verdantas.com>. Please contact planroom@verdantas.com or call (440) 530-2351 if you encounter any problems viewing, registering or paying for the documents.

There will be a Pre-Bid Conference on August 26, 2026 at 10:00 a.m. in the WPCD Conference Room, 2516 Main Street, Wheeling, WV 26003.

All bidders are required to have a West Virginia Contractor's License per Sections §21-11-11 of the West Virginia Code and it is to be included with the bid.

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SECTION 1
BID DOCUMENTS

INSTRUCTIONS TO BIDDERS

PART 1 GENERAL

- 1.1 Sealed bids shall be received by the Owner at the location specified and until the time and date specified in the Advertisement for Bids/Public Notice to Bidders.
- 1.2 Each bid shall contain the full name and address of each person or company interested in said bid. If no other person be so interested, the Bidder shall distinctly so state the fact.
- 1.3 Bid forms must be completed in ink or by typewriter. Any corrections to the bid forms prior to submission must be initialed by the person signing the bid. Failure to submit any bid form(s) or other required document(s) may be cause for rejection of the bidder's bid at the sole discretion of the Owner.
- 1.4 Bids by Corporations must be executed in the corporate name by the President, Vice President, or other officer accompanied by evidence of authority to sign and the corporate seal must be affixed and attested by the Secretary on the Corporate Resolution form.
- 1.5 Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature.
- 1.6 All names must be typed or printed below the signature.
- 1.7 The bid shall contain an acknowledgment of receipt of all Addenda.
- 1.8 If a Bidder wishes to withdraw his bid prior to the opening of bids, he shall state his purpose in writing to the Owner before the time fixed for the opening, and when reached it shall be handed to him unread.
- 1.9 After the opening of bids, no Bidder may withdraw his bid for a period of 120 days.

PART 2 EXAMINATION OF CONTRACT DOCUMENTS AND SITE

- 2.1 Before submitting a bid, each Bidder must
 - A. Examine the Contract Documents thoroughly.
 - B. Visit the site to familiarize himself with local conditions that may in any manner affect cost, progress, or performance of the work.
 - C. Familiarize himself with Federal, State, and local laws, ordinances, rules, and regulations that may in any manner affect cost, progress, or performance of the work.
 - D. Study and carefully correlate Bidder's observations with the Contract Documents.

- 2.2 Reference is made to the Specific Project Requirements for the identification of any reports of investigations and tests of subsurface and latent physical conditions at the site or otherwise affecting cost, progress or performance of the work which have been relied upon by the Engineer in preparing the drawings and specifications. Owner will make copies of such reports available to any Bidder requesting them if not made available with the bid documents. These reports are not guaranteed as to accuracy or completeness; nor are they part of the Contract Documents. Before submitting his bid each Bidder will, at his own expense, make such additional investigations and tests as the Bidder may deem necessary to determine his bid for performance of the work in accordance with the time, price and other terms and conditions of the Contract Documents.
- 2.3 Upon request, the Owner will provide each Bidder access to the site to conduct such reasonable investigations and tests as each Bidder deems necessary for submission for his bid.
- 2.4 The lands upon which the work is to be performed, rights-of-way for access thereto, and other lands designated for use by Bidder in performing the work are identified on the Drawings.
- 2.5 The submission of a bid will constitute an incontrovertible representation by the Bidder that he has complied with every requirement of this section and that the Contract Documents are sufficient in scope and detail to indicate and convey understanding of all terms and conditions for performance of the work.

PART 3 ESTIMATED QUANTITIES

- 3.1 In Unit Price Contracts, the quantities of the work itemized in the bid are approximate only and the bidders are hereby notified that the estimated quantities made by the Engineer are merely for the guidance of the Owner in comparing on a uniform basis all bids received for the work.
- 3.2 The contract quantities, where itemized, are based on plan horizontal and vertical dimensions unless otherwise specified. It is the Contractor's responsibility to verify and determine actual quantities of materials such as pipe, pavement, subgrade, etc. in his ordering materials.
- 3.3 Payments, except for lump sum contracts and except for lump sum items in unit price contracts, will be made to the Contractor only for the actual quantities of work performed or materials furnished in accordance with the plans and specifications. It is understood that the scheduled quantities of work to be done and materials to be furnished for items labeled as "Contingency" may be increased or diminished by any amount and the awarded quantity of all other items may be increased or diminished up to 15% without in any way invalidating the bid unit prices.
- 3.4 The successful Bidder will be required to furnish the Owner with a complete breakdown of the lump sum bid items, to the satisfaction of the Engineer/Architect, before signing the Contract documents.

PART 4 CONTRACTOR'S QUALIFICATION

- 4.1 Contract A - Bidder must be able to demonstrate ten (10) years' experience with work in wastewater treatment plants. Bidder shall supply at least 3 references of successful projects of Anaerobic Digester Cleaning with at least 1,000,000 Gallons or be subject to disqualification. Contractor's foreman must have a minimum of five (5) years' experience on such projects.
- 4.2 Contract B - Bidder shall provide detailed information relating to similar projects completed within the past 5 years which demonstrates the bidder's capability, responsibility, experience, skill, and financial standing to undertake this type of project and shall include a list of all projects currently under construction including status and contact person.
- 4.3 Bidder shall own, have rental or lease agreements for, or otherwise have readily available any and all equipment and tools necessary for proper execution of the work. The Owner reserves the right to request lists of equipment or tools available for the project including sources.
- 4.4 Bidder shall provide pertinent information to the Owner relative to any pending suits or outstanding liens. If no information is provided by the Bidder, the Owner shall assume that any such suits or liens do not exist.
- 4.5 The Owner may require similar information on any or all subcontractors proposed by the Bidder.

PART 5 SUBCONTRACTORS

- 5.1 The Owner reserves the right to limit the total amounts of subcontractors to 60% of the total contract price.
- 5.2 The Bidder shall state on the appropriate bid form the names of all Subcontractors proposed and the items of work they are to be assigned. All work not assigned to a Subcontractor shall be assumed by the Owner to be performed by the Bidder.
- 5.3 The Owner reserves the right to approve all subcontractors proposed by the Bidder. If the Owner, after due investigation, rejects the use of a proposed subcontractor, the apparent successful Bidder may either submit an acceptable substitution without increase in bid price or decline substitution and withdraw his bid without sacrificing his bid security. Any listed subcontractor to whom the Owner does not make written objection prior to award of contract, shall be deemed acceptable to the Owner.
- 5.4 Requests for changes of Subcontractor by the Bidder after the award shall be subject to the Owner's approval and shall not change the contract bid prices.
- 5.5 No contractor shall be required to employ any Subcontractor, person or organization against whom he has reasonable objection.

PART 6 BID REVIEW BY OWNER

- 6.1 The Owner reserves the right to reject any and all bids, to waive as an informality any and all irregularities, and to disregard all nonconforming, nonresponsive or conditional bids.
- 6.2 All extensions and totals of unit prices and quantities submitted as part of the bid shall be considered informal until verified by the Owner. All bids must be made on the forms contained herein and the bid prices must be written therein, in figures only. Unit prices shall be separately written for "Unit Price Labor," "Unit Price Material," and "Total Unit Price" for each item listed. Should an error in addition and/or multiplication be determined while checking the Contractor's math and verifying his total bid, the "Unit Price Labor" and the "Unit Price Material" figures shall govern in determining the correct "Total Unit Price" and the correct "Item Total."
- 6.3 Each bidder must bid on all Items, Alternates, Deductions, and Additions contained in the Bidding Forms. All bids not in conformity with this notice may be considered informal and may be rejected.
- 6.4 In evaluating bids, the Owner may consider:
 - A. The qualifications and experience of the Bidder, proposed subcontractors, and principal material suppliers as outlined in the plans and specifications.
 - B. Financial ability and soundness of the Bidder and proposed subcontractors.
 - C. Completeness of all bid forms and bid requirements.
 - D. Alternates and unit prices requested in the Bid Forms.
 - E. Unit prices or schedules of values that are or appear to be unbalanced.
 - F. Previous contractual experience with the Owner.
 - G. Whether or not the bid package complies with the prescribed requirements.
 - H. The proposed completion date, if applicable.
 - I. Any other matter allowed by law or local ordinance or resolution.
- 6.5 Owner may conduct further investigations as he deems necessary to assist in the evaluation of any bid and to establish the responsibility, qualifications, and financial ability of the Bidders, proposed Subcontractors, and other persons and organizations to do the work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.
- 6.6 Owner reserves the right to reject the bid of any Bidder who does not pass any such evaluation to Owner's satisfaction.

- 6.7 The Contract award shall be based on the lowest and best bid or lowest responsive and responsible bid (as applicable for the public contracting agency receiving bids) for the base bid and selected alternate items (if any) for this project.

PART 7 BID SECURITY

- 7.1 Each bid must be accompanied by bid security in the form of a certified or cashier's check or a bid bond in the amount of 5% of the amount bid including all alternates, if any. The certified or cashier's check shall be from a financial institution authorized to transact business in the State of West Virginia and acceptable to the Owner. The bond shall be underwritten by a Surety Company authorized to transact business in the State of West Virginia have an agent licensed to do business in West Virginia. The Surety Company shall be listed on the most current Department of the Treasury Circular 570, "Surety Companies Acceptable on Federal Bonds."
- 7.2 The certified or cashier's check or bid bond shall be made payable to the Owner and shall serve as a guarantee that in the event the bid is accepted and a contract is awarded to the successful Bidder, the contract will be executed by the bidder including any certifications, certificates or additional bonds required by the contract.
- 7.3 Failure on the part of the successful Bidder to execute the contract documents will cause the certified or cashier's check or bond to be forfeited to the Owner as damages.
- A. If the Owner awards the contract without rebidding, the Bidder (and the Surety on his bond if a bond was submitted) shall be liable to the Owner for a penal sum not to exceed the difference between the low bid and the next lowest bidder or 5% of the amount of the bid, whichever is less.
- B. If the Owner does not award the Contract to the next lowest Bidder, but resubmits the project for bidding; the Bidder (and the Surety on his bond if a bond was submitted) shall be liable to the Owner for a penal sum not to exceed the costs in connection with the resubmission of bids or 5% of the amount of the bid, whichever is less.
- 7.4 Checks for bid security of all bidders will be returned within seven days of the Effective Date of the Agreement.

PART 8 CONTRACT BOND / PERFORMANCE AND PAYMENT BOND

- 8.1 As security for faithful performance and payment of all obligations under the Contract, the Owner shall require and the successful Bidder shall furnish a Contract Bond AKA a Performance and Payment Bond in the amount of 100% of the awarded Contract Price. The Contractor and his Surety shall sign the Supplemental Bond Acknowledgement form and submit with the Contract forms.
- 8.2 The bond shall be underwritten by a Surety Company authorized to transact business in the State of West Virginia have an agent licensed to do business in West Virginia. The Surety Company shall be listed on the most current Department of the Treasury Circular 570, "Surety Companies Acceptable on Federal Bonds."

- 8.3 The contract bond shall cover correction of the work for the period stated in the specifications and the correction period shall start upon Final Acceptance of the entire project and final payment by the Owner.
The Awarded Contractor and his Surety shall sign the Supplemental Bond Acknowledgement form and submit it with the Contract (Performance and Payment) Bond.
- 8.4 Nothing in the performance of the Engineer's service to the Owner in connection with this project shall in any way imply any undertaking for the benefit of the successful Bidder, its subcontractor(s), or the surety of any of them.

PART 9 AWARD AND EXECUTION OF CONTRACT

- 9.1 After the Owner's legislative body awards the project, the successful bidder will receive the unsigned contract documents. Within 10 days after their receipt, the successful Bidder shall sign and deliver to the Owner said contract documents including any certifications, certificates, or additional bonds required by the contract.
- 9.2 The Owner shall execute the Contract within 120 days after the day of the bid opening. When necessary and by mutual consent between the Owner and the Successful Bidder, this 120-day period may be extended.
- 9.3 The date of the Owner's signature on the Contract Agreement shall be the effective contract date.
- 9.4 The Owner shall execute and deliver to the successful Bidder one set of fully executed contract documents.

PART 10 INSURANCE

- 10.1 Verification of limits for public liability, property damage, automobile, Worker's Compensation, or any other insurance required by the provisions of this Contract must be submitted to the Owner prior to execution of the Contract.
- 10.2 All insurance shall be endorsed so that it cannot be cancelled for non-payment of premium for 10 days or cancelled or non-renewed for any other reason in less than 30 days after a written notice of such proposed action by the insurer is given to the Owner. The cancellation clause on the Certificate(s) of Insurance shall read as specified in the Supplementary Conditions and failure to submit an insurance certificate or binder and/or policy endorsement verifying same shall be reason for the Owner to consider the Contractor non-responsive in complying with the requirements for contract execution and may be cause for forfeiture of the Bid Security to Owner.
- 10.3 The Contractor's Liability Insurance policy(s) shall be endorsed such that limits are on a Per Project basis.
- 10.4 The Contractor shall also provide an Owner's and Contractor's Protective Policy.

PART 11 NON-COLLUSION AFFIDAVIT

- 11.1 Each bid must be accompanied by a completed Noncollusion Affidavit provided within the contract documents.
- 11.2 Where there is reason to believe collusion or combination among bidders exists, the Owner reserves the right to reject the bid of those concerned.

PART 12 ORIGINAL DOCUMENTS

- 12.1 All bid forms, contract forms, bonds and any other bid documents or contract documents requiring signatures shall be submitted with original signatures. No photo copies or faxed copies of signed documents shall be accepted.

PART 13 ADDENDA

- 13.1 The bidder shall be responsible to obtain Addenda from the web at <https://bids.verdantas.com>.

END OF SECTION

07/20

CITY OF WHEELING



CITY COUNTY BUILDING
1500 CHAPLINE STREET
WHEELING, WEST VIRGINIA 26003

DEPARTMENT OF PUBLIC WORKS - ENGINEERING DIVISION
304.234.3731 Fax 304.234.3605 www.wheelingwv.gov

MEMORANDUM

TO: All Prospective Bidders
FROM: City Engineer

For your information, the following conditions are applicable for this project.

- 1) A City of Wheeling Contractor's License is required for the successful bidder. Cost is \$15.00 per year Beginning July 1st and will be prorated for less than one year if applicable.
- 2) A West Virginia Contractor's License is required at the time of bidding.
- 3) City of Wheeling contracting privilege tax is \$2.00 per \$100 of values (2%)
- 4) There is a City Service Fee of \$2.00 per week for individuals who work within the City of Wheeling. Copies of the regulations, documents, forms, etc. can be obtained from the City Finance Department or accessed online at wheelingwv.gov. Look in departments, finance, city service fee.
- 5) Tax releases from both City and State must be received before the release of the final payment will be made.
- 6) A 5% bid guaranty is required, see Instructions to Bidders in the contract documents.

If you have any questions concerning this information related to this project, please contact the Engineering Department at (304) 234-3731.

PRICES TO INCLUDE

PART 1 - GENERAL

Any work shown on the plans or required in the specifications but not paid for separately as a bid item shall be included in the cost of other bid items. The amount bid for each Bid Item shall include the following:

- 1.1 All labor, materials, tools, equipment, and transportation necessary for the proper execution of the work in accordance with the Contract Documents.
- 1.2 All assistance required by the Engineer to verify compliance with the Contract Documents, including measuring for final pay quantities.
- 1.3 Project coordination and scheduling.
- 1.4 Detailed breakdown of lump sum bid items as requested by the Engineer.
- 1.5 All provisions necessary to protect workmen, the general public, and property along the work in accordance with the Contract Documents.
- 1.6 Protection and/or replacement of existing property corner monuments.
- 1.7 Reimbursement to Owner for costs of re-inspection or re-testing of any work not installed in compliance with the Contract Documents.
- 1.8 Erosion control measures, as required to prevent the erosion of soil resulting from the work outlined in the project documents.
- 1.9 Pavement removal required for the installation of new pipe and removal of existing pipe.
- 1.10 Flap gates installed as part of the storm sewer system.
- 1.11 Outside drops for sanitary manhole.
- 1.12 Abandonment of existing sewers, bulkheads, blind connects, and masonry collars required for the installation of the proposed sewer.
- 1.13 All provisions required for connection of the proposed sewer system to an existing structure, including grout, sealants, coring, fittings, patching and reshaping of the existing flow channel.
- 1.14 Any locations on the plans where it is indicated to expose an existing utility, the cost for potholing, exposing, and excavation.
- 1.15 Bonds and Insurances (including "Owner/Contractor Protective Policy," "All Risk Builder's Risk Insurance," and/or "Installation Floater Insurance", and/or endorsements to fully comply with all contract requirements). See the Instructions to Bidders, Supplemental Conditions and Specific Project Requirements.

BID FORMS

The bid forms are not available online. The bid forms are available only by purchasing a set of plans and specifications at the location indicated in the Advertisement for Bids/Public Notice to Bidders.

SECTION 2
CONTRACT FORMS

NOTICE OF AWARD

TO: «ContractName»
«ContractAddr»
«ContractCity», «ContractState» «ContractZip»

PROJECT: «TitleCaps»

You are notified that your Bid which was opened on «Bidopening» has been accepted for items in the amount of «ContractDollars» at the unit bid prices as reflected in the bid tabulation contained herein for the ***(fill in awarded parts, i.e. for Base Bid and Alternate C, ... or delete).***

You are required by the Instructions to Bidders to execute the Agreement and furnish the required Bonds, Certificates of Insurance, and other documents within 10 calendar days from the date of receipt of this Notice.

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

The Owner will return to you one (1) fully signed set of the contract documents.

«OwnerCaps»

«OwnerCEOFirst» «OwnerCEOLast», «OwnerCEOTitle»

ACKNOWLEDGMENT

«ContractCAPName»

«ContractFirst» «ContractLast», «ContractTitle»

CONTRACT

FOR «TitleCaps»

THIS AGREEMENT, made and entered into at «OwnerCity», «OwnerState», this _____ day of _____, 20____, by and between the «OwnerMuni», «OwnerState» (“OWNER”), and «ContractName» (“CONTRACTOR”).

WITNESSETH: That the said CONTRACTOR has agreed and by this presents does agree with the OWNER for the consideration hereinafter mentioned and contained, and under penalty expressed in a bond given with these presents, and herein contained or hereunto annexed, to furnish at his own cost and expense, all the necessary tools, equipment, materials, labor, and tests in an expeditious, substantial and workmanlike manner, the equipment and appurtenances herein contemplated, commencing work within 20 days from the date of the Notice to Proceed and executing the work within the time and in the manner specified and in conformity with the requirements set forth in this Contract.

The following form essential parts of the Contract (may vary with project).

1. Advertisement for Bids/Public Notice to Bidders
2. Instruction to Bidders
3. Bid Forms and Proposal
4. Contract Forms and Exhibits
5. Contract Bond or Performance and Payment Bond
6. Contract Provisions
7. General Conditions
8. Supplementary Conditions
9. Specifications
10. Specific Project Requirements
11. Contract Drawings, if any

The CONTRACTOR agrees and understands that the work on this contract shall be subject to the acceptance of the OWNER based upon and in accordance with the contract specifications and contract plans and drawings on file in the office of the OWNER.

The CONTRACTOR shall proceed with the said work in a prompt and diligent manner and shall do the several parts thereof, at such times and in such order as the OWNER may direct. Further he shall complete the whole of said work in accordance with the specifications and contract drawings to the satisfaction of the OWNER on or before the time stated, and in default of completion within the time as fixed, the CONTRACTOR shall pay to the OWNER as liquidated damages, an amount equal to «Liquidated», for each and every day (Sundays and legal holidays excepted) the completion of the work may be delayed beyond the date fixed in the manner and as stipulated.

It is hereby mutually agreed that the OWNER is to pay and the CONTRACTOR is to receive, as full compensation for furnishing all materials and labor in building, constructing and testing and in all respect completing the herein described work and appurtenances in the manner and under the conditions herein specified, the prices stipulated in the proposal herein contained or hereto annexed and the total contract sum is «ContractDollars».

This Contract shall be in full force and effect from the date of execution by the parties.

IN WITNESS WHEREOF: The parties hereunto affixed their signature the day and year first mentioned above.

«ContractCAPName»

«ContractFirst» «ContractLast», «ContractTitle»

«OwnerCaps»

«OwnerCEOFirst» «OwnerCEOLast», «OwnerCEOTitle»

I hereby certify that funds in the amount of «ContractAmtwords» Dollars («ContractDollars») necessary for the foregoing Contract have been appropriated and are in the Treasury, or are in the process of collection, or are available through grants and/or loans from other funding sources.

«OwnerFiscalFirst» «OwnerFiscalLast», «OwnerFiscalTitle»

APPROVED AS TO FORM:

«OwnerLegalName», «OwnerLegalTitle»

**THE CONTRACTOR SHALL FURNISH THE FOLLOWING ITEMS
WITHIN 10 DAYS OF NOTIFICATION OF AWARD:**

- A) CERTIFICATE OF INSURANCE FOR
CONTRACTOR'S GENERAL LIABILITY INSURANCE POLICY
AND AUTOMOTIVE INSURANCE POLICY**

- B) CERTIFICATE OF INSURANCE FOR
OWNER'S AND CONTRACTOR'S PROTECTIVE POLICY**

- C) CERTIFICATE OF WORKER'S COMPENSATION**

- D) CONTRACT BOND OR PERFORMANCE AND PAYMENT BOND
(Made payable to the Owner)**



CERTIFICATE OF LIABILITY INSURANCE

DATE (MM/DD/YYYY)

THIS CERTIFICATE IS ISSUED AS A MATTER OF INFORMATION ONLY AND CONFERS NO RIGHTS UPON THE CERTIFICATE HOLDER. THIS CERTIFICATE DOES NOT AFFIRMATIVELY OR NEGATIVELY AMEND, EXTEND OR ALTER THE COVERAGE AFFORDED BY THE POLICIES BELOW. THIS CERTIFICATE OF INSURANCE DOES NOT CONSTITUTE A CONTRACT BETWEEN THE ISSUING INSURER(S), AUTHORIZED REPRESENTATIVE OR PRODUCER, AND THE CERTIFICATE HOLDER.

IMPORTANT: If the certificate holder is an ADDITIONAL INSURED, the policy(ies) must have ADDITIONAL INSURED provisions or be endorsed. If SUBROGATION IS WAIVED, subject to the terms and conditions of the policy, certain policies may require an endorsement. A statement on this certificate does not confer rights to the certificate holder in lieu of such endorsement(s).

PRODUCER SAMPLE CERTIFICATE OF INSURANCE	<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td colspan="2">CONTACT NAME:</td> </tr> <tr> <td>PHONE (A/C, No. Ext.):</td> <td>FAX (A/C, No.):</td> </tr> <tr> <td colspan="2">E-MAIL ADDRESS:</td> </tr> <tr> <td colspan="2" style="text-align: center;">INSURER(S) AFFORDING COVERAGE</td> </tr> <tr> <td colspan="2">INSURER A:</td> </tr> <tr> <td colspan="2">INSURER B:</td> </tr> <tr> <td colspan="2">INSURER C:</td> </tr> <tr> <td colspan="2">INSURER D:</td> </tr> <tr> <td colspan="2">INSURER E:</td> </tr> <tr> <td colspan="2">INSURER F:</td> </tr> </table>	CONTACT NAME:		PHONE (A/C, No. Ext.):	FAX (A/C, No.):	E-MAIL ADDRESS:		INSURER(S) AFFORDING COVERAGE		INSURER A:		INSURER B:		INSURER C:		INSURER D:		INSURER E:		INSURER F:	
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COVERAGES

CERTIFICATE NUMBER:

REVISION NUMBER:

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

INSR LTR	TYPE OF INSURANCE	ADDL INSR	SUBR WVD	POLICY NUMBER	POLICY EFF (MM/DD/YYYY)	POLICY EXP (MM/DD/YYYY)	LIMITS														
	☒ COMMERCIAL GENERAL LIABILITY ☐ CLAIMS-MADE ☒ OCCUR ☒ XCU Included ☒ Contractual Liability GEN'L AGGREGATE LIMIT APPLIES PER: ☐ POLICY ☒ PRO-JECT ☐ LOC OTHER:						<table border="1" style="width: 100%; border-collapse: collapse;"> <tr><td>EACH OCCURRENCE</td><td>\$ 2000,000</td></tr> <tr><td>DAMAGE TO RENTED PREMISES (Ea occurrence)</td><td>\$ 1,000,000</td></tr> <tr><td>MED EXP (Any one person)</td><td>\$ Excluded</td></tr> <tr><td>PERSONAL & ADV INJURY</td><td>\$ 1,000,000</td></tr> <tr><td>GENERAL AGGREGATE</td><td>\$ 4,000,000</td></tr> <tr><td>PRODUCTS - COMPROP AGG</td><td>\$ 2,000,000</td></tr> <tr><td></td><td>\$</td></tr> </table>	EACH OCCURRENCE	\$ 2000,000	DAMAGE TO RENTED PREMISES (Ea occurrence)	\$ 1,000,000	MED EXP (Any one person)	\$ Excluded	PERSONAL & ADV INJURY	\$ 1,000,000	GENERAL AGGREGATE	\$ 4,000,000	PRODUCTS - COMPROP AGG	\$ 2,000,000		\$
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	WORKERS COMPENSATION AND EMPLOYERS' LIABILITY ANY PROPRIETOR/PARTNER/EXECUTIVE OFFICER/MEMBER EXCLUDED? (Mandatory in NH) If yes, describe under DESCRIPTION OF OPERATIONS below	Y/N	N/A	Include WV Broad Form, Employers Liability Section 23-4-2 of WV Code			<table border="1" style="width: 100%; border-collapse: collapse;"> <tr> <td>☒ PER STATUTE</td> <td>☐ OTHER</td> <td></td> </tr> <tr><td>E.L. EACH ACCIDENT</td><td>\$</td><td>1,000,000</td></tr> <tr><td>E.L. DISEASE - EA EMPLOYEE</td><td>\$</td><td>1,000,000</td></tr> <tr><td>E.L. DISEASE - POLICY LIMIT</td><td>\$</td><td>1,000,000</td></tr> </table>	☒ PER STATUTE	☐ OTHER		E.L. EACH ACCIDENT	\$	1,000,000	E.L. DISEASE - EA EMPLOYEE	\$	1,000,000	E.L. DISEASE - POLICY LIMIT	\$	1,000,000		
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E.L. DISEASE - POLICY LIMIT	\$	1,000,000																			

DESCRIPTION OF OPERATIONS / LOCATIONS / VEHICLES (ACORD 101, Additional Remarks Schedule, may be attached if more space is required)

- Project Name
- City of Wheeling and CT Consultants, Inc. are Additional Insured with a Waiver of Subrogation and primary & non-contributor language on all policies except Workers Compensation.
- Workers Compensation includes a Waiver of Subrogation
- It is understood and agreed that any insurance carried by the named Additional insured(s) is excess and in no way contributory or quota share.

CERTIFICATE HOLDER

CANCELLATION

City of Wheeling 1500 Chapline Street Wheeling, WV 26003	SHOULD ANY OF THE ABOVE DESCRIBED POLICIES BE CANCELLED BEFORE THE EXPIRATION DATE THEREOF, NOTICE WILL BE DELIVERED IN ACCORDANCE WITH THE POLICY PROVISIONS. AUTHORIZED REPRESENTATIVE

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SUPPLEMENTAL BOND ACKNOWLEDGEMENT

PROJECT: _____

OWNER: _____

By signature of the attached Contract and these presents the undersigned contractor and his surety acknowledge that the attached Contract Bond or Performance and Payment Bond shall cover and warrant all work for the correction period per the General Conditions and as supplemented or amended elsewhere in these Contract Documents, which period is one (1) year commencing on the final acceptance of the work by Owner. Any proceeding, legal or equitable, under this Bond may be instituted in any court of competent jurisdiction in the location in which the project or part of the project is located and shall be instituted within one year from the last day of the correction period under the project or within one year after the Surety refuses or fails to perform its obligations under this Bond, whichever first occurs.

BIDDER

SURETY

BIDDER: _____

SURETY: _____

SIGNATURE: _____

SIGNATURE: _____

NAME: _____

NAME: _____

TITLE: _____

TITLE: _____

DATE: _____

DATE: _____

PHONE NO.: _____

PHONE NO.: _____

*Attach Power of Attorney

APPROVED SUBCONTRACTORS

PROJECT: «TitleCaps»

PRIME CONTRACTOR: «ContractCAPName»

1. Name: _____
Address: _____
City/State/Zip: _____
Description of Work
to be Performed: _____
Phone: _____ Amount: _____ % of Contract: _____
EIN# _____ Unique Entity ID# _____
2. Name: _____
Address: _____
City/State/Zip: _____
Description of Work
to be Performed: _____
Phone: _____ Amount: _____ % of Contract: _____
EIN# _____ Unique Entity ID# _____
3. Name: _____
Address: _____
City/State/Zip: _____
Description of Work
to be Performed: _____
Phone: _____ Amount: _____ % of Contract: _____
EIN# _____ Unique Entity ID# _____
4. Name: _____
Address: _____
City/State/Zip: _____
Description of Work
to be Performed: _____
Phone: _____ Amount: _____ % of Contract: _____
EIN# _____ Unique Entity ID# _____

«OwnerCaps»

«OwnerCEOFirst» «OwnerCEOLast», «OwnerCEOTitle»

NOTICE TO PROCEED

Project: «Title»

Owner: «OwnerMuni»
«OwnerAddr»
«OwnerCity», «OwnerState» «OwnerZip»

To: «ContractName»
«ContractAddr»
«ContractCity», «ContractState» «ContractZip»

Date: _____

You are hereby notified to commence work in accordance with the Contract. All work shall be completed by «Completion_Date».

«OwnerCaps»

«OwnerCEOFirst» «OwnerCEOLast», «OwnerCEOTitle»

SECTION 3
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.

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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

Endorsed by



CONSTRUCTION SPECIFICATIONS INSTITUTE

These General Conditions have been prepared for use with the Suggested Forms of Agreement Between Owner and Contractor (EJCDC C-520 or C-525, 2007 Editions). Their provisions are interrelated and a change in one may necessitate a change in the other. Comments concerning their usage are contained in the Narrative Guide to the EJCDC Construction Documents (EJCDC C-001, 2007 Edition). For guidance in the preparation of Supplementary Conditions, see Guide to the Preparation of Supplementary Conditions (EJCDC C-800, 2007 Edition).

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www.asce.org

Associated General Contractors of America
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(703) 548-3118
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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

- A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.
1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.
 2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.
 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. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.
 5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.
 6. *Bidder*—The individual or entity who submits a Bid directly to Owner.
 7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).
 8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.
 9. *Change Order*—A document recommended by Engineer 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, issued on or after the Effective Date of the Agreement.
 10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.
 11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.
13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).
14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.
15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.
16. *Cost of the Work*—See Paragraph 11.01 for definition.
17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.
18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.
19. *Engineer*—The individual or entity named as such in the Agreement.
20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.
21. *General Requirements*—Sections of Division 1 of the Specifications.
22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.
23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.
24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.
25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.
26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.
28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.
29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.
30. *PCBs*—Polychlorinated biphenyls.
31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.
32. *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.
33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.
34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.
35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.
36. *Resident Project Representative*—The authorized representative of Engineer who may be assigned to the Site or any part thereof.
37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.
38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.
39. *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.

40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *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.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *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 Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.
51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

addition, deletion, or revision in the Work, or responding to differing or unforeseen subsurface or physical conditions under which the Work is to be performed or to emergencies. A Work Change Directive will not change the Contract Price or the Contract Times but is evidence that the parties expect that the change ordered or documented by a Work Change Directive will be incorporated in a subsequently issued Change Order following negotiations by the parties as to its effect, if any, on the Contract Price or Contract Times.

1.02 Terminology

A. The words and terms discussed in Paragraph 1.02.B through F 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 Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

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

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or
 - c. has been damaged prior to Engineer’s recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

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

1. The word “furnish,” when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word “install,” when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words “perform” or “provide,” when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. When “furnish,” “install,” “perform,” or “provide” is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, “provide” is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases 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. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

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

2.03 *Commencement of Contract Times; Notice to Proceed*

- A. The Contract Times will commence to run on the thirtieth day after the Effective Date of the Agreement or, if a Notice to Proceed is given, on the day indicated in the Notice to Proceed. A Notice to Proceed may be given at any time within 30 days after the Effective Date of the Agreement. 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 Agreement, whichever date is earlier.

2.04 *Starting the Work*

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

2.05 *Before Starting Construction*

- A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:
 - 1. a preliminary Progress Schedule 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 Documents;
 - 2. a preliminary Schedule of Submittals; and
 - 3. a preliminary Schedule of Values for all of the Work which includes quantities and prices of items which when added together equal the Contract Price and subdivides the Work into component parts in sufficient detail to serve as the basis for progress payments during performance of the Work. Such prices will include an appropriate amount of overhead and profit applicable to each item of Work.

2.06 *Preconstruction Conference; 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 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, 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 instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.
 - 1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of

the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

- A. The Contract Documents are complementary; what is required by one is as binding as if required by all.
- B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.
- C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

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

3.03 *Reporting and Resolving Discrepancies*

- A. *Reporting Discrepancies:*

1. *Contractor's Review of Contract Documents Before Starting Work:* Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.
2. *Contractor's Review of Contract Documents During Performance of Work:* If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation, (b) any standard, specification, manual, or code, or (c) 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 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.
3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. Resolving Discrepancies:

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

3.04 Amending and Supplementing Contract Documents

- A. The Contract Documents may be amended to provide for additions, deletions, and revisions in the Work or to modify the terms and conditions thereof by either a Change Order or a Work Change Directive.
- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
 1. A Field Order;
 2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

- A. Contractor and any Subcontractor or Supplier shall not:
 1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or
 2. 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.
- 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.

3.06 *Electronic Data*

- A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.
- B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.
- C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

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

4.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the

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

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

4.02 *Subsurface and Physical Conditions*

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

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

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

4.03 *Differing Subsurface or Physical Conditions*

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

- 1. is of such a nature as to establish that any "technical data" on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
- 2. is of such a nature as to require a change in the Contract Documents; or

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

then Contractor shall, promptly after becoming aware thereof and before further disturbing the subsurface or physical conditions or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), notify Owner and Engineer in writing about such condition. Contractor shall not further disturb such condition or perform any Work in connection therewith (except as aforesaid) until receipt of written order to do so.

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

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or
 - c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other

professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

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

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data 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 such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the consequences of the existence or location of the Underground Facility. During such time, Contractor shall be responsible for the safety and protection of such Underground Facility.
2. If Engineer concludes that a change in the Contract Documents is required, a Work Change Directive or a Change Order will be issued to reflect and document such consequences. An equitable adjustment shall be made in the Contract Price or Contract Times, or both, to the extent that they are attributable to the existence or location of any Underground Facility that was not shown or indicated or not shown or indicated with reasonable accuracy in the Contract Documents and that Contractor did not know of and could not reasonably have been expected to be aware of or to have anticipated. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment in Contract Price

or Contract Times, Owner or Contractor may make a Claim therefor as provided in Paragraph 10.05.

4.05 *Reference Points*

- A. Owner shall provide engineering surveys to establish reference points for construction which in Engineer's judgment are necessary to enable Contractor to proceed with the Work. Contractor shall 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.

4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their 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 any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by

Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. 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 4.06.E.

- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, 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: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

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

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

- A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.
- B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent 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 each bond.
- C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

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

5.03 *Certificates of Insurance*

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

- B. Owner shall deliver to Contractor, with copies to each additional insured and loss payee identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance requested by Contractor or any other additional insured) which Owner is required to purchase and maintain.
- C. Failure of Owner to demand such certificates or other evidence of Contractor's full compliance with these insurance requirements or failure of Owner to identify a deficiency in compliance from the evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.
- D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.
- E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:
 - a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
 - 5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 - 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:

1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, 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;
2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
6. include completed operations coverage:
 - a. Such insurance shall remain in effect for two years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

- A. In addition to the insurance required to be provided by Contractor under Paragraph 5.04, Owner, at Owner's option, may purchase and maintain at Owner's expense Owner's own liability insurance as will protect Owner against claims which may arise from operations under the Contract Documents.

5.06 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full 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 interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;
 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, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, 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.
 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
 4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
 5. allow for partial utilization of the Work by Owner;
 6. include testing and startup; and
 7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.
- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property

insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.

- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their 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 Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (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 as trustee 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 utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery

against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

- A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.
- B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

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

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

ARTICLE 6 – CONTRACTOR’S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

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

6.02 *Labor; Working Hours*

- A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.
- B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner’s written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

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

6.04 *Progress Schedule*

- A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.
1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.
 2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:
 - a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
 - 3) it has a proven record of performance and availability of responsive service.
 - 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.

2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;
 - 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
 - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
 - 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services; and

- 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.
- B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.
- C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.
- D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.
- E. *Engineer's Cost Reimbursement:* Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute 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.
- F. *Contractor's Expense:* Contractor shall provide all data in support of any proposed substitute or "or-equal" at Contractor's expense.

6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or

other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.

- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
 - 1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
 - 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.
- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (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 such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

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

6.08 *Permits*

- A. Unless otherwise provided in the Supplementary Conditions, Contractor shall obtain and pay for all construction permits and licenses. Owner shall assist Contractor, when necessary, in obtaining such permits and licenses. Contractor shall pay all governmental charges and inspection fees necessary for the prosecution of the Work which are applicable at the time of opening of Bids, or, if there are no Bids, on the Effective Date of the Agreement. Owner shall pay all charges of utility owners for connections for providing permanent service to the Work.

6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all

court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.

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

6.10 Taxes

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

6.11 Use of Site and Other Areas

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

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.
2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

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

- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor

shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.

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

6.12 *Record Documents*

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

6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. 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, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. 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 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or 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 for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

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

1. *Shop Drawings:*
 - a. Submit number of copies specified in the General Requirements.
 - b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.
 2. *Samples:*
 - a. Submit number of Samples specified in the Specifications.
 - b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.
- B. Where a Shop Drawing or Sample is required by the Contract Documents or the Schedule of Submittals, any related Work performed prior to Engineer's review and approval of the pertinent submittal will be at the sole expense and responsibility of Contractor.
- C. *Submittal Procedures:*
1. Before submitting each Shop Drawing or Sample, Contractor shall have:
 - a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;
 - 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 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 and approval of that submittal.
 3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop

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

D. Engineer's Review:

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.
2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.
3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. Resubmittal Procedures:

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

6.18 *Continuing the Work*

- A. Contractor shall carry on the Work and adhere to the Progress Schedule during all disputes or disagreements with Owner. No Work shall be delayed or postponed pending resolution of any disputes or disagreements, except as permitted by Paragraph 15.04 or as Owner and Contractor may otherwise agree in writing.

6.19 *Contractor's General Warranty and Guarantee*

- A. Contractor warrants and guarantees to Owner that all Work will be in accordance with the Contract Documents and will not be defective. Engineer and its officers, directors, members, partners, employees, agents, consultants, and subcontractors shall be entitled to rely on representation of Contractor's warranty and guarantee.
- B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or
 2. normal wear and tear under normal usage.
- C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:
1. observations by Engineer;
 2. recommendation by Engineer or payment by Owner of any progress or final payment;
 3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;
 4. use or occupancy of the Work or any part thereof by Owner;
 5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;
 6. any inspection, test, or approval by others; or
 7. any correction of defective Work by Owner.

6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor,

Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.

- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, 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.

6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.
- B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.
- C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.
- D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.
- E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
1. written notice thereof will be given to Contractor prior to starting any such other work; and
 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering 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. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.
- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

- A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:
1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;
 2. the specific matters to be covered by such authority and responsibility will be itemized; and
 3. the extent of such authority and responsibilities will be provided.
- B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

7.03 *Legal Relationships*

- A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.
- B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.
- C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

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

8.03 *Furnish Data*

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

8.04 *Pay When Due*

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

8.05 *Lands and Easements; Reports and Tests*

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

8.06 *Insurance*

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

8.07 *Change Orders*

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

8.08 *Inspections, Tests, and Approvals*

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

8.09 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

- A. 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.

8.12 *Compliance with Safety Program*

- 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 pursuant to Paragraph 6.13.D.

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

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

9.02 *Visits to Site*

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

and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.

- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

- A. If Owner and Engineer agree, Engineer will furnish a Resident Project Representative to assist Engineer in providing more extensive observation of the Work. The authority and responsibilities of any such Resident Project Representative and assistants will be as provided in the Supplementary Conditions, and limitations on the responsibilities thereof will be as provided in Paragraph 9.09. If Owner designates another representative or agent to represent Owner at the Site who is not Engineer's consultant, agent or employee, the responsibilities and authority and limitations thereon of such other individual or entity will be as provided in the Supplementary Conditions.

9.04 *Authorized Variations in Work*

- A. Engineer may authorize minor variations in the Work from the requirements of the Contract Documents which do not involve an adjustment in the Contract Price or the Contract Times and are compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents. These may be accomplished by a Field Order and will be binding on Owner and also on Contractor, who shall perform the Work involved promptly. If Owner or Contractor believes that a Field Order justifies an adjustment in the Contract Price or Contract Times, or both, and the parties are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

9.05 *Rejecting Defective Work*

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

9.06 *Shop Drawings, Change Orders and Payments*

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

- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

- A. Engineer will determine the actual quantities and classifications of Unit Price Work performed by Contractor. Engineer will review with Contractor the Engineer's preliminary determinations on such matters before rendering a written decision thereon (by recommendation of an Application for Payment or otherwise). Engineer's written decision thereon will be final and binding (except as modified by Engineer to reflect changed factual conditions or more accurate data) upon Owner and Contractor, subject to the provisions of Paragraph 10.05.

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

- A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.
- B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.
- C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.
- D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.

- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.
- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

- A. While at the Site, Engineer's employees and representatives shall comply with the specific applicable requirements of Contractor's safety programs of which Engineer has been informed pursuant to Paragraph 6.13.D.

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

- A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).
- B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

- A. Contractor shall not be entitled to an increase in the Contract Price or an extension of the Contract Times with respect to any work performed that is not required by the Contract Documents as amended, modified, or supplemented as provided in Paragraph 3.04, except in the case of an emergency as provided in Paragraph 6.16 or in the case of uncovering Work as provided in Paragraph 13.04.D.

10.03 *Execution of Change Orders*

- A. Owner and Contractor shall execute appropriate Change Orders recommended by Engineer covering:
1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;
 2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and
 3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

- A. If 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.

10.05 *Claims*

- A. *Engineer's Decision Required:* All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.
- B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The

opposing party shall submit any response to Engineer and the claimant within 30 days after receipt of the claimant's last submittal (unless Engineer allows additional time).

- C. *Engineer's Action:* Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:
1. deny the Claim in whole or in part;
 2. approve the Claim; or
 3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.
- D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.
- E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.
- F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

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

11.01 *Cost of the Work*

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

Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are 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 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.
- g. The cost of utilities, fuel, and sanitary facilities at the Site.
- h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.
- i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

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

- 1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, 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 11.01.A.1 or specifically covered by Paragraph 11.01.A.4, all of which are to be considered administrative costs covered by the Contractor's fee.
- 2. Expenses of Contractor's principal and branch offices other than Contractor's office at the Site.
- 3. Any part of Contractor's capital expenses, including interest on Contractor's capital employed for the Work and charges against Contractor for delinquent payments.
- 4. Costs due to the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, including but not limited to, the correction of defective Work, disposal of materials or equipment wrongly supplied, and making good any damage to property.
- 5. Other overhead or general expense costs of any kind and the costs of any item not specifically and expressly included in Paragraphs 11.01.A.

C. *Contractor's Fee:* When all the Work is performed on the basis of cost-plus, Contractor's fee shall be determined as set forth in the Agreement. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, Contractor's fee shall be determined as set forth in Paragraph 12.01.C.

- D. *Documentation:* Whenever the Cost of the Work for any purpose is to be determined pursuant to Paragraphs 11.01.A and 11.01.B, Contractor will establish and maintain records thereof in accordance with generally accepted accounting practices and submit in a form acceptable to Engineer an itemized cost breakdown together with supporting data.

11.02 Allowances

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

B. *Cash Allowances:*

1. Contractor agrees that:

- a. the cash allowances include the cost to Contractor (less any applicable trade discounts) of materials and equipment required by the allowances to be delivered at the Site, and all applicable taxes; and
- b. Contractor's costs for unloading and handling on the Site, labor, installation, overhead, profit, and other expenses contemplated for the cash allowances have been included in the Contract Price and not in the allowances, and no demand for additional payment on account of any of the foregoing will be valid.

C. *Contingency Allowance:*

1. Contractor agrees that a contingency allowance, if any, is for the sole use of Owner to cover unanticipated costs.

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

11.03 Unit Price Work

- A. Where the Contract Documents provide that all or part of the Work is to be Unit Price Work, initially the Contract Price will be deemed to include for all Unit Price Work an amount equal to the sum of the unit price for each separately identified item of Unit Price Work times the estimated quantity of each item as indicated in the Agreement.
- B. The estimated quantities of items of Unit Price Work are not guaranteed and are solely for the purpose of comparison of Bids and determining an initial Contract Price. Determinations of the actual quantities and classifications of Unit Price Work performed by Contractor will be made by Engineer subject to the provisions of Paragraph 9.07.
- C. Each unit price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for each separately identified item.

- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 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; and
 2. there is no corresponding adjustment with respect to any other item of Work; and
 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

ARTICLE 12 – CHANGE OF CONTRACT PRICE; CHANGE OF CONTRACT TIMES

12.01 *Change of Contract Price*

- A. The Contract Price may only be changed by a Change Order. Any Claim for an adjustment in the Contract Price shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. The value of any Work covered by a Change Order or of any Claim for an adjustment in the Contract Price will be determined as follows:
1. where the Work involved is covered by unit prices contained in the Contract Documents, by application of such unit prices to the quantities of the items involved (subject to the provisions of Paragraph 11.03); or
 2. where the Work involved is not covered by unit prices contained in the Contract Documents, by a mutually agreed lump sum (which may include an allowance for overhead and profit not necessarily in accordance with Paragraph 12.01.C.2); or
 3. where the Work involved is not covered by unit prices contained in the Contract Documents and agreement to a lump sum is not reached under Paragraph 12.01.B.2, on the basis of the Cost of the Work (determined as provided in Paragraph 11.01) plus a Contractor's fee for overhead and profit (determined as provided in Paragraph 12.01.C).
- C. *Contractor's Fee:* The Contractor's fee for overhead and profit shall be determined as follows:
1. a mutually acceptable fixed fee; or
 2. if a fixed fee is not agreed upon, then a fee based on the following percentages of the various portions of the Cost of the Work:
 - a. for costs incurred under Paragraphs 11.01.A.1 and 11.01.A.2, the Contractor's fee shall be 15 percent;
 - b. for costs incurred under Paragraph 11.01.A.3, the Contractor's fee shall be five percent;

- c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;
- d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;
- e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and
- f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

- A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.
- B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

- A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.
- B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.
- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the

control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.

- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

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

13.01 *Notice of Defects*

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

13.02 *Access to Work*

- A. Owner, Engineer, their consultants and other representatives and personnel of Owner, independent testing laboratories, and governmental agencies with jurisdictional interests will have access to the Site and the Work at reasonable times for their observation, 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.

13.03 *Tests and Inspections*

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;
 - 2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
 - 3. as otherwise specifically provided in the Contract Documents.

- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
- D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
- E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
- F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

- A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.
- B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.
- C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.
- D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

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

13.06 *Correction or Removal of Defective Work*

- A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).
- B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. repair such defective land or areas; or
 - 2. correct such defective Work; or
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.
- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute

resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.

- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

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

13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.
- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and

equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.

- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 *Schedule of Values*

- A. The Schedule of Values established as provided in Paragraph 2.07.A will serve as the basis for progress payments and will be incorporated into a form of Application for Payment acceptable to Engineer. Progress payments on account of Unit Price Work will be based on the number of units completed.

14.02 *Progress Payments*

A. *Applications for Payments:*

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

Work have been applied on account to discharge Contractor's legitimate obligations associated with prior Applications for Payment.

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

B. Review of Applications:

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations 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 9.07, 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 Documents; 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 moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
- a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

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

D. Reduction in Payment:

- 1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;
 - b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or

- d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
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 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

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

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, 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 tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.
- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities

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

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

14.05 *Partial Utilization*

- A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:
 - 1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.
 - 2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.
 - 3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.
 - 4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

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

14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.
2. The final Application for Payment shall be accompanied (except as previously delivered) by:
 - a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;
 - b. consent of the surety, if any, to final payment;
 - c. a list of all Claims against Owner that Contractor believes are unsettled; and
 - d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.
3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner 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.

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

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due:*

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

14.08 *Final Completion Delayed*

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

14.09 *Waiver of Claims*

- A. The making and acceptance of final payment will constitute:
 1. a waiver of all Claims by Owner against Contractor, except Claims arising from unsettled Liens, from defective Work appearing after final inspection pursuant to Paragraph 14.06, from failure to comply with the Contract Documents or the terms of any special guarantees specified therein, or from Contractor's continuing obligations under the Contract Documents; and
 2. a waiver of all Claims by Contractor against Owner other than those previously made in accordance with the requirements herein and expressly acknowledged by Owner in writing as still unsettled.

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

- A. At any time and without cause, Owner may suspend the Work or any portion thereof for a period of not more than 90 consecutive days by notice in writing to Contractor and Engineer which will fix the date on which Work will be resumed. Contractor shall resume the Work on the date so fixed. Contractor shall be granted an adjustment in the Contract Price or an extension of the Contract Times, or both, directly attributable to any such suspension if Contractor makes a Claim therefor as provided in Paragraph 10.05.

15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:

1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's repeated disregard of the authority of Engineer; or
 4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
 2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
 3. complete the Work as Owner may deem expedient.
- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.
- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

- A. Upon seven days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract. In such case, Contractor shall be paid for (without duplication of any items):
1. completed and acceptable Work executed in accordance with the Contract Documents prior to the effective date of termination, including fair and reasonable sums for overhead and profit on such Work;
 2. expenses sustained prior to the effective date of termination in performing services and furnishing labor, materials, or equipment as required by the Contract Documents in connection with uncompleted Work, plus fair and reasonable sums for overhead and profit on such expenses;
 3. all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred in settlement of terminated contracts with Subcontractors, Suppliers, and others; and
 4. reasonable expenses directly attributable to termination.
- B. Contractor shall not be paid on account of loss of anticipated profits or revenue or other economic loss arising out of or resulting from such termination.

15.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may, upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.
- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

- A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.
- B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.
- C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:
 - 1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or
 - 2. agrees with the other party to submit the Claim to another dispute resolution process; or
 - 3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

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

17.02 *Computation of Times*

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

17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

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SECTION 4
SUPPLEMENTARY CONDITIONS

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract (EJCDC C-700, 2007 ed.) and other provisions of the Contract Documents as indicated below. All provisions which are not so amended or supplemented herein or in the Specific Project Requirements remain in full force and effect.

- SC-1.01 The terms used in these Supplementary Conditions which are defined in the General Conditions have the meaning assigned to them in the General Conditions.
- SC-2.02 Delete paragraph 2.02A in its entirety and insert the following in its place:
- Owner shall furnish one (1) printed/hard copy of the drawings and Project Manual which shall be an executed contract set and one set in electronic format (.pdf), if requested.
- SC-2.03 (A) In the last sentence of 2.03A, change "sixtieth day" to "one hundred fiftieth day."
- SC-2.03 (B) By submission of a bid, the bidder hereby grants consent that the award and execution period shall be extended from sixty days to one hundred twenty days after the date on which the bids are opened.
- SC-4.02(A) Change "Supplementary Conditions" to read "Specific Project Requirements."
- SC-5.03(A)(1) The required Certificate of Insurance shall be in a form satisfactory to the Owner (most current version of ACORD 25 or approved equal). If the Contractor fails to procure and maintain any specified and/or required insurance, the Owner shall have the right to procure and maintain the said insurance for and in the name of the Contractor and the Contractor shall pay the cost thereof and shall furnish all necessary information to make effective and maintain such insurance.
- SC-5.04(B)(1) Change "Supplementary Conditions" to read "Specific Project Requirements." It is understood and agreed that any insurance carried by the Owner is excess and in no way contributory or quota share.
- SC-5.04(B)(2) The limits of liability for the insurance required by paragraph 5.04(A) of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:
- All of the limits below may be satisfied with an Umbrella/Excess Liability as needed to increase the Primary Policy to required limits.
- 5.04(A)(1) and (2) Workers' Compensation, etc., under paragraphs 5.04(A)(1) and 5.04(A)(2) of the General Conditions:

(a) State	Statutory
(b) Applicable Federal (e.g., Longshoreman's):	Statutory
(c) Employer's Liability:	\$1,000,000

5.04(A)(3), (4) and (5). Contractor's Liability Insurance under paragraphs 5.04(A)(3) through 5.04(A)(5) of the General Conditions which shall also include completed operations and product liability coverage.

- (a) Bodily Injury and Property Damage, Combined Single Limit (CSL) (Except Products and Completed Operations) Property Damage liability insurance will provide Explosion, Collapse, and Underground coverage where applicable.

Each Occurrence	\$2,000,000*

General Aggregate	\$4,000,000*

- (b) Products and Completed Operations Aggregate \$2,000,000

Products and Completed Operations to be maintained for two (2) years after final payment and Contractor shall continue to provide evidence of such coverage to the Owner on an annual basis during the aforementioned period.

- (c) Personal and Advertising Injury (Per Person/Organization and per occurrence) with Employment Exclusion deleted. \$1,000,000

- (d) Fire Damage \$100,000

- (e) If the General Liability Policy includes a General Aggregate, such policy shall be endorsed to have the General Aggregate have a Per Project Aggregate Limit.

5.04(A)(6) Automobile Liability - (Owned, Non-Owned, Hired)
Contractor may provide split limits or combined single limit.

- (a) Split Limits:

Bodily Injury,	Each Person:	\$2,000,000
	Each Occurrence	\$2,000,000

Property Damage,	Each Occurrence	\$1,000,000

or

(b) Combined Single Limit

Bodily Injury and Property Damage,	
Each Occurrence	\$2,000,000

SC-5.04(B)(3) Add the following to the end of the paragraph: "to the extent available in the insurance industry with industry standard exclusions and as allowed under the laws and regulations in the State of West Virginia;"

SC-5.04(B)(4) Add the following:

Written notice of cancellation for non-payment of premium shall be at least 10 days.

Add the following paragraphs:

SC-5.04(C)	Unless otherwise stated in Specific Project Requirements, the Contractor shall purchase and provide an "Owner's and Contractor's Protective Policy" with the Owner listed as the insured for the following limits:	
	Each Occurrence	\$1,000,000
	General Aggregate	\$2,000,000

SC-5.04(D) Unless otherwise stated in Specific Project Requirements the Contractor shall purchase and maintain during the Contract Time "All Risk Builders' Risk Insurance," and/or "Installation Floater Insurance," and/or "Boiler and Machinery Insurance," and any and all insurance requirements of section GC-5.06 of the General Conditions as applicable for the type of work to be performed upon the Project to the full insurable value thereof for the benefit of the Owner, the Contractor, Subcontractors and Suppliers as their interest may appear. This insurance shall cover the work until final acceptance and final payment by the Owner. This provision shall in no way release the Contractor or Contractor's Surety from obligations under the Contract Documents to fully complete the Project. The original policy(s) shall be filed with the Owner or his designated representative.

SC-5.05 *Owner's Liability Insurance*

See SC-5.04(C) above.

SC-5.06 *Property Insurance*

Unless otherwise stated in Specific Project Requirements the Contractor, not the Owner, shall purchase and maintain during the Contract Time all property insurance required in section GC-5.06 of the General Conditions and as outlined in SC-5.04(D) above.

SC-6.02(C) Add the following Paragraph:

The Contractor shall be responsible for the Owner and/or Engineer's additional inspection and administrative costs for work performed beyond regular working hours as defined in this Section.

SC-6.07(B) Delete paragraph 6.07(B) in its entirety.

SC-6.10(B) Add the following:

The Owner is exempt from West Virginia Sales Taxes and, by West Virginia Code §11-15-8d, can now extend this tax exemption to Contractors supplying goods on their behalf. The Contractor shall coordinate with the Owner the filing of any and all applications to the State of West Virginia, exempting the purchase of the specified Goods from West Virginia Sales Tax and hereby agrees to include the savings from such sales tax exemption in its total base bid. from State Sales and Use Taxes on materials and equipment to be incorporated in the Project.

1. Owner will furnish the required certificates of tax exemption to Contractor for use in the purchase of supplies and materials to be incorporated into the work
2. Owner's exemption to Contractor does not apply to construction tools, machinery, equipment, or other property by or leased by Contractor, or to supplies or materials not incorporated into the work.

The Contractor shall withhold and/or pay all consumer, use, property, employment, income and other taxes in accordance with the laws and regulations of the United States, State of West Virginia and Owner which are applicable during the performance of the work.

SC 6.17 *Shop Drawings and Samples*

Add the following new paragraphs immediately after paragraph 6.17(E):

- F. Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three (3) submittals. Engineer will record Engineer's time for reviewing subsequent materials of shop drawings, samples, or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time.
- G. In the event that Contractor requests a substitution for a previously approved item, Contractor shall reimburse Owner for Engineer's charges for such time unless the need for such substitution is beyond the control of the Contractor.

SC-7.02 Delete Section 7.02 of the General Conditions in its entirety and insert the following:

SC-7.02(A) The General Construction Contractor shall be referred to and defined as the Construction Coordinator.

SC-7.02(B) Duties of the Construction Coordinator include the following:

1. Scheduling and coordinating the work of the Prime Contractors including submission and periodic updating of project schedule.
2. Establishing and administering the site safety program and procedures for the project.
3. See that permits are applied for and obtained on a timely basis. Advise the Engineer of any problems related to permit approval.
4. Monitoring compliance with Laws and Regulations.
5. Maintain project site for dust, sedimentation, debris, waste, and general site cleanliness.
6. Coordinate location and use of temporary construction facilities including but not limited to sanitary, water, power, telephone, and parking.
7. Coordinate Owner interface for utility tie-ins/shut downs.
8. Monitor shop drawing submittal and coordination of submittal information between Prime Contractors.

SC-9.03 Add the following new paragraphs immediately after Paragraph 9.03.A:

SC-9.03 (B)

B. The Resident Project Representative (RPR) will be Engineer's representative at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions.

1. General: RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall only be through or with the full knowledge and approval of Contractor. RPR shall generally communicate with Owner only with the knowledge of and under the direction of Engineer.
2. Schedules: Review the progress schedule, schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.
3. Conferences and Meetings: Attend meetings with Contractor, such as preconstruction conferences, progress meetings, job conferences, and other Project-related meetings, and prepare and circulate copies of minutes thereof.

4. Liaison:
 - a. Serve as Engineer's liaison with Contractor. Working principally through Contractor's authorized representative or designee, assist in providing information regarding the provisions and intent of the Contract Documents.
 - b. Assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's on-Site operations.
 - c. Assist in obtaining from Owner additional details or information, when required for proper execution of the Work.
5. Interpretation of Contract Documents: Report to Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.
6. Shop Drawings and Samples:
 - a. Record date of receipt of Samples and Contractor-approved Shop Drawings.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 - c. Advise Engineer and Contractor of the commencement of any portion of the Work requiring a Shop Drawing or Sample submittal for which RPR believes that the submittal has not been approved by Engineer.
7. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, if any, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
8. Review of Work and Rejection of Defective Work:
 - a. Conduct on-Site observations of Contractor's work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents.
 - b. Report to Engineer whenever RPR believes that any part of Contractor's work in progress is defective, will not produce a completed Project that conforms generally to the Contract Documents, or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise Engineer of that part of work in progress that RPR believes should be corrected or

rejected or should be uncovered for observation, or requires special testing, inspection or approval.

9. Inspections, Tests, and System Start-ups:

- a. Verify that tests, equipment, and systems start-ups and operating and maintenance training are conducted in the presence of appropriate Owner's personnel, and that Contractor maintains adequate records thereof.
- b. Observe, record, and report to Engineer appropriate details relative to the test procedures and systems start-ups.

10. Records:

- a. Prepare a daily report or keep a diary or log book, recording Contractor's hours on the Site, Subcontractors present at the Site, weather conditions, data relative to questions of Change Orders, Field Orders, Work Change Directives, or changed conditions, Site visitors, deliveries of equipment or materials, daily activities, decisions, observations in general, and specific observations in more detail as in the case of observing test procedures; and send copies to Engineer.
- b. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all Contractors, Subcontractors, and major Suppliers of materials and equipment.
- c. Maintain records for use in preparing Project documentation.

11. Reports:

- a. Furnish to Engineer periodic reports as required of progress of the Work and of Contractor's compliance with the Progress Schedule and schedule of Shop Drawing and Sample submittals.
- b. Draft and recommend to Engineer proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from Contractor.
- c. Immediately notify Engineer of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, force majeure or delay events, damage to property by fire or other causes, or the discovery of any Constituent of Concern or Hazardous Environmental Condition.

12. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work

completed, and materials and equipment delivered at the Site but not incorporated in the Work.

13. Certificates, Operation and Maintenance Manuals: During the course of the Work, verify that materials and equipment certificates, operation and maintenance manuals and other data required by the Contract Documents to be assembled and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have these documents delivered to Engineer for review and forwarding to Owner prior to payment for that part of the Work.

14. Completion:

- a. Participate in Engineer's visits to the Site to determine Substantial Completion, assist in the determination of Substantial Completion and the preparation of a punch list of items to be completed or corrected.
- b. Participate in Engineer's final visit to the Site to determine completion of the Work, in the company of Owner and Contractor, and prepare a final punch list of items to be completed and deficiencies to be remedied.
- c. Observe whether all items on the final list have been completed or corrected and make recommendations to Engineer concerning acceptance and issuance of the notice of acceptability of the work.

C. The RPR shall not:

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

7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.

8. Authorize Owner to occupy the Project in whole or in part.

SC-13.07 (A) In the First sentence of Section 13.07(A) remove "Substantial Completion" and insert "Final Acceptance of the entire project and final payment by the Owner."

SC-13.07(C) Remove 13.07(C) and replace with the following:

All materials and equipment shall be warranted by the respective material supplier or equipment manufacturer until the end of the Contractor's "correction period" (or longer if specified elsewhere in the contract) regardless of date of initial installation or operation of the material or equipment. The cost of such extended warranties as needed from material suppliers or equipment manufacturers to provide warranty coverage until the end of the "correction period" or other period as specified in the contract shall be the responsibility of the prime contractor and shall be assumed to have been included in his bid.

SC-14.02 (A) (3) Delete Section 14.02(A) (3) of the General Conditions in its entirety and insert the following:

Until the job is 50% complete, the Contractor will be paid 92% of the estimated value of labor and material completed in acceptable form. After the work is 50% complete, no further funds shall be retained and the Contractor shall be paid 100% of the estimated value of the remaining labor and material completed in acceptable form, provided that the Contractor is making satisfactory progress and there is no specific cause for greater withholding. Upon the Owner's agreement that the project is substantially complete, the Retainage may be reduced to twice the value of the remaining punch list work subject to the recommendation of the Engineer and the approval by the Owner.

SC-14.02(A) (4) Add the following paragraph:

Payment for stored materials at invoice prices or at the unit price bid for materials, or the lesser value of the two, will be made for accepted nonperishable equipment and materials which are to be incorporated into the work, when accepted, delivered, properly stored, and protected upon the site and verified to the Engineer by a copy of the invoice. For materials and equipment meeting the foregoing conditions, the Owner will pay, when properly included in an approved estimate, 92% of the invoice value of the same. Subsequent to the inclusion of a payment for delivered materials in a progress payment, Contractor shall submit no later than the next payment submission, a partial waiver of lien from each and every supplier for whom delivered materials were paid. If no such waiver is submitted prior to or along with the next payment, the amount of delivered materials paid commensurate with that particular item will be deducted from future payments. No payment for delivered materials shall be made for any items that are scheduled to be

incorporated in the work within 30 days of submission of the pay estimate. Delivered materials will not be paid in any given month for a total amount less than \$5,000.00. Payment for delivered materials for such items as pipe backfill and roadway subbase will not be routinely considered.

SC-16.01 Delete Article 16 in its entirety and replace with the following:

ARTICLE 16 - DISPUTE RESOLUTION AGREEMENT - JUDICIAL SYSTEM

OWNER and CONTRACTOR hereby agree that Article 16 of the General Conditions to the Agreement between OWNER and CONTRACTOR is amended to provide for the following agreement of the parties:

16.01 All claims, disputes and other matters in question between Owner and Contractor arising out of or relating to the Contract Documents or the breach thereof (except for claims which have been waived by the making or acceptance of final payment as provided by Paragraph 14.09) will be decided through the Ohio County Court of Common Pleas. Arbitration will be entered into only if agreed upon in writing by both parties.

SECTION 5
SPECIFICATIONS

SECTION 011100 - SUMMARY OF WORK

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 LOCATION OF THE PROJECT

- A. The project is located in the City of Wheeling, Ohio County, West Virginia. The project site is at the City of Wheeling Water Pollution Control Division (WPCD) located at 2516 Main Street, Wheeling, WV 26003.

1.3 PROJECT SCOPE

- A. This project is not subject to the Build America, Buy America Act (BABA) under assistance list # 97.036.
- B. The Sludge Dewatering Improvements Project – Construction Contract includes the complete installation, integration, and commissioning of a fully furnished sludge dewatering packaged system procured under a separate Equipment Procurement Contract.
- C. The Work under this Contract includes, but is not limited to
 - 1. Receiving, unloading, handling, and storage of Owner-furnished sludge dewatering equipment
 - 2. Installation of all process equipment and accessories
 - 3. Structural modifications and supports required for installation
 - 4. Installation of mechanical piping systems, valves, and appurtenances
 - 5. Electrical work, including conduit, wiring, terminations, and integration with control panels

6. Instrumentation installation and calibration
 7. System integration, testing, and commissioning
 8. Coordination with the Equipment Vendor and Manufacturer's field services
 9. Startup assistance and operator training support
- D. The Contractor shall provide all labor, materials, equipment, tools, and incidentals required to place the sludge dewatering system into full operation in accordance with the Contract Documents.

1.4 COORDINATION WITH EQUIPMENT PROCUREMENT CONTRACT

- A. The sludge dewatering packaged system has been procured separately by the Owner as a complete, fully integrated system.
1. The Contractor shall be responsible for the proper installation and system integration of all Owner-furnished equipment in accordance with the Manufacturer's written instructions.
 2. The Contractor shall review all Vendor submittals, shop drawings, and installation requirements prior to installation.
 3. The scope of this Contract includes but is not limited to the following:
 - a. Demolition of the existing centrifuges, sludge feed pumps, polymer feed system, selective structural demolition, electrical, and mechanical;
 - b. Installation of the new dewatering packaged system, including but not limited to screw press and shaftless screw conveyor, sludge feed pump, polymer feed system, and flowmeter, control panels, and other pertaining components under the Equipment Procurement Contract. The improvements, including the structural, mechanical, electrical, and system integration work, will be performed under the Construction Contract.

4. Responsibility Matrix:

Task	Responsible Party	Notes
Fabrication	Manufacturer	As defined in the Equipment Procurement Contract.
Shipping/Freight	Manufacturer	▪ Manufacturer shall be responsible for packaging, loading, securing for transport, and delivery of equipment to the Project site, including all freight costs, insurance, and risk of loss or damage until delivery is completed and accepted at the Project site. ▪ Screw press drums shall be shipped partially disassembled, with three (3) drums of the six (6) total provided loose and packaged separately from the filtrate collection tray (frame). ▪ Contractor shall be responsible for unloading, handling, field assembly of partially disassembled components, and installation in accordance with the Manufacturer's requirements.
Offloading & Rigging	Contractor	▪ Contractor shall be responsible for all offloading, rigging, hoisting, and placement of equipment. ▪ Contractor shall provide cranes, rigging equipment, and qualified personnel as required for safe handling and installation. ▪ Minimum crane capacity shall be 2 tons, unless otherwise required by equipment weights and configuration. ▪ Contractor shall comply with Manufacturer's handling and lifting requirements.
Storage	Contractor	▪ Contractor shall provide storage facilities and maintain required

		environmental conditions, including temperature, humidity, and cleanliness, in accordance with the Manufacturer's written requirements. ▪ Contractor shall continuously monitor and maintain such conditions to prevent damage, deterioration, or degradation of equipment and components. ▪ Contractor shall protect stored equipment from weather, moisture, dust, and physical damage, and shall implement corrective measures promptly if required storage conditions are not maintained.
Startup	Manufacturer (lead) & Contractor (support)	▪ Contractor shall schedule and coordinate field service visits, provide required installation readiness. ▪ Manufacturer shall lead for equipment startup and commissioning, including directing startup procedure, establishing operating parameters, and determining readiness for startup and initial operation. ▪ Manufacturer shall have final authority regarding equipment-specific adjustments and acceptance of installation for startup. ▪ Contractor shall support startup activities as directed by the Manufacturer, including provision of labor, utilities, temporary services, and correction of installation deficiencies. ▪ Contractor shall not operate equipment without Manufacturer's direction during startup. ▪ Manufacturer's determination of successful startup shall be subject to

		final acceptance by the Owner/Engineer.

1.5 DEFINITIONS

- A. Contractor: The entity responsible for installation, construction, system integration, and commissioning under this Construction Contract.
- B. Vendor: The entity that furnished the complete sludge dewatering packaged system under a separate Equipment Procurement Contract.
- C. Manufacturer: The entity that fabricated individual equipment components. Installation shall comply with the manufacturer's requirements.

1.6 PROJECT DESCRIPTION

A. Scope of Construction:

- 1. The Contractor's scope includes, but is not limited to:
 - a. Receiving and inventorying equipment delivered to the site.
 - b. Inspection for damage upon delivery and notification to Owner
 - c. Offloading, rigging, and placement of equipment.
 - d. Installation of:
 - 1) Dewatering Screw Press and flocculation tank
 - 2) Sludge feed pumps
 - 3) Polymer blending skid systems
 - 4) Shaftless screw conveyor
 - 5) Flow meters and instrumentation
 - 6) Control panels and associated systems
 - e. Installation of all associated piping systems, including sludge feed, polymer, filtrate, and drain lines.
 - f. Electrical connections to all equipment and systems.
 - g. Integration of local and main control panels with plant control systems.

- h. Installation of equipment supports, anchors, and appurtenances.
- i. Coordination of all interfaces between equipment and building systems.
- j. Testing, startup, and commissioning of the complete system.

B. Basis of Design

- 1. The system has been designed based on the Esmil Group Multi-Disc Screw Press, Model MDQ-506 CS.
- 2. The Contractor shall install the furnished system in accordance with:
 - a. Approved submittals
 - b. Manufacturer's requirements
 - c. Contract Documents.

1.7 CONTRACT DOCUMENTS

- A. The Contract Documents include the Project Manual and the Drawings.
- B. The Construction Contract for the installation of the fully integrated packaged dewatering system consists of Contract Documents, including, but not limited to: Legal Notice, Table of Contents, Instructions to Bidders, Forms to be completed with the Bid, Contract Forms, General Conditions, Supplementary Conditions, Specific Project Requirements, and the technical specifications, including:
 - 1. Division 01 – General Requirements.
 - 2. Division 02 – Existing Conditions
 - 3. Division 03 – Concrete
 - 4. Division 05 – Metals
 - 5. Division 26 – Electrical
 - 6. Division 33 – Control Systems
 - 7. Division 40 – Process Integration
 - 8. Division 43 – Process Liquid Handling

9. Division 46 – Wastewater Equipment.

- C. In general, these Specifications describe the work to be performed by the various trades, other than work specifically excluded. It shall be the responsibility of the Contractor and Subcontractors to perform all work incidental to their trade, whether or not specific mention is made of each item, unless such incidentals are included under another Item.
- D. It is advised that the Contractor and all Subcontractors familiarize themselves with the contents of the complete Specifications, particularly for the trades preceding, following, related or adjacent to their work.
- E. The Major Equipment List is included in Appendix 1, Paragraph 3.4, at the end of this section, and defines responsibilities for furnishing and installation.
- F. Existing Sludge Pump Local Control Panel Reference Drawings (supporting document).

1.8 DRAWINGS

- A. The drawings define the Work and include installation details for all equipment systems, piping, mechanical, electrical, and instrumentation integration.
- B. The Contract Drawings contain a detailed description of work to be furnished for the proposed City of Wheeling WPCD, WV – Sludge Dewatering Improvements Project. The scope of work is divided into the Series, presented, and identified under “Sheet Name”. The project includes the following improvements:
 - 1. Series 00G: General – Sheets 00G-01 through 00G-08, include Index Sheet; General Notes; Process Flow Diagram; Work Location Map; Hazardous Location Plan.
 - 2. Series 10A: Architectural – Sheets 10A-01 & 10A-02, include Life Safety Plan and Floor Plan Schedules.
 - 3. Series 10S: Structural – Sheet 10S-01, includes Proposed Equipment Foundation Plan.
 - 4. Series 10D: Process – Sheets 10D-01 through 10D-11, include selective equipment demolition plans and sections; and proposed equipment layout plans and sections.

5. Series 10M: Mechanical – Sheets 10M-01 through 10M-03, include mechanical schedules, legends and notes; the mechanical demolition plans; and proposed mechanical equipment plans.
 6. Series 10E: Electrical – Sheets 10E-01 through 10E-12
 7. Series 10I: Instrumentation - Improvements
 8. Series SD: Standard Details - Structural
- C. The Contractor shall verify all dimensions and field conditions before installation.

1.9 SCHEDULES AND SEQUENCE OF CONSTRUCTION

- A. The Contractor shall prepare and submit detailed construction schedules in accordance with the General Conditions. Schedules shall identify all phases of the Work from mobilization through Final Acceptance and shall include all milestones, critical path activities, coordination requirements with the Owner and Vendor, and all operational impacts.
- B. The Contractor shall incorporate into the schedule all sequencing requirements necessary for the installation of the Owner-furnished sludge dewatering packaged system. The schedule shall reflect coordination with the Manufacturer's field service personnel, including installation readiness, startup support, performance testing, and Operational Demonstration.
- C. The Contractor shall incorporate the following critical sequencing requirements into the construction schedule, which are mandatory for proper coordination with the Owner, Engineer, and Manufacturer:
 1. Solids Control Center – Second Floor Plan at EL 672.50:
 - a. Demolition of the existing centrifuges, sludge conveyors, and associated structural, electrical, and mechanical systems.
 - b. Perform structural work, including installation of the equipment pad foundation for the new Screw Press.
 - c. Removal of the existing 1.5-ton crane.

- d. Coordination with Konecranes for design, furnishing, and installation of the new 2-ton crane system. The Contractor shall coordinate crane installation sequencing with the installation of the Screw Press and associated equipment.
 - e. Installation of the new screw press, conveyor, sludge feed and polymer feed piping, filtrate drain, water lines, and etc.
- 2. Solids Control Center – First Floor Plan at EL 658.25:
 - a. Demolition of the existing polymer feed skid system, the existing polymer transfer pump from the 330-gal totes to the existing 950-gal Storage Tank.
 - b. Modifications to polymer feed and water piping.
 - c. Installation of the new polymer blending skid system and all associated piping, valves, and piping supports.
 - d. Replace the existing polymer transfer pump used to convey polymer from the 330-gal totes to the existing 950-gal Storage Tank with one (1) salvaged polymer feed pump (P-17, 18 or 19) removed from the basement, including all associated piping, valves and connections.
 - e. Electrical work associated with polymer system installation.
- 3. Solids Control Center – Basement Floor Plan at EL 644.50:
 - a. Demolition of the polymer aging tanks, polymer feed pumps P-17, 18 & 19, and auxiliary components.
 - b. Demolition of the Sludge Feed Pump P-11 & 12
 - c. Installation of new progressive cavity pumps and associated piping, supports, valves and electrical connection.
- D. Interruption of existing utility services shall be minimized and shall be limited to times approved by the Owner.
- E. Work shall not commence until all labor, materials, and equipment are available, and Owner-furnished components required for the scheduled activities are available.
- F. The + into the schedule all responsibilities defined in Appendix 1, including:
 - 1. Installation of Owner-furnished equipment
 - 2. Electrical conduit, cable, and terminations

3. Supports, anchors, and appurtenances
 4. Coordination with Vendor-provided field services
 5. Startup, testing, and commissioning activities
- G. The schedule shall clearly identify all tasks assigned to the Contractor under the Construction Contract and all tasks performed by the Vendor under the Equipment Procurement Contract.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Comply with Section 016600, Product Storage and Handling Requirements.
- B. The Owner-Furnished Equipment: The Owner will furnish major sludge dewatering equipment. The Contractor shall:
1. Verify equipment condition upon delivery
 2. Provide proper storage and protection
 3. Install equipment in accordance with the Manufacturer's requirements.
- C. The Contractor-Furnished Materials: The Contractor shall furnish all materials not specifically identified as Owner-furnished, including:
1. Piping and fittings
 2. Supports and anchors
 3. Conduit, wiring, and terminations
 4. Grouting and installation materials
 5. Miscellaneous hardware and accessories.

2.2 STORAGE AND HANDLING

- A. The Contractor shall be responsible for:
 - 1. Receiving equipment transferred from the manufacturer's storage
 - 2. Protecting equipment from damage or environmental exposure
 - 3. Maintaining storage conditions in accordance with Manufacturer requirements
- B. Responsibility for equipment transfers to the Contractor upon delivery to the site.

2.3 CONTRACTOR USE OF SITE

- A. The existing plant is an operational plant and must remain in continual operation at all times. The Work of this Contractor, or its personnel, shall not interfere in any way with the daily operations of the facility. Portions of the plant may be shut down for connection of piping, electrical work, etc., for a maximum of 4 hours, and then only as approved by the Owner. Request for a partial shutdown shall be submitted to the Engineer no less than 48 hours prior to the requested shutdown period.
- B. The City of Wheeling WPCD facility operations staff normally works until 3:00 P.M. Monday through Friday, at which time the main entrance gate is secured. The Contractor shall coordinate in advance with the Owner to obtain site access for deliveries, start-up activities, or other work occurring outside normal operating hours.

PART 3 - EXECUTION

3.1 INSTALLATION REQUIREMENTS

- A. Install equipment in strict accordance with the manufacturer's instructions.
- B. Field verify dimension and condition prior to installation.
- C. Coordinate all trades and interfaces
- D. Provide alignment, leveling, anchoring, and grouting.

3.2 PROTECTION OF WORK AND IMPROVEMENTS

- A. Contractor shall protect the property of the Owner, existing improvements, and the Work installed by the Contractor and others from abuse, damage, dust, debris, and other objectionable materials resulting from construction activities.
- B. Contractor shall provide suitable covers, partitions, or other dust and fume containment devices to suit construction operations.
- C. Contractor shall keep property, existing improvements, and the Work, including structures, piping, fittings, and accessories, free from dirt and foreign matter at all times.
- D. Contractor shall provide temporary plugging of openings, holes, and pipe ends that are existing or that the Contractor has installed.
- E. Property, improvements, and Work damaged by Contractor shall be repaired or replaced by Contractor to the satisfaction of the Owner.

3.3 TESTING AND COMMISSIONING

- A. The Contractor shall:
 - 1. Perform pre-operational inspections
 - 2. Assist the manufacturer with startup.
 - 3. Perform function and performance testing
 - 4. Correct deficiencies identified during testing.
 - 5. Conduction Operation instruction training

3.4 APPENDIX 1 - MAJOR EQUIPMENT LIST

- A. Sludge dewatering improvements, the major equipment list in Appendix 1 defines responsibilities for:
 - 1. Furnishing (Owner/Vendor)

2. Installation (Contractor)
 3. Electrical connections
 4. Supports and appurtenances
- B. The Contractor shall comply with all responsibilities assigned under the Construction Contract.
 - C. Appendix 1 – Sludge Dewatering Improvements Major Equipment List is included as part of this Specification and identifies the major equipment and system components associated with the Sludge Dewatering Improvements.
 - D. The Major Equipment List defines, for each listed item, the responsible party for engineering, furnishing, installation, cable/conduit and terminations, and mounting materials and supports, as applicable.
 - E. The responsibilities indicated in Appendix 1 are provided for clearly delineating the scope of work between the Equipment Procurement Contract and the subsequent Construction Contract.
 - F. Unless otherwise noted, equipment marked as “Provided By Vendor” is included in the scope of this Equipment Procurement Project, while installation and site-related activities identified as “Installed By the Contractor” shall be performed under the Construction Contract.
 - G. The Major Equipment List is intended to supplement the requirements of the Contract Documents and shall not be construed to relieve the Vendor or Construction Contractor of their respective responsibilities as defined elsewhere in the Specifications.

APPENDIX 1 - SLUDGE DEWATERING IMPROVEMENTS PROJECT - MAJOR EQUIPMENT LIST

									
Sludge Dewatering Improvement Project - Major Equipment List									
Date:	4/14/2026								
Note:									
Item	Qty	Description	Status	Engineering By	Provided By	Installed By	Cable Conduit & Terminations By	All Mounting Material, Hardware and Supports By	Notes
1	1	Screw Press Complete Skid including all drums, motors, mixers, conveyor, and instrumentation	New	Vendor	Owner	Contractor	Contractor	Contractor	Screw Press (On skid) instrumentation wiring to (On skid) Local Control Panel by Vendor
2	1	Screw Press Local Control Panel (On skid)	New	Vendor	Owner	Vendor	Vendor	Vendor	-
3	1	Screw Press Main Control Panel (Off Skid)	New	Vendor	Owner	Contractor	Contractor	Contractor	Panel shall be installed in 2nd floor electrical room Screw Press (Off-Skid) Main Control Panel Power, Control and Network wiring to (On skid Local Control panel) by Site contractor
4	1	Sludge Inlet Flow Meter (In Field)	New	Vendor	Owner	Contractor	Contractor	Contractor	Wired to Screw Press Main control panel by Site contractor
5	2	Polymer Blending Skid (Each with local control panel)	New	Vendor	Owner	Contractor	Contractor	Contractor	Wired to the Screw Press Main control panel by the Site contractor.
6	2	Sludge Pump ABB 15HP VFD Local Control Panel	Existing Reuse	N/A	Existing	Existing	Contractor	Contractor	Existing Sludge Pumps P11 & P12 Local Control Panels shall be reused for new sludge pumps
7	2	Sludge Pump Smart Box (Pressure interlock for VFD)	Existing Replace	N/A	Existing	Contractor	Contractor	Contractor	The Existing Smart Boxes shall be replaced with a new pressure monitor system to prevent the pumps from running dry or over pressure.
8	2	Sludge Pump Pressure Monitor System (Pressure interlock for VFD)	New	Vendor	Owner	Contractor	Contractor	Contractor	New pressure monitor system to prevent the pumps from running dry or over pressure
9	2	Sludge Pumps P11 & P12	New	Vendor	Owner	Contractor	Contractor	Contractor	Replacement for existing Sludge pumps
10	2	Sludge Pumps P11 & P12 Field Disconnects	New	Contractor	Contractor	Contractor	Contractor	Contractor	Furnish and install new field disconnects per NEC. Wire feedback for disconnect AUX to VFD as a interlock

END OF SECTION 011100

SECTION 011419 – USE OF SITE

PART 1 - GENERAL

1.1 GENERAL

- A. The Contractor will be allowed the use of as much of the site designated for the improvements as is necessary for his operation.

1.2 USE OF STREETS

- A. During the progress of the work, the Contractor shall make ample provisions for both vehicle and pedestrian traffic on any public street and shall indemnify and save harmless the Owner from any expense whatsoever due to their operations over said streets or walks. The Contractor shall also provide free access to all the fire hydrants, water, and gas valves located along the line of his work. Gutters and waterways must be kept open, or other provisions must be made for the removal of stormwater.
- B. In the event of the Contractor's failure to comply with these provisions, the Owner may cause the same to be done and may deduct the cost of such work from any monies due the Contractor under this Agreement, but the performance of such work by the Owner at its instance shall serve in no way to release the Contractor from his general or particular liability for the safety of the public or the work.
- C. The Contractor shall repair at no cost to the Owner all existing roads, parking areas, and grassed areas that are damaged due to the execution of his work. The Contractor shall remove daily all debris that may be tracked onto existing streets, drives, or walks by his equipment or that of subcontractors or suppliers.

1.3 PROTECTING EXISTING BUILDINGS, STRUCTURES, AND ROADWAYS

- A. The Contractor shall, at his own expense, shore up and protect any buildings, roadways, utilities, or other public or private structures which may be encountered or endangered in the prosecution of the work, and that may not be otherwise provided for, and he shall repair and make good any damages caused to any such property by reason of his operations. All existing fences removed due to the prosecution of the work shall be replaced by the Contractor. No extra payment will be made for said work or material, but the cost of this work must be included in the price stipulated for the work to be done under this contract.

1.4 SITE FACILITIES

- A. The Contractor shall furnish and place sufficient quantities of portable toilet facilities at locations convenient for use by the Contractor's personnel, Subcontractors, the Engineer, and the Owner.

1.5 RESTORATION

- A. The Contractor shall restore all areas per the plans and specifications, and if not specified, at least to the conditions existing prior to the start of work.

END OF SECTION 011419

SECTION 011423 - ADDITIONAL WORK, OVERTIME

PART 1 - GENERAL

1.1 NIGHT, SUNDAY AND HOLIDAY WORK

- A. No work will be permitted at night, on Sundays, or legal holidays except as noted on the plans or in the case of an emergency, and then only upon written authorization of the Owner. Where no emergency exists, but the Contractor feels it advantageous to work at night, Sunday, or legal holidays, the Contractor shall notify the Owner at least two (2) days in advance, requesting written permission. Any work performed during the absence of the Owner will be done at the Contractor's risk and responsibility and may be subject to rejection upon later inspection.

END OF SECTION 011423

SECTION 012100 - ALLOWANCES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements governing allowances.
 - 1. Selected materials and equipment are specified in the Contract Documents by allowances. In some cases, these allowances include installation. Allowances have been established in lieu of additional requirements and to defer selection of actual materials and equipment to a later date when additional information is available for evaluation. If necessary, additional requirements will be issued by Change Order.
- B. Types of allowances include the following:
 - 1. Lump-sum allowances.
 - 2. Unit-cost allowances.
 - 3. Contingency allowances.
 - 4. Inspection and testing allowances.
- C. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 1 Section "Modification Procedures" specifies procedures for submitting and handling Change Orders.
 - 2. Division 1 Section "Quality Control Services" specifies procedures governing the use of allowances for inspection and testing.

1.3 SELECTION AND PURCHASE

- A. At the earliest practical date after award of the Contract, advise the Architect of the date when the final selection and purchase of each product or system described by an allowance must be completed to avoid delaying the Work.
- B. At the Architect's request, obtain proposals for each allowance for use in making final selections. Include recommendations that are relevant to performing the Work.
- C. Purchase products and systems selected by the Architect from the designated supplier.

1.4 SUBMITTALS

- A. Submit proposals for purchase of products or systems included in allowances, in the form specified for Change Orders.
- B. Submit invoices or delivery slips to show the actual quantities of materials delivered to the site for use in fulfillment of each allowance.

1.5 CONTINGENCY ALLOWANCES

- A. Use the contingency allowance only as directed for the Owner's purposes and only by Change Orders that indicate amounts to be charged to the allowance.
- B. The Contractor's related costs for products and equipment ordered by the Owner under the contingency allowance are not part of the Contract Sum. These costs include delivery, installation, taxes, insurance, equipment rental, and similar costs.
- C. Change Orders authorizing use of funds from the contingency allowance will include Contractor's related costs and reasonable overhead and profit margins.
- D. At Project closeout, credit unused amounts remaining in the contingency allowance to the Owner by Change Order.

1.6 INSPECTION AND TESTING ALLOWANCES

- A. Inspection and testing allowances include the cost of engaging the inspection or testing agencies, the actual inspections and tests, and reporting the results.
- B. The allowance does not include incidental labor required to assist the testing agency or costs for retesting upon failure of previous tests and inspections.
- C. Costs of services not required by the Contract Documents are not included in the allowance.
- D. At Project closeout, credit unused amounts remaining in the inspection and testing allowance to Owner by Change Order.

1.7 UNUSED MATERIALS

- A. Return unused materials to the manufacturer or supplier for credit to the Owner, after installation has been completed and accepted.
 - 1. When requested by the Architect, prepare unused material for storage by Owner where it is not economically practical to return the material for credit. When directed by the Architect, deliver unused material to the Owner's storage space. Otherwise, disposal of unused material is the Contractor's responsibility.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine products covered by an allowance promptly upon delivery for damage or defects.

3.2 PREPARATION

- A. Coordinate materials and their installation for each allowance with related materials and installations to ensure that each allowance item is completely integrated and interfaced with related work.

3.3 SCHEDULE OF ALLOWANCES

- A. **Allowance No. 1: A cash allowance in the amount of \$115,000.00 is established for crane system procurement and associated installation work. The Contractor shall include all coordination necessary to support the Owner's final crane procurement strategy. Final manufacturer selection and scope definition will be addressed through allowance authorization or change order procedures following completion of the structural evaluation and crane system design.**

END OF SECTION 012100

SECTION 013119 - PROJECT MEETINGS

PART 1 - GENERAL

1.1 PRECONSTRUCTION MEETING

- A. Prior to the Contractor beginning any work on the project, the Owner will schedule and hold a preconstruction meeting to discuss all aspects of the contract work.
- B. The Contractor shall be present and be prepared to comment in detail on all aspects of his work.
- C. The Contractor shall bring to the preconstruction meeting a proposed construction progress schedule, erosion control plan, quality control program, concrete mix designs, etc. Approval of each by the Engineer is required prior to the start of any work.
- D. Included in the construction progress schedule shall be an implementation sequence of the proposed erosion control efforts required by the contract.

1.2 PROGRESS MEETINGS

- A. Monthly progress meetings will be held at a location to be determined by the Owner on a regularly scheduled day mutually convenient to the Owner, Contractor, and Engineer.
- B. The Contractor shall provide an updated construction progress schedule and be prepared to comment in detail on all aspects of his work.

END OF SECTION 013119

SECTION 013233 – CONSTRUCTION PHOTOGRAPHS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 SUMMARY

- A. This Section includes administrative and procedural requirements for the following:
 - 1. Preconstruction photographs.
 - 2. Periodic construction photographs.
 - 3. Final Completion construction photographs.

1.3 PROGRESS PHOTOGRAPHS

- A. Construction Photographs: Contractor shall submit electronic photographic image files within seven (7) days of taking photographs /weekly to the Engineer.
 - 1. Format: Provide photographs as cut-and-paste files onto a Word document (maximum 4 images to a page). Save digital page files in PDF format.
 - 2. Identification: On each page of photos, provide the following information:
 - a. Owner's Name
 - b. Contract Description
 - c. Contractor's Name
 - d. Description of view, indicating location, direction (by compass point), and elevation or story of construction
 - e. Date photograph was taken
- B. The General Construction Contractor shall have two (2) color photographs made of the project every three (3) weeks it is in progress. The photographs shall be of such views and taken at such times as the Engineer directs.

1.4 COORDINATION

- A. Temporary Services: Contractor to cooperate with the photographer and provide temporary services requests, including access to the project site and use of temporary facilities, including temporary lighting.

PART 2 - PRODUCTS

2.1 PHOTOGRAPHIC MEDIA

- A. Digital Images: Provide images in PDF format as noted above or as otherwise posted to the website as individual photographs, with a minimum sensor size of 4 megapixels.

PART 3 - EXECUTION

3.1 GENERAL

- A. Date Stamp: Unless otherwise indicated, date and time stamp each photograph as it is being taken, so the stamp is integral to the photograph.
- B. Field Office Prints: Retain one set of prints of progress photographs in the field office at the project site, available at all times for reference. Identify photographs the same as those posted on the project's website.

END OF SECTION 013233

SECTION 013236 – VIDEO MONITORING AND DOCUMENTATION

PART 1 - GENERAL

1.1 SCOPE

- A. Provide all labor, materials, equipment, and services, and perform all operations necessary to furnish to the Owner a complete color audio-video record on a USB Flash Drive of the surface features within the proposed construction zone of influence. This record shall include, but not be limited to, all audio-video USB Flash Drives, storage cases, video logs, and indexes. The purpose of this coverage shall be to accurately document the pre-construction condition of these surface features.

1.2 QUALIFICATIONS

- A. The color audio-video documentation shall be done by a responsible commercial firm known to be skilled and regularly engaged in the business of pre-construction color audio-video documentation. The firm shall furnish such information as the Owner deems necessary to determine the ability of that firm to perform the work in accordance with the Contract specifications.

1.3 PRODUCTS

- A. The color audio-video recording delivered to the Owner shall be on a high-quality USB Flash Drive.

END OF SECTION 013236

SECTION 013323 - SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES

PART 1 - GENERAL

1.1 SUMMARY

- A. This Section defines the requirements for preparation, submission, review, and resubmission of shop drawings, product data, and related submittals required to demonstrate compliance with the Contract Documents.
- B. All submittals shall be prepared by the Manufacturer and reviewed and approved by the Vendor prior to submission to the Engineer. Vendor approval constitutes confirmation of coordination, completeness, and conformance with the Contract Documents.
- C. Requirements of Section 013323 govern the preparation, review, and approval of all submittals associated with the equipment installation of the sludge dewatering packaged system procured under the separate Equipment Procurement Contract and as described in Section 011100.

1.2 GENERAL REQUIREMENTS

- A. The Manufacturer or Vendor submitted and approved equipment submittals under the Procurement Contract, which constituted confirmation of coordination of detailed drawings, catalog data, specifications, and material certifications for all equipment and materials specified or required for proper completion, completeness, and conformance with the Contract Documents.
- B. Contractor approval constitutes confirmation of field verification, coordination with all trades, and compliance with installation requirements under the Construction Contract.
- C. The Installation Contractor (hereinafter referred to as "Contractor") shall be responsible for coordination, review, and submission of all submittals required for the Work under the Construction Contract.
- D. The Contractor's responsibilities under this Section are in addition to those defined in Section 011100 and include all activities necessary to properly install, integrate, test, and commission Owner-furnished equipment.
- E. The Contractor shall be responsible for the coordination of all submittals and shall ensure that submittals are compatible with field conditions, installation requirements, and related Work.
- F. Submittals shall also demonstrate that the proposed equipment and materials can be properly installed within the existing facility conditions and coordinated with structural, mechanical, electrical, and instrumentation systems.

- G. Prior to submission and installation, the Contractor shall:
1. Verify field conditions: Confirm all dimensions, elevations, clearances and utilities locations affecting the Work.
 2. Coordinate with all trades: Ensure compatibility with structural, mechanical, electrical, and instrumentation systems.
 3. Confirm installation requirements: Review manufacturer instructions, access needs and lifting/rigging constraints.
 4. Resolve conflicts: Identify and correct discrepancies between field conditions, Contract Documents, and manufacturer data before submitting.
 5. Integrate Owner-furnished equipment: Verify interfaces, connections, and support requirement for all Owner-provided components.
 6. Ensure completeness: Confirm that each submittal package includes all required drawings, certifications, and coordination information.

1.3 ENGINEER REVIEW

- A. Review of submittals by the Engineer is for general conformance with the design concept and Contract Documents only. Such review does not relieve the Manufacturer or Vendor of responsibility for accuracy, completeness, coordination, proper fit, functioning, performance, or compliance with all Contract requirements.
- B. Engineer review shall not relieve the Contractor of responsibility for field verification, coordination, installation, system integration, or compliance with the Construction Contract requirements.
- C. The engineer review does not extend to means, methods, techniques, sequencing, procedures of construction, or safety precautions.
- D. Review by the Engineer shall not relieve the Contractor of responsibility for:
1. Accuracy and completeness of submittals
 2. Proper fit, functioning, and performance
 3. Coordination of the Work
 4. Compliance with all Contract requirements.
- E. Engineer review shall not be construed as approval of deviations from the Contract Documents unless such deviations are specifically identified in writing and expressly accepted.

1.4 SUBMITTAL SCHEDULING

- A. Shop Drawings shall be submitted in proper sequence and sufficiently in advance regarding the time required for checking, transmittal, and resubmittal without delay in the Work.

- B. The Contractor shall incorporate all required submittals into the Project schedule and shall coordinate submittal sequencing with procurement, delivery, installation, and commissioning activities.
- C. Failure to submit required submittals in a timely manner shall not constitute grounds for time extension.
- D. Allow a minimum of twenty-one (21) calendar days for Engineer review following receipt of a complete submittal.
- E. No Work requiring shop drawing shall proceed until submittals have been reviewed by the Engineer.
- F. Accepted and reviewed Shop Drawings shall not be construed as approval of changes from Contract plan and specification requirements.
- G. The Engineer will review the first and second complete Shop Drawing submittals at no cost to the Owner. Review of a third or subsequent resubmittal required due to incomplete, incorrect, or non-conforming information provided by the Manufacturer or Vendor shall be performed at the Contractor's expense.
- H. A detailed field performance testing plan shall be submitted for review prior to shipment, including duration, sampling methods, acceptance criteria, and corrective action procedures.

1.5 SUBMITTAL PROCEDURE FOR THE EQUIPMENT PROCUREMENT CONTRACT

- A. All submittals shall be transmitted to the Engineer by the Contractor. Submittals prepared by Manufacturers or Vendors shall be routed through the Contractor for review, coordination, and approval prior to submission.
- B. The Contractor shall review all Vendor submittals associated with Owner-furnished equipment and shall verify compatibility with installation requirements, utilities, supports, and field conditions prior to submission.
- C. The Vendor of the packaged sludge dewatering equipment shall review and approve all Shop Drawings prior to submission.
- D. Vendor review does not relieve the Contractor of responsibility for installation, coordination, or integration of the equipment into the Work.
- E. The General Contractor shall install all equipment and materials in accordance with:
 - 1. Contract Documents
 - 2. Reviewed submittals
 - 3. Manufacturer's written instructions
- F. In the event of conflict among these requirements, the General Contractor shall promptly notify the Engineer for clarification prior to proceeding.

G. Submittal Preparation: Mark each submittal with a permanent label or page for identification. Provide the following information on the label for proper processing and recording of action taken:

1. Project name
2. Contract name
3. Location
4. Engineer's name and address
5. Vendor of the complete packaged system
6. Manufacturer name and address of individual equipment.
7. Specification Section number and title
8. Drawing numbers and detail references
9. Submittal sequence or log number
10. Space for Vendor approval and Engineer action stamp.

H. Each submittal shall include the following certification statement signed by the Manufacturer:

By this submittal, I hereby certify that all constraints, construction criteria, materials, dimensions, catalog numbers, and related data have been determined and verified, and that each item has been checked and coordinated with all applicable approved shop drawings and Contract requirements.

I. Each submittal shall include the following certification statement signed by the Contractor:

By this submittal, the Contractor certifies that the submittal has been reviewed, coordinated, and verified for compliance with field conditions, Contract Documents, and related Work. The Contractor further certifies that dimensions, quantities, and installation requirements have been checked and that the Work will be constructed in accordance with the reviewed submittal.

Signature

Date

Company

J. Shop Drawings shall be submitted in electronic format for review. Upon approval by the Engineer, the Contractor shall provide the final approved Shop Drawings in electronic format only; no hard copies are required.

1.6 DEVIATIONS

- A. The General Contractor shall clearly identify all deviations from the Contract Documents at the time of submittal.
- B. Failure to identify deviations shall constitute a representation that the submittal fully complies with the Contract Documents and shall not be grounds for subsequent claims.

1.7 ENGINEER ACTION

- A. The Engineer will review each properly submitted submittal and stamp it to indicate action taken.
- B. Review of individual components does not constitute review of assemblies; complete systems shall be submitted as coordinated packages.
- C. Compliance with Contract requirements remains the Contractor's responsibility regardless of review status.

1.8 REVIEW PROCEDURE

- A. Drawings shall be clean, legible, and shall show necessary working dimensions, arrangement, material finish, erection data, and information needed to define what is to be furnished and to establish its suitability for the intended use. Specifications may be required for equipment or materials to establish any characteristics of performance where such are pertinent. Suitable catalog data sheets showing all options and marked with complete model numbers may, in certain instances, be sufficient to define the articles which it is proposed to furnish.
- B. Action Stamp: The Engineer will stamp each submittal with a uniform, self-explanatory action stamp. The stamp will be appropriately marked, as follows, to indicate the action taken:
 - 1. Reviewed – No Exceptions Taken: Submittal is in general compliance; no resubmittal required.
 - 2. Reviewed – Approved as Note: Minor comments noted; resubmittal not required.
 - 3. Revise and Resubmit: Submittal is incomplete or inadequate; resubmittal required.
 - 4. Rejected: Submittal does not comply with Contract Documents; new submission required.
- C. Submittals requiring a Change Order will not be returned until the Change Order is approved or otherwise directed by the Owner.

END OF SECTION 013323

SECTION 013325 - WARRANTY

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section provides procedures and requirements for warranting the Work. The enumerated warranties herein are in no way intended to abrogate any implied warranties associated with goods supplied under this Contract.

1.2 SUMMARY

- A. Work Included:
 - 1. Preparation of Warranties for submittals.
 - 2. Requirements for the content and submittal of Warranties.

1.3 RELATED DOCUMENTS

- A. This Section includes minimum requirements for the warranty of the equipment. See also all equipment specification sections for additional requirements.
- B. Section 013323, Shop Drawings, Product Data, and Samples.

1.4 SUBMITTALS

- A. As a part of the submittals for each item of equipment or a group of equipment items, include a DRAFT Warranty containing all of the language and terms specified.
- B. Following completion of the terms for establishment of the Warranty specified, prepare Warranties for submittal per section 013323 and the following:
 - 1. Warranties for projects or portions of the work, established on a particular date as specified herein, may be submitted as a group.
 - 2. Label each submittal with the title "WARRANTY", the project name, the effective date, the Contractor's name, address, and telephone number.
 - 3. A Table of Contents shall be included, identifying each item with a number and title of specification section and the name of the product or Work item.
 - 4. Separate Warranty for each specification section item with index tab sheets. Label tables to conform to the Table of Contents.
- C. The Warranty shall contain, as applicable:
 - 1. Effective starting date and end date of the Warranty period.
 - 2. Statement of the terms and conditions of the Warranty, if any.

3. Statement that all Operating and Maintenance information has been provided and approved.
 4. Statement that all training and training materials have been provided and approved.
 5. Statement that the equipment or system commissioning is complete and has been reviewed and accepted by the manufacturer in accordance with provisions of the individual Sections in Divisions 1 through 46 of the Project Manual, as applicable.
 6. Certifications by the Contractor and/or Manufacturer that the statements noted above are true and correct. This certification shall be signed by a person authorized to sign documents on behalf of the Contractor.
- D. Special warranties, as required by individual Sections in Divisions 1 through 46 of the Project Manual, shall be submitted in accordance with the requirements of this Section.

PART 2 - PRODUCTS

2.1 WARRANTIES

A. Term or Period

1. The Warranty shall guarantee that the equipment is free from defects in materials and workmanship for a period of twelve (12) months from the dated of Substantial Completion and successful startup, or eighteen (18) months from the date of deliver to the Contractor, whichever occurs first, unless a longer warranty period is specified in the applicable individual Sections of Divisions 1 through 46 of the Project Manual.
2. The delivery of the packaged equipment shall occur under a separate Construction Contract following selection of the General Contractor, but not earlier than October 2026.

B. Contractor's Responsibilities

1. During the Warranty period, the Manufacturer is responsible for repair or replacement of all failures and defects, exclusive of ordinary and routine maintenance and failures directly traceable to the lack thereof. This requirement shall be thoroughly explained by the Contractor to all prospective equipment suppliers. Repairs or replacement shall be performed in accordance with the Conditions.

PART 3 - EXECUTION

3.1 EXECUTION OF WARRANTY

- A. The approved DRAFT Warranty will be executed and placed in effect as the FINAL Warranty on the date of Final Completion of the Work for the specific equipment item or group named in the Warranty.

END OF SECTION 013325

SECTION 013326 – PRODUCT TESTING AND CERTIFYING

PART 1 - GENERAL

1.1 QUALITY OF MATERIALS

- A. Where the specifications require mill or factory tests, the Manufacturer shall furnish duplicate copies of certified manufacturer's test reports demonstrating compliance with the Contract requirements, including applicable quality and performance data.
- B. Mill, shop, or witness tests shall be subject to observation by the Engineer's authorized representative; however, such observation shall not relieve the Manufacturer of the obligations to furnish the required certified test reports.
- C. The Manufacturer shall notify the Engineer in writing at least two (2) weeks in advance of scheduled testing to allow arrangements for witnessing the test to be made. Any waiver of test witnessing shall be made in writing by the Engineer only.
- D. All reasonable costs associated with travel, lodging, meals, and transportation necessary for the Engineer's representative and the Owner's representative to attend witness tests shall be paid by the Owner.
- E. Unless otherwise specified, all materials, equipment, and articles shall be erected, installed, or connected, used, cleaned, and conditioned in accordance with the printed instructions and directions of the manufacturer.
- F. The installation shall be so made that its several components will function together as a workable system. It shall be complete with all accessories necessary for its operation and shall be left with all equipment properly adjusted and in working order.
- G. The work shall be executed in conformity with the best practice and to contribute to efficiency of operation, minimum maintenance, accessibility, and sightliness. It shall also be executed so that the installation will conform and accommodate itself to the building structure, its equipment, and usage.
- H. Whenever in the contract documents a particular brand, make of material, device, or equipment is shown or specified, such brand, make of material, device, or equipment is to be regarded merely as a standard, and such trade name shall be followed by "or equal".

1.2 QUALITY ASSURANCE

- A. The equipment and materials to be furnished under this Contract shall be the products of well-established and reliable firms that have had ample experience for at least five (5) years in the manufacture of equipment or materials similar in design and of equal quality to that specified. If required, the manufacturer shall submit a list of installations of similar equipment that have been in successful operation for at least five (5) years.

1.3 EXPERIENCE CLAUSE REQUIREMENT AND PERFORMANCE BONDS FOR MANUFACTURER

- A. For every piece of equipment furnished under this Contract, the manufacturer will be required to have a minimum of five (5) years of experience in providing this specific type of equipment. In lieu of this experience requirement, the manufacturer will be required to provide performance bond(s) for the faithful performance of the equipment and guarantee payment in a sum of not less than one hundred and fifty percent (150%) of the total equipment price for the completed work for that item. In the absence of verifiable experience, the manufacturer will be required to provide the performance bond(s) for the same number of years that the manufacturer was found lacking in experience from the specified five (5) year period. The performance bond(s) shall be from an approved surety company to the satisfaction of the Owner's Law Director.
- B. Agents of bonding companies which write bonds for the performance and payment of the contract shall furnish the power of attorney bearing the seal of the company, evidencing such agent's authority to execute the particular type of bond to be furnished, and evidencing also the right of the surety company to do business in the State of West Virginia. A copy of this proof shall be attached to each copy of the contract.
- C. The bond shall be purchased through a surety company with a local agent upon whom service of process can be made.
- D. In the event of failure of surety or co-surety, the manufacturer shall immediately furnish a new bond, as required herein. The manufacturer's bond will not be released until all provisions of the contract have been fulfilled.

END OF SECTION 013326

SECTION 013326.01 - QUALITY CONTROL PLAN

PART 1 - GENERAL

1.1 QUALITY CONTROL

- A. The Contractor shall be responsible for the quality of all materials incorporated into the project work and shall be responsible for all costs of testing and certification of the same. The Contractor shall provide the City Engineer with a list of three (3) local qualified firms for the City to select from to be the Contractor's testing firm.
- B. The Contractor shall provide the Engineer with a Quality Control Plan in which their testing methods/procedures are defined. Said Plan shall meet with the approval of the Engineer and include identification of laboratories, types of testing, and the tentative amount and scheduling of each.

All certifications of tests and/or gradations for materials to be utilized in the work and all quality control testing shall be performed by an independent laboratory (not affiliated with, owned by, or managed by the Contractor).

- C. The Owner may perform field Quality Assurance testing; however, such testing shall not relieve the Contractor from the responsibility of Quality Control testing or from supplying certificates from manufacturers or suppliers to demonstrate compliance with the specifications. It is intended that the testing by the Contractor and the Owner be complimentary toward a quality project; however, the Contractor may not assume the Owner will test or that any tests will be done in lieu of the Contractor's own Quality Control testing. In the same sense, the Contractor may not rely on Owner Quality Assurance testing as a basis of acceptance or approval of his work, nor may any Owner-performed testing be reflected in his submitted plan.

1.2 TEST CRITERIA

- A. The following tests at a minimum shall be included with the Contractor's Quality Control Plan in accordance with the specifications:
 - 1. Concrete Mix Design
 - a. For each type of concrete, the laboratory shall perform the necessary mix design, providing all test data as required by the specifications.
 - 2. Concrete Field and Laboratory Tests
 - a. The laboratory shall cast concrete cylinders and test beams:
 - 1) One set of four cylinders per 50 C.Y. with a minimum of two sets per day. The cylinders shall be broken: one at 7 days, two at 28 days, one at 56 days, unless otherwise directed by the Engineer.
 - 2) One beam per 50 C.Y. with a minimum of two beams per day.
 - b. Temperature and unit weight shall be run on fresh concrete at intervals sufficient for the type of structure being placed and a minimum of once per day. Bulk weight, bucket weight, (tare), net weight, bucket factor (bucket volume), and unit weight shall be recorded on the fresh concrete report. Show

all batch weights for yield calculations. Slump and air content tests shall be taken with a minimum of one test per 20 C.Y. and at least once per day.

- c. All field and laboratory testing shall be performed by technicians certified by the American Concrete Institute (ACI) for the type of testing performed.
- d. Initial cure of all cylinders shall be in a temperature-controlled cure box or temperature-controlled water tank with a hi-low thermometer. Hi-low temperature readings shall be recorded on the fresh concrete report.

1.3 LABORATORY REPORTS

- A. Reports of laboratory and field tests will be distributed to the Engineer, Owner, and Suppliers within 24 hours of completion.

END OF SECTION 013326.01

SECTION 014223 - INDUSTRY STANDARDS

PART 1 - GENERAL

1.1 ABBREVIATIONS

- A. Abbreviations, as used, designate the following:

ACI	-	American Concrete Institute
AIEE	-	American Institute of Electrical Engineers
AISC	-	American Institute of Steel Construction
ANSI	-	American National Standards Institute
ASTM	-	American Society of Testing and Materials
AWWA	-	American Water Works Association
CMS	-	Construction and Material Specifications
NEMA	-	National Electrical Manufacturers Association
W. Va Code	-	West Virginia Code Chapters
UL	-	Underwriters Laboratories, Inc.

1.2 REFERENCE TO OTHER SPECIFICATIONS

- A. Where reference is made to specifications such as ASTM, AWWA, or ANSI, the latest edition shall be used, unless otherwise noted on the plans or in the specifications.

1.3 CODES AND STANDARDS

- A. All work provided for by these specifications must be installed according to the provisions of the State and local building codes, subject to inspection and acceptance by the State and local inspectors.

END OF SECTION 014223

SECTION 014323 – QUALIFICATIONS OF TRADESMEN

PART 1 - GENERAL

1.1 CHARACTER OF WORKMEN AND EQUIPMENT

- A. The Contractor shall employ competent and efficient workmen for every kind of work. Any person employed on the work who shall refuse or neglect to obey directions of the Owner or his representative, or who shall be deemed incompetent or disorderly, or who shall commit trespass upon public or private property in the vicinity of the work, shall be dismissed when the Owner so orders, and shall not be re-employed unless express permission be given by the Owner. The methods, equipment, and appliances used on the work and the labor employed shall be such as will produce a satisfactory quality of work and shall be adequate to complete the contract within the specified time limit.
- B. In hiring of employees for the performance of work under this Contract, or any Subcontract hereunder, no Contractor or Subcontractor, nor any person acting on behalf of such Contractor or Subcontractor, shall, by reason of race, sex, creed, or color, discriminate against any citizen of the State of West Virginia in the work to which the employment relates. No Contractor, Subcontractor, nor any person on his behalf shall, in any manner, discriminate against or intimidate any employee hired for the performance of work under this contract on account of race, creed, sex, or color.

END OF SECTION 014323

SECTION 014523 – TESTING, ADJUSTING, AND BALANCING

PART 1 - GENERAL

1.1. GENERAL DESCRIPTION

- A. This Section includes general requirements for the testing, adjusting, and balancing of equipment and systems furnished and installed under the Contract.

1.2. SUMMARY

- A. Testing, adjusting, and balancing shall be performed in accordance with recognized industry standards and as specified in the Contract Documents.

1.3. RELATED DOCUMENTS

- A. Section 013323 – Shop Drawings, Product Data, and Submittals
- B. Section 017517 – Starting of Systems / Commissioning
- C. Section 017901 – Operational Demonstration

1.4. DEFINITIONS

- A. Field Testing:
 - 1. Field Testing is the overall on-site testing phase performed after installation and startup. It includes all testing activities conducted in the field and must be witnessed by the Owner. Field Testing includes, but is not limited to:
 - a. Dry Testing
 - b. Wet Testing
 - c. Performance Testing
 - d. Operational Demonstration
 - 2. Conform to the specific test requirements as given in individual sections of the Project Manual.
 - 3. Provide all necessary assistance to Owner personnel, at no additional cost to the Owner.
- B. Dry Testing:
 - 1. Dry Testing is performed by the Contractor and Manufacturer/Vendor without introducing process sludge, water, or any test material into the system. Dry Testing verifies alignment, lubrication, rotation, electrical continuity, control logic, interlocks, alarms, and proper operation of all motors, drives, valves, sensors, and instrumentation.

C. Wet Testing:

1. Wet Testing is performed by the Contractor and Manufacturer/Vendor using clean water or other approved test material to verify mechanical and electrical operability under flow conditions. Wet Testing confirms leak-tightness, pump operation, polymer system operation (including mineral-oil testing where applicable), valve function, flow distribution, and proper operation of all piping and appurtenances

D. Performance Testing:

1. Performance Testing is performed jointly by the Manufacturer/Vendor and Contractor under actual operating conditions using process sludge. Performance Testing demonstrates that the complete dewatering system meets all performance requirements specified in the Contract Documents.

E. Operational Demonstration: A commissioning activity performed by the Owner during which the Owner operates and maintains a fully functional component, system, or unit process under normal operating conditions to demonstrate compliance with the Contract Documents. The Contractor shall provide on-site supervision, required labor, materials, and technical support throughout the demonstration period.

1.5. SUBMITTALS

A. Quality Control Submittals:

1. Submit Test Reports within 48 hours of the completion, suspension, or termination of the test unless otherwise approved by the Owner. Submit Test Reports per Section 013323 – Shop Drawings, Product Data, and Submittals.

B. Project Record Documents:

1. Test, adjustment, and balancing data shall be recorded by the Contractor in accordance with the Specifications.

1.6. REGULATORY REQUIREMENTS

A. Comply with all applicable regulatory requirements except where modified by the Contract Documents.

PART 2 - PRODUCTS

2.1 MATERIALS AND EQUIPMENT

- A. The Contractor shall supply all materials and equipment used in testing, adjusting, and balancing.
- B. Materials and equipment used shall be of good quality and suitable for the intended service. The use of miscellaneous items found at the job site is not acceptable.

- C. Select capacity or range of test equipment to provide meaningful test results. Select pressure or differential pressure gauges so that the test pressure is 50% to 75% of the gauge capacity.

2.2 FABRICATION

- A. The Contractor shall fabricate temporary equipment used in testing.

2.3 SOURCE QUALITY CONTROL

- A. All test instruments shall be calibrated to recognized standards, traceable to NBS standards, by the instrument manufacturer or a qualified independent calibration laboratory. Submit instrument calibration data for the Contractor's review prior to the test.

PART 3 - EXECUTION

3.1. EXAMINATION AND VERIFICATION OF CONDITION

- A. Verify the equipment, component, or system is completely and correctly installed before beginning tests.
- B. Review the design and installation of the system or equipment to ensure that the proposed test will not result in a hazard to personnel or equipment.

3.2. PREPARATION

- A. Design, fabricate, and install test equipment before commencing the test.
- B. Where required by the Contract Documents, or when required by the Contractor, an approved representative of the manufacturer shall be on site to provide technical direction.
- C. Notify and obtain approval of the Contractor not less than 72 hours prior to each test. See Section 017517, Starting of Systems/Commissioning.

3.3. TESTING, ADJUSTING, AND BALANCING

- A. Dry Testing: Prior to introducing any process sludge, the Contractor and Manufacturer shall perform Dry Testing of all mechanical and electrical components of the dewatering system.
 - 1. Dry Testing shall include verification of alignment, lubrication, rotation, electrical continuity, control logic, interlocks, alarms, and proper operation of all motors, drives, valves, sensors, and instrumentation
 - 2. Test individual components before testing the system of which they are a part.

B. Wet Testing:

1. Test all equipment and systems with test material, such as potable water or plant-treated effluent water, including mineral-oil testing where applicable.
2. Wet Testing confirms leak-tightness, pump operation, polymer system operation (including mineral-oil testing where applicable), valve function, flow distribution, and proper operation of all piping and appurtenances.
3. All costs, including materials and equipment, for delivery of the test material shall be at the Contractor's expense.
4. After testing, adjusting, and balancing, test all equipment and systems for a minimum of 4 hours under the design operating conditions utilizing test material.
5. Suspend or secure all tests in the event of test failures or if hazardous conditions occur. Make repairs, replacements, or adjustments and restart the test in its entirety.
6. The Contractor shall dispose of the test material at the approval of the Owner at no additional expense to the Owner.
7. The Contractor shall clean all equipment systems and structures upon conclusion of testing, unless otherwise directed by the Owner, at no additional expense to the Owner.

C. Performance Testing

1. After successful completion of Wet Testing, the Contractor and Manufacturer shall perform Performance Testing of the complete dewatering system under actual sludge loading conditions. Performance Testing shall demonstrate compliance with all performance criteria specified in this Section, including but not limited to:
 - a. Sludge throughput capacity
 - b. Solids capture rate
 - c. Dewatered cake solids concentration
 - d. Polymer usage
 - e. Proper integration and operation of all ancillary equipment

- D. If equipment or materials fail or if testing must be extended beyond the original approved duration due to additional testing required as a result of the appearance of a defect in the work, or if testing could not be completed or conducted as outlined in the approved schedule, the cost of such re-testing, including additional or extended conveyance and maintenance of the Owner, shall be borne by the Contractor.

3.4. FIELD QUALITY CONTROL

- A. Submit Test Reports for all tests, successful or unsuccessful, in accordance with Section 013323 – Shop Drawings, Product Data and Submittals.
- B. Test shall be repeated per the General Conditions if results of testing fail to meet test criteria, whether the failure is identified in the field at the time of testing or through Test Report review.

END OF SECTION 014523

SECTION 015213 - FIELD OFFICES

PART 1 - GENERAL

1.1 CONTRACTOR'S OFFICE

- A. Each Contractor shall provide and maintain an office on the site of the work during the construction period of the contract, at which he or his authorized agent shall be present at all times while the work is in progress.

1.2 RESIDENT ENGINEER'S OFFICE

- A. The General Construction Contractor shall be required to provide and maintain the herein described Resident Engineer's office, services, and office equipment until completion of the contract, including the punch list. All equipment shall be provided with a maintenance contract that provides prompt service. At any time a service or equipment is non-operative, the Resident Engineer may utilize a commercial service or rental equipment at the Contractor's expense until the service or equipment is restored.
- B. The Electrical Contractor shall provide and install temporary power, internet access, and telephone lines to the Engineer's office.
- C. Office Equipment
 - 1. One (1) Desk with Desk Chair
 - 2. One (1) Plan Racks
 - 3. One (1) Plan Tables
 - 4. One (1) Conference Table (Approximately 3' x 6')
 - 5. Eight (8) Chairs for Conference Table
 - 6. The drafting table and drafting stool are required
 - 7. Two (2) Four-Drawer Letter Size Lockable Filing Cabinets
 - 8. One (1) Bookcase (36" x 30" x 10" each)
 - 9. Four (4) Wastepaper Baskets
 - 10. One (1) Two-Drawer Letter Size Lockable Filing Cabinet

11. A printer, copier, and scanner are required. Hardware, services, and maintenance of a printer, scanner, and copier with a collator and automatic feeder in the Resident Engineer's office. The copier shall be a plain paper copier, capable of making 8-1/2 by 11 inches and 11x17 inches size for size copies. Also included shall be an allowance for copy materials (including paper supply) in the amount of 2,000 copies per month.

1.3 AID TO THE INJURED

- A. The Contractor shall keep in his office and on the work site, all articles necessary for giving "First Aid to the Injured." He shall also have standing arrangements for the immediate removal and hospital treatment of any employee or other person who may be injured on the work site.

END OF SECTION 015213

SECTION 016600 - PRODUCT STORAGE AND HANDLING REQUIREMENTS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section includes requirements for packing, delivery, storage, handling, protection, inspection, and preservation of equipment and materials furnished under the Multi-Disc Screw Press Equipment Procurement Contract.

PART 2 - DELIVERY AND STORAGE OF MATERIALS

2.1 DELIVERY

- A. The Vendor shall be responsible for proper packing, protection, and storage of all furnished equipment at the Vendor's designated storage facility contingent upon the selection of the General Contractor (aka Contractor) not earlier than October 2026, or until otherwise directed by the Owner. Storage shall be in accordance with the Manufacturer's written equipment preservation requirements.
- B. The Vendor shall coordinate shipment and transfer dates with the Contractor at least thirty (30) calendar days in advance. Risk of loss, damage, or delay shall remain with the Vendor until the equipment has been transferred and accepted as specified herein
- C. At the conclusion of the storage period, the Vendor shall transfer the equipment and all applicable Operation and Maintenance Manuals, preservation records, and installation requirements to the Installation Contractor. Responsibility for handling, storage, and protection shall be transferred at that time.

2.2 INSPECTION AND ACCEPTANCE

- A. Upon transfer to the Contractor or designated delivery location, the Contractor shall inspect the equipment within five (5) business days for damage, shortages, or non-conformance with the Contract Documents. Any deficiencies shall be documented and reported in writing to the Vendor and Engineer within the inspection period.
- B. Acceptance shall occur upon written confirmation that all identified deficiencies have been corrected or resolved. Title to and risk of loss of the equipment shall be transferred to the Contractor upon acceptance.
- C. Following transfer and acceptance, the Contractor shall be responsible for storage, handling, and protection of the equipment in accordance with the Final O&M Manuals and applicable Contract Documents.

PART 3 - EXECUTION

3.1 MAINTENANCE OF STORAGE

- A. The Contractor shall preserve and protect the equipment in accordance with approved Manufacturer's preservation requirements.
- B. The Contractor shall implement and maintain a documented storage inspection and maintenance program to ensure that equipment remains in a condition acceptable for installation and warranty compliance. At a minimum, the program shall include the following:
 - 1. Storage Facilities: Maintain storage areas that provide the environmental conditions required by the Manufacturer, including protection from weather, moisture, dust, contamination, and physical damage.
 - 2. Environmental Monitoring: Monitor and maintain environmental conditions, including temperature, humidity, and cleanliness, within limits specified by the Manufacturer.
 - 3. Protection from Deterioration: Protect equipment from corrosion, ultraviolet exposure, biological growth, and other adverse environmental effects.
 - 4. Maintenance and Servicing: Perform periodic inspection, maintenance, and servicing of equipment in accordance with the Manufacturer's written instructions for long-term storage.
 - 5. Manufacturer Requirements: Maintain and follow all Manufacturer-provided storage, handling, and preservation instructions for each item. Ensure such instructions remain readily available at the storage location.
 - 6. Electrical Equipment Preservation: Energize and operate space heaters and other preservation devices provided with electrical equipment continuously, unless otherwise directed in writing by the Manufacturer.
- C. Upon receipt of equipment, the Contractor shall establish and maintain written records of all storage inspections and maintenance activities. Such records shall be kept current and shall be made available to the Engineer and Vendor upon request.
- D. Records of inspections, environmental conditions, servicing activities, and corrective actions shall be maintained and transferred with the equipment for inclusion in the Final O&M Manual.
- E. Prior to release of equipment from storage for installation, the Contractor shall coordinate and participate in a pre-installation inspection with the Owner and Engineer to verify that storage and preservation requirements have been maintained. The Contractor shall document the results of the inspection and submit the documentation to the Engineer. Approved inspection records shall be included in the Final O&M Manual.

END OF SECTION 016600

SECTION 016617 – MAINTENANCE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. This Section provides general requirements for the maintenance of equipment in the field. Storage maintenance requirements are provided by Section 016600, Product Handling and Protection. Specific maintenance requirements are provided by manufacturers per individual Sections in the Project Manual.
- B. Maintenance is performed to ensure delivery to the Owner of equipment in an undeteriorated and fully serviceable condition.
- C. Maintenance activities described in this Section are intended solely to preserve the equipment's condition prior to installation and commencement of the Warranty period.
- D. All manufacturer warranties for equipment shall commence only after installation, start-up, and acceptance under the separate Construction Contract, in accordance with the requirements of the Contract Documents governing that Construction Contract. Nothing in this Section shall be interpreted to initiate, extend, diminish, or otherwise affect warranty obligations.

1.2 RELATED SECTIONS

- A. Section 016600, Product Handling and Protection.

1.3 DEFINITIONS

- A. Storage maintenance consists of establishing and maintaining the environment required by the stored materials and performing periodic servicing.
- B. Preventive maintenance consists of activities performed on a periodic basis to maintain operating or operational items or equipment.
- C. Corrective maintenance consists of correcting faults or failures in an item or equipment. This may include adjustments or replacement of defective parts.

1.4 SUBMITTALS

- A. The Maintenance Log shall be submitted to the Owner upon completion of the Operational Demonstration and prior to commencement of the equipment Warranty period under the Construction Contract.
- B. No submittals are required by this Section, except as noted above. Maintenance schedules and practices shall conform to approved submittals required by individual Sections in the Project Manual.

PART 2 - PRODUCTS

2.1 COMPONENTS, ACCESSORIES, AND REPAIR PARTS

- A. All components, accessories, and repair parts used in maintenance shall be supplied by or approved by the equipment manufacturer for use on the equipment.

2.2 SOURCE QUALITY CONTROL

- A. All parts and materials used in maintenance shall meet the quality control requirements provided for the item or equipment. These are specified in individual Sections of the Project Manual.

PART 3 - EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

- A. The Contractor shall prepare a Maintenance Log for all equipment.
 - 1. This log shall include a list of required maintenance services and inspections, as provided by the manufacturer and submitted under individual Sections of the Project Manual.
 - 2. The Maintenance Log shall include checklists for the periodic services and inspections required.
 - 3. The Contractor shall initial and date the requisite log entries upon completion of the individual servicing or inspection.
 - 4. The Maintenance Log shall be located in the Contractor's Field Office and shall be available for review by the Owner until it is submitted for record purposes upon completion of the Operational Demonstration and the start of the Warranty period.

3.2 PREPARATION

- A. Before removing an item from storage per Section 016600, the Contractor shall review the installed location. Protection and services at the installed location must meet the equipment storage requirements.
- B. Before moving equipment to the installed location, the Contractor shall have available materials for temporary shelter or services required to establish the proper storage environment after the equipment is installed until it is placed in service in its final operating environment.

3.3 PERFORMANCE OF MAINTENANCE

- A. The Contractor shall perform all storage, preventive maintenance, and inspections required by the manufacturer at the specified intervals during the Construction Contract.

- B. When notified by the Owner, the Contractor shall perform corrective maintenance. This shall be performed at no cost to the Owner. Corrective maintenance shall be performed per the Manufacturer's written instructions or at the direction of the approved manufacturer representative.
- C. The Contractor shall restore equipment to its operating condition before start-up.
- D. Warranty obligations, coverage periods, and warranty enforcement shall be governed exclusively by the Construction Contract Documents and shall not begin until equipment has been installed, commissioned, and accepted under that Contract
- E. When the equipment warranty becomes effective under the separate Construction Contract, the Owner will assume responsibility for maintenance in accordance with the Construction Contract Documents.

END OF SECTION 016617

SECTION 017517 - STARTING OF SYSTEMS/COMMISSIONING

PART 1 - GENERAL

1.1. DESCRIPTION OF WORK

- A. This Section includes general requirements for the commissioning of the Work and start-up and operation of systems and equipment.

1.2. SUMMARY

- A. Starting, testing, and operating the completed Work including systems and equipment until Substantial Completion is achieved and operation of the completed Work including systems or equipment are accepted by the Owner. Contractor shall cooperate and coordinate with the Owner in the operation, maintenance, and adjustment of the Work.

1.3. RELATED SECTIONS

- A. Section 013323 – Shop Drawings, Product Data and Samples
- B. Section 017901 – Operational Demonstration
- C. Section 017902 – Instruction of Owner's Personnel
- D. Section 016617 – Maintenance
- E. Section 467331 – Dewatering Equipment

1.4. DEFINITIONS

- A. Commissioning: Commissioning is a series of activities, or processes, necessary to ensure that systems and equipment are designed, installed, functionally tested, started up, and capable of being operated and maintained to perform in conformity with the design intent for the facility improvements. Commissioning includes, but is not limited to, factory testing, field testing, dry testing, wet testing, performance testing, manufacturer's checkout, start-up, and Operational Demonstration.
- B. Field Testing: Field Testing is performance testing, operational testing, or documentation verification conducted in the field after installation, to provide comparison with the results obtained in the Factory Testing.
- C. Dry Testing: Dry Testing is performed by the Contractor without introducing either process material or other test material into the component, system, or unit process.

- D. Wet Testing: Wet Testing is testing performed by the Contractor utilizing test material in the component, system, or unit process. Tankage shall be filled with test material to operating level.
- E. Performance Testing: Performance Testing is performed by the Contractor to demonstrate system performance in accordance with the Project Manual requirements.
- F. Manufacturer's Check-Out: Field inspection, testing, adjustments, and sign off by the approved representative of the Manufacturer, indicating that the component, system, or unit process meets the manufacturer's requirements.
- G. Start-Up: Narrowly defined as placing a component, system, or unit process on-line. Start-up can be a commissioning activity or a normal operating activity.
- H. Operational Demonstration: A commissioning activity performed by the Owner during which the Owner operates and maintains a fully functional component, system, or unit process under normal operating conditions to demonstrate compliance with the Contract Documents. The Contractor shall provide on-site supervision, required labor, materials, and technical support throughout the demonstration.

1.5. SUBMITTALS

- A. Quality Control Submittals:
 - 1. Field Installation Reports – Submit reports by Manufacturer's Representative in accordance with Paragraph 3.3 of this Section.
- B. Commissioning Documentation: Contractor shall prepare and submit all documentation for review and approval. The documentation shall include, but not be limited to, the following:
 - 1. Verify field conditions: Confirm all dimensions, elevations, clearances, and utilities locations affecting the Work.
 - 2. Certification by the preparer that he/she is the person responsible for the data, and that the data is authentic and accurate.
 - 3. Certification by the Contractor or equipment or unit process systems supplier that the equipment or the unit process systems were operated continuously for the specified period and that the equipment or unit process systems operated in compliance with the specified operating conditions, parameters and performance: and that the equipment or unit process systems are suitable for Performance Testing.
 - 4. Pertinent background information shall include, but not be limited to, the following:
 - a. Equipment or unit process systems Started-Up and Commissioned
 - b. Start-Up and Commissioning dates
 - c. Items or performance criteria tested clearly showing requirements and field data that verify requirements were met.

- d. Names of witnesses for Start-Up and Commissioning.
 - e. Any repairs, corrections, or modifications required for the equipment or unit process systems to successfully complete Start-Up and Commissioning.
 - f. Loop diagrams accurately depicting the installed condition of instrumentation and controls.
 - g. Any other important background information.
5. Appendix
- a. A summary of all data used in the calculation, including source, formulas with all terms defined.
 - b. Calculations for all data submitted, fully defined.
 - c. Copies of all raw field data sheets, including those indicating sampling point locations, and notes.
 - d. Production and/or operational data.
 - e. Calibration procedures and worksheets for sampling equipment.
 - f. Copies of calibration records for instrumentation.
 - g. PLC Ladder logic documented with comments.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1. EXAMINATION AND VERIFICATION OF CONDITION

- A. The Contractor shall inspect systems and equipment prior to each start-up and verify their readiness for start-up. Conditions hazardous to equipment or personnel shall be corrected by the Contractor prior to start-up of equipment.
 - 1. Start-up operations shall not proceed using temporary power or temporary instrumentation and control wiring. All electrical and control connections shall be permanent and complete, and all such electrical components and equipment fully functional.
 - 2. Use of repair parts during start-up operations shall not be permitted, except in such situations where the actual on-site verification of such repair parts' operability is specified.
 - 3. The Contractor shall verify that all initial copies of the Maintenance and Operating Instructions have received an acceptable disposition as defined in Section 013323, and the only outstanding item is the field verification of the Instructions.
- B. On successful completion of Start-up, process flows, and solids shall be used for commissioning the equipment and unit process systems to show the equipment and unit process systems function properly. Commissioning shall confirm the proper operation of the equipment and unit process systems with process fluids and process solids; adjustments shall be made, and the equipment or unit process systems shall be optimized and brought into compliance with design criteria in preparation for Operational Demonstration.

- C. The Contractor shall coordinate all Start-up and Commissioning activities for equipment and unit processes. The Contractor shall develop a detailed start-up and commissioning plan that includes the following as a minimum:
 - 1. Description of the overall general start-up and commissioning process.
 - 2. List of equipment and unit process systems included for start-up and commissioning activities.
 - 3. Detailed start-up and commissioning sequence of activities.
 - 4. Listing of staff and responsibilities for activities.
 - 5. Contractor shall use a form that will be provided by the Owner.

3.2 PREPARATION

- A. Prior to start-up of equipment or systems, all necessary test equipment shall be in place and operable.
- B. Approved representative(s) of the Manufacturer and Contractor shall be present for the initial start-up of systems or equipment.
- C. The Contractor shall request permission to start-up equipment, including electrical gear, and notify the Owner using a standard Start-Up Request form.
 - 1. The Start-Up Request shall be submitted to the Owner a minimum of 72 hours before the scheduled start-up. Requests shall be made during normal working hours.
 - 2. The Contractor shall provide all information in the first Section of the Start-Up Request form.
 - 3. The Owner will indicate approval or disapproval of the request.
 - 4. Approval of the request is based solely on impact on plant operations. Approval does not relieve the Contractor of any responsibility for plant and personnel safety.
 - 5. The Contractor shall obtain the approved Start-Up Request prior to the system or equipment start-up.
 - 6. If training is to be conducted in conjunction with the start-up this should be indicated on the Start-Up Request form. All requirements of Section 017902, Instruction of Owner's Personnel must be met for training sessions.
 - 7. Start-ups performed at the direction of the Contractor, per paragraph 3.3(G) of this Section, do not require advance notification to the Engineer.
- D. Normal installation checks, such as for rotation, are not considered start-ups and do not normally require start-up notification. For all equipment and systems so designated in the Contract Documents, or so designated by the Engineer, such checks shall be under the supervision of the approved representative of the manufacturer and shall be reviewed by the Engineer.
 - 1. All electrical apparatus which is energized shall be clearly marked.

3.3 CONDUCT OF START-UP AND COMMISSIONING

A. Start-up:

1. All initial start-ups of equipment or systems shall be performed under the technical direction of the approved representative of the manufacturer.
2. Any lack of readiness of associated systems or failure of a system or equipment previously started prior to the date of Final Completion of the Project shall require additional initial start-up service to be performed, under the direction of the approved representative of the manufacturer.
3. The Contractor shall repair, replace or modify any equipment or system which fails to perform as specified in the Contract Documents. Such repair, replacement or modification of deficient work shall be performed under the terms of the General Conditions.
4. During the Operational Demonstration period per Section 017901, Operational Demonstration and at other times when the system is on-line and an integral part of the Wastewater Treatment Plant operations and process, start-ups shall be performed as required by the Contractor.

B. The Contractor shall be responsible for commissioning all work. Final acceptance shall be by the Owner.

C. The Contractor is responsible for the performance and operation of the systems and equipment during commissioning.

D. When Owner personnel are operating systems or equipment, the Contractor shall make available, at all times, persons knowledgeable about the systems or equipment to direct the Owner personnel in its operation.

E. The Contractor shall make all adjustments and corrections necessary to achieve normal, stable operation of systems. Adjustment and corrections shall be in accordance with Section 016617, Maintenance.

F. Any failures of equipment or systems operated under the direction of the Contractor shall be considered deficiencies and shall be corrected in accordance with the General Conditions.

G. During the Operational Demonstration period as defined in Section 017901, Operational Demonstration and at other times, the work will be on-line and an integral part of the Wastewater Treatment Plant operations and process. The Owner maintains control of Wastewater Treatment Plant operations and processes at all times. Therefore:

1. The Contractor shall not commence, resume, terminate, or suspend the operations without the permission of the Owner and only in a sequence and manner suitable to the Owner.

2. The Contractor shall immediately, on a 24-hour per day, 7-day per week basis, adjust or repair any malfunction in the work which in the opinion of the Owner jeopardizes or may jeopardize the proper operation of the Wastewater Treatment Plant.
3. The Contractor shall not start-up, shut down, adjust, or otherwise alter the operation of any component, system, or unit process without the permission of the Owner except in the case of an emergency and in accordance with the General Conditions.

3.2. QUALITY CONTROL

A. Reports of the Approved Representative of the Manufacturer:

1. The approved representative of the manufacturer shall prepare a daily report on each site visit for each system or item of equipment inspected, adjusted, started-up, or worked on.
2. The report shall state the purpose of the visit, the representative's observations and conclusions, and recommendations for further visits or action.
3. The reports shall be submitted in accordance with Section 013323, Shop Drawings, Product Data and Samples within three (3) days of the visit.

END OF SECTION 017517

SECTION 017800 - FINAL COMPLIANCE AND SUBMITTALS

PART 1 - GENERAL

- 1.1 The following forms and related sign-offs shall be documented in accordance with the provisions of the contract. These forms shall be completed by the Contractor and approved by the Owner before the final retainer is approved for release. Forms for Items A to G will be attached to the Contractor's executed copy of the contract.
- A. Certificate of Substantial Completion (To be submitted at time of Substantial Completion).
 - B. Contractor's Certification of Completion.
 - C. Contractor's Affidavit of Prevailing Wage.
 - D. Consent of Surety Company for Final Payment.
 - E. Affidavit of Final Acceptance Date and Correction Period.
 - F. Before the Owner will approve and accept the work and release the retainer, the Contractor will furnish the Owner a written report indicating the resolution of any and all property damage claims filed with the Contractor by any party during the construction period. The information to be supplied shall include, but not be limited to, the name of the claimant, date filed with Contractor, name of insurance company and/or adjuster handling claim, how the claim was resolved, and if the claim was not resolved for the full amount, a statement indicating the reason for such action.
 - G. Build America, Buy America Certifications (When Applicable).

END OF SECTION 017800

SECTION 017821 - CLEANING AND PROTECTION

PART 1 - GENERAL

1.1 GENERAL

- A. On or before the completion date for the work, the Contractor shall tear down and remove all temporary structures built by him, all construction plant used by him, and shall repair and replace all parts of existing embankments, fences, or other structures which were removed or injured by his operations or by the employees of the Contractor. The Contractor shall thoroughly clean out all buildings, sewers, drains, pipes, manholes, inlets, and miscellaneous and appurtenant structures, and shall remove all rubbish, leaving the grounds in a neat and satisfactory condition.
- B. As circumstances require and when ordered by the Engineer, the Contractor shall clean the road, driveway, and/or sidewalk on which construction activity under this contract has resulted in dirt or any other foreign material being deposited with an automatic self-contained mechanical sweeper with integral water spray, vacuum, and on-board or supplementary containment.
- C. Failure to comply with this requirement when ordered by the Engineer or his representative may serve as cause for the Engineer to stop the work and to withhold any monies due the Contractor until such order has been complied with to the satisfaction of the Engineer.
- D. As the work progresses, and as may be directed, the Contractor shall remove from the site and dispose of debris and waste material resulting from his work. Particular attention shall be given to minimizing any fire and safety hazard from form materials or from other combustibles as may be used in connection with the work, which should be removed daily.
- E. The Contractor shall wash all windows and other glass surfaces, leaving all areas free from putty marks, paint, etc.
- F. During and after installation, the Contractor shall furnish and maintain satisfactory protection to all equipment against injury by weather, flooding, or breakage, thereby permitting all work to be left in a new condition at the completion of the contract.

END OF SECTION 017821

SECTION 017823 – MAINTENANCE MANUALS

PART 1 - GENERAL

1.1 SUMMARY

- A. This section includes requirements for preparation, review, approval, and delivery of Operation and Maintenance (O&M) Manuals for equipment furnished under the Contract.
- B. Submittal of O&M Manuals shall be divided into a two-stage process:
 - 1. Preliminary O&M Manuals shall be submitted by the Vendor/ Manufacturer and approved by the Engineer under the Equipment Procurement Contract, prior to equipment shipment. These manuals are not final, as they do not reflect as-installed conditions. These manuals are to support proper storage, handling, installation planning, and coordination with the separately bid Installation Contract.
 - 2. Final O&M Manuals: Compiled and submitted by the Contractor under the separate Installation Contract, after equipment installation, startup, and commissioning are complete.
- C. The Manufacturer (Supplier or Vendor) shall be responsible for Preliminary O&M Manuals. The Installation Contractor (under a separate contract) shall be responsible for Final O&M Manuals, incorporating the Supplier's documentation and supplementing it with site-specific information developed during installation and commissioning.
- D. The Preliminary O&M Manual shall be considered an interface deliverable between the Equipment Procurement Contract and the Installation Contract. The Vendor shall formally transmit the approved Preliminary O&M Manual to the Installation Contractor, and the Installation Contractor shall acknowledge receipt and completeness prior to commencement of installation work.

1.2 DEFINITIONS

- A. Preliminary O&M Manual: The initial operation and maintenance documentation prepared by the equipment Supplier and submitted for the Engineer's review and approval prior to authorization of equipment shipment.
 - 1. Preliminary O&M Manuals shall contain the manufacturer's standard operating instructions for the equipment handling and protection during short- and long-term storage and maintenance requirements, lubrication requirements, factory test performance and nameplate data, installation details and requirements, diagrams and illustrations, recommended spare parts lists, and all other essential data available before field installation.
 - 2. Preliminary O&M Manuals are understood to exclude certain site-specific details (such as built configurations, field-verified settings, commissioning records, and field test results) that are not yet available at the time of equipment fabrication and shipment.

3. Preliminary O&M Manuals shall reflect factory-standard information only and shall not include site wiring diagrams, final control settings, or as-built conditions, which are the responsibility of the Installation Contractor.
- B. Final O&M Manual: Complete, consolidated documentation reflecting actual installed, tested, started up, and commissioned, prepared by the Installation Contractor.
 1. Final O&M Manuals incorporate the approved Preliminary O&M Manual content (updated as necessary) together with all project-specific data, including as-built drawings, final control settings and relay settings, startup and performance test results, field wiring diagrams, warranty certificates, and other information obtained during installation and commissioning.
 2. In the event of conflict between the Preliminary O&M Manual and site-specific information developed during installation, the Final O&M Manual shall govern.

1.3 COORDINATION REQUIREMENTS

- A. Preliminary O&M Manuals are designated as interface deliverables between the Equipment Procurement Contract and the Installation Contract.
- B. The Equipment Supplier shall formally transmit approved Preliminary O&M Manuals to the Installation Contractor. The General Contractor (aka Contractor) shall acknowledge receipt and completeness prior to commencement of installation work.

1.4 SUBMITTAL REQUIREMENTS FOR THE PRELIMINARY O&M MANUALS (EQUIPMENT PROCUREMENT CONTRACT)

- A. Submit Preliminary O&M Manuals electronically for Engineer review not less than 30 calendar days prior to the scheduled shipment date.
- B. Equipment shall not be released for shipment until Preliminary O&M Manuals have received an acceptable disposition from the Engineer
- C. Preliminary O&M Manuals shall include, as applicable:
 1. Equipment Handling and Storage Requirements
 2. Maintenance requirements for the equipment during the short- and long-term storage.
 3. Descriptive literature, bulletins, or other data covering equipment or system.
 4. Complete list of equipment and appurtenances included with the system, complete with manufacturer and model number.
 5. Functional description of each principal component of the system.
 6. Installation instructions.
 7. General arrangement and assembly drawings
 8. Utility requirements
 9. Materials of construction

10. Factory performance test data
 11. Performance guarantee
 12. Spare parts list
 13. Lubrication requirements
 14. Procedure for starting, proper adjustment, and test procedures
 15. Shutdown instructions.
 16. Emergency operating instructions and emergency shutdown instructions
 17. Schematic wiring diagrams
 18. Schematic piping diagrams
 19. Instrumentation data
 20. Drive data
 21. Control data
 22. Maintenance instructions, including troubleshooting guidelines and preventative maintenance instructions, with a task schedule
 23. Required tools and equipment for operation and maintenance
 24. Safety Considerations for O&M procedure
- D. All material shall be specific to the function that the equipment serves in the facility. If the manufacturer's literature covers more than one product type or includes information not relevant to this project, the applicable information shall be clearly indicated. Only files and documentation specific to the equipment furnished under this Contract shall be included.
- E. Preliminary O&M Manuals shall be submitted electronically for review by the Engineer.
- F. This information will be accepted only if properly identified and only after it has been revised, where necessary, to conform to previous transmittals of the same material that have been "Approved As Noted" by the Engineer.
- G. Upon approval, one (1) hard copy shall be provided to the Owner together with the final electronic version. Submittals shall be on 8-1/2" x 11" paper or folded to that size.
- H. Failure to submit acceptable Preliminary O&M Manuals shall constitute a nonconformance and may result in withheld payment or delayed shipment at no additional cost to the Owner
- 1.5 SUBMITTAL REQUIREMENTS FOR FINAL O&M MANUALS (EQUIPMENT INSTALLATION CONTRACT)
- A. Submit Final O&M Manuals electronically not later than 60 calendar days after successful completion of commissioning

- B. It will be the responsibility of the Installation Contractor to furnish the Final O&M Manuals, which shall include, at a minimum, site-specific details, as-built configurations, including the field-verified settings, performance test reports, commissioning records, and field test results.
- C. This manual shall either contain or make reference to all information that has been issued during the construction and start-up periods, as well as information necessary for the proper operation and maintenance of equipment.
- D. Final O&M Manuals shall include documentation of storage duration, storage conditions, inspections, servicing activities, and any deviations from manufacturer-recommended storage requirements occurring prior to installation.
- E. Final O&M Manuals shall incorporate and update Preliminary O&M Manual content and include:
 - 1. As-built drawings
 - 2. Final wiring and piping diagrams
 - 3. Actual control, relay, and calibration settings
 - 4. Startup and performance test reports
 - 5. Warranty documentation
 - 6. Maintenance procedures applicable to in-service operation.
 - 7. Documentation of storage duration, conditions, inspections, and servicing activities prior to installation.
- F. Acceptance of Final O&M Manuals is a condition precedent to Final Completion and final payment.
- G. Final O&M Manuals shall be submitted electronically for review by the Engineer.
- H. This information will be accepted only if properly identified and only after it has been revised, where necessary, to conform to previous transmittals of the same material that have been "Approved As Noted" by the Engineer.
- I. Upon approval, one (1) hard copy shall be provided to the Owner together with the final electronic version. Submittals shall be on 8-1/2" X 11" size paper or folded to that size.

END OF SECTION 017823

SECTION 017839 - PROJECT RECORDS, DRAWINGS

PART 1 - GENERAL

1.1 RECORD DRAWINGS

- A. The Contractor shall furnish an authentic set of marked-up drawings showing the installation insofar as the installation shall have differed from the Engineer's drawings. The drawings shall be delivered to the Engineer for making revisions to the original drawings immediately after final acceptance by the Owner.

END OF SECTION 017839

SECTION 017901 – OPERATIONAL DEMONSTRATION

PART 1 - GENERAL

1.1 GENERAL DESCRIPTION

- A. Work Included: A demonstration of the operation of all systems is required. This Operational Demonstration shall be conducted, coordinated, and recorded by the Contractor in accordance with the requirements specified herein.
- B. Where requirements of this Section conflict with or supplement Section 017517, Starting of Systems / Commissioning, the more stringent requirement shall govern. Operational Demonstration requirements are in addition to, and do not replace, commissioning requirements.
- C. Completion of commissioning or Operational Demonstration shall not be construed as Final Acceptance nor as commencement of any warranty period.

1.2 SUMMARY

- A. This Section includes requirements for planning, conducting, documenting, and accepting the Operational Demonstration of the Work.
- B. The Operational Demonstration is in addition to any other installation, shop, and factory testing, field testing, dry testing, wet testing, performance testing, balancing, or adjustments required elsewhere in the Contract Documents.

1.3 RELATED SECTIONS

- A. Section 017517 - Starting of Systems / Commissioning
- B. Section 467331 – Dewatering Multi-Disc Screw Press

1.4 DEFINITIONS

- A. Operational Demonstration: A commissioning activity performed by the Owner during which the Owner operates and maintains a fully functional component, system, or unit process under normal operating conditions to demonstrate compliance with the Contract Documents. The Contractor shall provide on-site supervision, required labor, materials, and technical support throughout the demonstration period
- B. Stable Operation: Operation of the component, system, or unit process at design operating conditions, with all mechanical, electrical, instrumentation, and control systems functioning as intended, and without unplanned shutdowns or performance instability, for a minimum continuous period acceptable to the Owner.

- C. Operational Demonstration Log: Chronological record documenting system status, adjustments, outages, and test results during the demonstration period.
 - 1. The operation log shall include all changes in status or system parameters, adjustments, and results of tests.
 - 2. Entries shall be made, noting the date and time, at the occurrence of each event.
 - 3. Operational Demonstration Logs shall be on a form acceptable to the Owner.

1.5 SUBMITTALS

A. Quality Control Submittals:

- 1. Operational Demonstration log per subparagraph 3.4.A of this Section.
- 2. Report of Operational Demonstration per subparagraph 3.4.B.2 of this Section.

PART 2 - PRODUCTS

(NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

A. Prior to initiating the Operational Demonstration, verify that

- 1. Construction is complete and does not interfere with normal operation.
- 2. Startup and commissioning per Section 017517 are complete.
- 3. Repair parts, maintenance materials, and manuals are delivered
- 4. Required training has been completed. Training for Operations, Electrical, Instrumentation, and Maintenance Personnel shall be completed before the Operational Demonstration.

3.2 PREPARATION

- A. The Contractor shall assign two (2) qualified representatives—one (1) primary and one (1) alternate—for the duration of the Operational Demonstration. The Contractor's representatives shall be fully authorized and responsible for providing continuous on-site supervision and for promptly responding to and correcting any operational issues, deficiencies, or service calls that arise during the Operational Demonstration. The Contractor shall ensure representatives are available at all times during system operation.
- B. Submit start-up notification to the Owner per Section 017517, Starting of Systems/Commissioning.

3.3 OPERATIONAL DEMONSTRATION

- A. The Owner will perform the Operational Demonstration of the Work after approval of Start-Up and completion of commissioning activities in accordance with Section 017517,

Starting of Systems / Commissioning. The Operational Demonstration shall commence only after stable operation has been achieved. The Owner shall operate a fully functional system for a continuous twenty (20) -day period totaling one hundred sixty (160) operating hours, unless otherwise specified.

- B. Operation shall occur 8 hours per day, 5 days per week, with systems fully functional
- C. Startup activities, cleaning cycles, or stabilization time shall not be counted.
- D. Contractor shall provide on-site supervision and required labor throughout the demonstration.
- E. Consumables Responsibility: The Owner shall furnish polymer, consumables, utilities coordination, and materials required to operate and maintain the Work continuously for the full duration of the Operational Demonstration.
- F. During the Operational Demonstration, the Owner shall retain control of overall plant operations and processes. The Contractor shall remain fully responsible for system performance, compliance with the Contract Documents, supervision of operation, and the prompt correction of any deficiencies or malfunctions. Owner personnel will operate the Work under the direction and supervision of the Contractor.
- G. Start-up and operation of the system and all associated equipment shall be in accordance with the Initial Maintenance and Operating Instructions, which have received an acceptable disposition from the Owner. If deviations from these instructions are necessary, these shall be noted in the Operational Demonstration Log and subsequently submitted as revisions to the Maintenance and Operating Instructions.
- H. All required maintenance and servicing prior to the Date of Substantial Completion shall be performed by the Contractor at the specified interval and as necessary. All maintenance and service shall be provided in the Operational Demonstration Log.
- I. All outages of equipment, system(s), or the plant should be noted in the Operational Demonstration Log. Plant outages are considered a part of normal plant operation and will not invalidate the Operational Demonstration. The Contractor is responsible for the safe and orderly shutdown and restart of equipment as necessary in the event of an outage. Outage time is not to be included in the Operational Demonstration period.
- J. The Contractor shall attend operational coordination meetings as called by the Owner to review operating conditions of equipment and systems.
- K. If, during the Operational Demonstration, any portion of the Work fails to conform to the requirements of the Contract Documents, the Operational Demonstration shall be deemed to have failed. The Owner shall notify the Contractor in writing. The Contractor shall correct all deficiencies and restart the full Operational Demonstration period at no additional cost to the Owner.
- L. Upon failure, correct deficiencies and restart the full demonstration period at no additional cost to the Owner.

- M. During the Operational Demonstration, the Owner may require or permit the Operational Demonstration to be suspended:
 - 1. As provided in the General Conditions.
 - 2. Upon the written request of the Contractor to correct or adjust the work when, in the judgment of the Owner, such required correction or adjustment is insufficient to deem the Operational Demonstration to have failed.
 - 3. If the Operational Demonstration is suspended for any reason except failure, Operational Demonstration time shall accrue to the work from the beginning of the Operational Demonstration to the time of the suspension.

3.4 REPORTING

- A. Submit daily logs to the Owner by 9:00 a.m. the following day.
- B. Within 14 days after completion, submit an Operational Demonstration Report for approval, detailing:
 - 1. Equipment utilized
 - 2. Chemical utilized
 - 3. Deviations from approved procedures described in the approved Operation and Maintenance Manuals.
- C. A report of the Operational Demonstration shall describe the equipment utilized and any repairs, modifications, adjustments, or other work performed during the demonstration period.

END OF SECTION 017901

SECTION 017902 - INSTRUCTION OF OWNER'S PERSONNEL

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Provide complete instruction and training for the Owner's permanent operating personnel regarding the proper operation, maintenance, and safety of all equipment furnished under the Contract. Training shall be sufficient to enable safe, reliable, and warranty-compliant operation of the equipment.
- B. Training requirements specific to individual equipment items are included in the applicable technical Sections of the Contract Documents.
- C. Training shall be conducted using the approved Operation and Maintenance (O&M) Manuals specified in Section 017823.

1.2 SUMMARY OF WORK

- A. Except as otherwise specified, work under this Section includes preparation of Lesson Plans and conduct of comprehensive training for all equipment provided under the Installation Contract.
- B. Training sessions and duration shall be in accordance with the equipment manufacturer's recommendations; however, not fewer than two (2) training sessions shall be provided to accommodate multiple shifts. Training shall include, at a minimum, instruction in operation, maintenance, and electrical/instrumentation systems.
- C. Training required by this Section constitutes part of the Work and shall be fully completed prior to Final Acceptance and prior to recommendation of Final Payment
- D. Related Sections
 - 1. Section 013323 – Shop Drawings, Product Data, and Submittals
 - 2. Section 016600 – Product Storage and Handling Requirements
 - 3. Section 017823 – Maintenance Manuals
 - 4. Section 017901 – Operational Demonstrations

1.3 DEFINITIONS

- A. Lesson Plan: A submittal describing the instructional objectives, training outline, instructor qualifications, instructional methods, audiovisual requirements, training materials, and proposed schedule for each training session.
- B. Training Aid: A mock-up, model, sample, or other device used to demonstrate equipment operation or maintenance.

1.4 SUBMITTALS

- A. Submit training-related submittals in accordance with Section 013323.
- B. The Contractor shall submit the following:
 - 1. Training Schedule: A proposed training schedule for the entire Installation Contract, showing tentative dates, number of sessions, duration, and subject matter for each training session. The schedule shall be submitted no less than one hundred twenty (120) days prior to the commencement of any training.
 - 2. Instructor's Credentials: Detailed credentials of each proposed instructor, including name, education, experience, training qualifications, and employment history with the equipment manufacturer. Credentials shall demonstrate specific experience with the operation and maintenance of the equipment being taught. Instructor credentials shall be submitted no less than sixty (60) days prior to the commencement of training.
 - 3. Lesson Plans: Lesson Plans shall be submitted no less than sixty (60) days prior to the commencement of training. Lesson Plans shall be consistent with the approved O&M Manuals and shall address all equipment components, regardless of manufacturer. Include at a minimum:
 - a. Title page with project, equipment, and Contractor information
 - b. Instructional objectives
 - c. Detailed training outline
 - d. Method of instruction
 - e. Training duration and session breakdown
 - f. List of training materials and aids
 - g. Evaluation or verification of training completion
- C. Lesson Plans shall clearly identify training categories (operations/maintenance, electrical and instrumentation, or system), session description, duration, and format. The training shall include, as a minimum:
 - 1. Electrical and Instrumentation Training – System Equipment Overview:
 - a. Describe the system (equipment), fundamental operating principles, and dynamics.
 - b. Identify the system's (equipment's) mechanical, electrical, and electronic components and features. Review system (equipment) wiring diagrams and process and instrumentation diagrams.
 - c. Identify support systems (equipment) associated with the operation (e.g., air intake filters, valve actuators, motors).
 - d. Identify and describe safety precautions and potential hazards related to maintenance.
 - e. Identify and describe in detail safety and control interlocks.
 - f. Identify and describe alarm conditions and response to alarms.
 - g. Cover the supply of power to process equipment and related appurtenances, lighting, etc.
 - h. Cover low voltage controls, monitoring devices, etc.

2. Electrical and Instrumentation Training – Equipment Preventive Maintenance (PM) and Equipment Troubleshooting:
 - a. Describe PM inspection procedures required to perform an inspection of the equipment in operation, spot potential trouble symptoms, anticipate breakdowns, and forecast maintenance requirements (predictive maintenance).
 - b. Define the recommended PM intervals for each component.
 - c. Provide lubricant and replacement part recommendations and limitations.
 - d. Describe appropriate cleaning practices and recommend intervals.
 - e. Identify and describe the use of special tools required for maintenance of the equipment.
 - f. Describe component removal and installation, and disassembly and assembly procedures.
 - g. Perform at least 2 "field" demonstrations of preventive maintenance procedures.
 - h. Describe recommended measuring instruments and procedures, and provide instruction on interpreting alignment measurements, as appropriate.
 - i. Define recommended torque settings, mounting, calibration, and alignment procedures and settings, as appropriate.
 - j. Describe recommended procedures to check or test equipment following a corrective repair.
3. Electrical and Instrumentation Training – Equipment Troubleshooting:
 - a. Define recommended systematic troubleshooting procedures.
 - b. Provide component-specific troubleshooting checklists.
 - c. Describe applicable equipment testing and diagnostic procedures to facilitate troubleshooting.
4. Maintenance and Operation Training: System (Equipment) Overview
 - a. Describe the system (equipment) operating (process) function and performance objectives.
 - b. Describe the system (equipment) fundamental operating principles and dynamics.
 - c. Identify the system's (equipment's) mechanical, electrical, and electronic components and features.
 - d. Identify support systems (equipment) associated with the operation (e.g., air intake filters, valve actuators, motors).
 - e. Identify and describe safety precautions and potential hazards related to the operation.
 - f. For systems (equipment) comprised of several components: Identify and describe in detail each component's function. Where applicable, group related components into subsystems. Describe subsystem functions and their interaction with other subsystems.
 - g. Identify and describe in detail safety and control interlocks.
5. Operation and Maintenance Training – Operation of Equipment and Troubleshooting:
 - a. Describe operating principles and practices.
 - b. Describe routine operating, start-up, and shutdown procedures.
 - c. Describe abnormal or emergency start- up, operating, and shutdown

- procedures that may apply.
 - d. Describe alarm conditions and responses to alarms.
 - e. Describe routine monitoring and record-keeping procedures.
 - f. Describe recommended housekeeping procedures.
 - g. Describe how to determine if either corrective maintenance or an operating parameter adjustment is required.
- D. Training Materials: Provide sufficient copies of instructional materials for all attendees at the first training session. Provide two (2) copies of all audiovisual aids. Video materials should be submitted on a thumb drive in AVI or MPEG format.
- E. Approval of training submittals does not relieve the Contractor of responsibility for complete and compliant training

PART 2 - PRODUCTS

2.1 QUALIFICATIONS OF INSTRUCTOR

- A. Instructors shall be experienced and knowledgeable in the operation and maintenance of the equipment and familiar with its application for this Project
- B. The Owner reserves the right to reject Instructors who do not meet these qualifications. Replacement of rejected Instructors shall be at no additional cost to the Owner.

PART 3 - EXECUTION

3.1 EXAMINATION AND VERIFICATION OF CONDITION

- A. The training site for the classroom instruction will be provided by the Owner. The Owner will provide this location.
- B. Prior to training, the Contractor shall verify that
 - 1. Equipment is ready for Operational Demonstration in accordance with Section 017901, Operational Demonstration.
 - 2. Construction required for all operating modes is complete.
 - 3. Training areas are adequately lit, safe, and unobstructed.
 - 4. Training activities will not conflict with active construction operations.
 - 5. Required training material and aids are available.
 - 6. Required representatives from interfacing Contractors or suppliers are present.

3.2 PREPARATION

- A. Training facilities for classroom instruction will be provided by the Owner. The Contractor shall provide all required audiovisual equipment and training aids.

- B. Training may be submitted for continuing education approval if the Owner elects to seek CEU/CH credit.
- C. All training sessions shall be recorded by the Contractor. Contractor shall verify acceptable sight lines, lighting, and participant locations prior to the start of training.
- D. Training shall begin within 45 days prior to the start of the Operational Demonstration Period, unless otherwise approved. Contractor shall plan for multiple Owner shifts.

3.3 CONDUCT OF TRAINING

- A. Training shall be coordinated with startup, commissioning, and Operational Demonstration activities and conducted at times approved by the Owner.
- B. Training shall reflect actual installed conditions and be consistent with the approved Final O&M Manuals.
- C. Cover operation, maintenance, electrical, and instrumentation topics consistent with approved Lesson Plans
- D. All topics identified in the approved Lesson Plans shall be covered in sufficient detail to permit Owner personnel to safely operate and maintain the equipment under all anticipated conditions. Warranty-related maintenance requirements shall be explicitly addressed.
- E. Provide a minimum 30-minute break for any training session exceeding three (3) hours.
- F. Training shall be attended by the Owner's personnel and by other parties designated by the Owner.

3.4 EVALUATION AND COMPLETION

- A. Immediately following training, provide evaluation forms to Owner personnel. Collect completed evaluation forms and attendance sheets and submit originals to the Owner.
- B. If training is determined to be incomplete or deficient, or if instructors are unable to adequately respond to questions, provide additional training at no additional cost to the Owner.
- C. Training shall be completed prior to Final Acceptance.
- D. Training shall be considered complete only after all required sessions are conducted, materials are delivered, and attendance documentation is submitted.

END OF SECTION 017902

SECTION 018000 - SYSTEM PERFORMANCES

PART 1 - GENERAL

1.1 GENERAL

- A. It is the intent of this Contract that the completed installation shall be fully functional, properly integrated, and complete in all respects.
- B. The Contractor shall provide all labor, materials, equipment, and incidentals necessary to place the Owner-furnished sludge dewatering system into continuous, reliable operation in accordance with the Contract Documents.
- C. The Contractor shall be responsible for all minor details, required for a complete and operable system, whether or not specifically shown on the Drawings or listed in these Specifications, unless such items are clearly identified as being furnished under the separate Equipment Procurement Contract.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. All facilities, systems, and equipment installed under this Construction Contract shall function properly and in accordance with the Drawings, Specifications, and applicable industry standards. Systems shall operate as an integrated whole and shall meet all performance requirements specified in the technical Sections.
- B. Procurement Contract Responsibilities: Equipment identified as “Provided by Vendor” in Section 011100 – Appendix 1, Major Equipment List is furnished under a separate Equipment Procurement Contract. Under that Contract, the Vendor/Manufacturer is responsible for:
 - 1. Engineering and fabrication of the complete packaged sludge dewatering system.
 - 2. Factory testing and quality control.
 - 3. Packaging, shipping, and delivery to the Project site.
 - 4. Providing field service technicians for startup, testing, and commissioning support.
 - 5. Providing O&M manuals, shop drawings, and technical documentation.
- C. Construction Contract Responsibilities (Contractor): The Contractor is responsible for all work required to install, integrate, and commission the Owner-furnished equipment, including but not limited to:
 - 1. Receiving, unloading, handling, and storing Owner-furnished equipment.
 - 2. Field assembly of partially disassembled components.
 - 3. Installation of all equipment, piping, valves, supports, anchors, and appurtenances.
 - 4. Electrical conduit, wiring, terminations, and integration with control panels
 - 5. Instrumentation installation, calibration, and system integration.

6. Alignment, leveling, anchoring, and grouting.
 7. Testing, startup assistance, and commissioning.
 8. Correction of installation deficiencies identified by the Manufacturer or Engineer.
 9. Providing training support as required by Section 017902.
- D. Responsibilities for furnishing, installation, electrical connections, and supports for each major equipment item shall be as defined in Section 011100 – Appendix 1, Major Equipment List.
- E. Coordination Requirement: The Contractor shall coordinate closely with the Vendor/Manufacturer to ensure that all Owner-furnished equipment is installed in strict accordance with the Manufacturer's written requirements and is fully integrated with the facility's structural, mechanical, electrical, and control systems.

1.3 EQUIPMENT AND SYSTEMS INCLUDED

- A. The following systems are included in the performance requirements of this Section, whether furnished under the Procurement Contract or installed under the Construction Contract:
1. Sludge Dewatering Package System
 2. Progressive Cavity Sludge Feed Pumps
 3. Polymer Feed Skid System
 4. Dewatered Cake Conveyors
 5. Valves and Piping Systems
 6. Electrical Power and Control Systems
 7. Instrumentation and SCADA Integration
- B. The Contractor is responsible for all work necessary to place the Owner-furnished equipment into proper operating condition, including installation, alignment anchorage, piping and electrical connections, system integration, testing, and commissioning.

1.4 CERTIFICATION

- A. The Contractor shall obtain and submit written certification from the Vendor/Manufacturers and/or installers confirming that:
1. Equipment has been installed in accordance with the Manufacturer's written instructions
 2. Equipment is properly aligned, anchored, and connected.
 3. Equipment is ready for startup, testing, and commissioning,
 4. All required field adjustments have been completed.

- B. Certification shall be submitted prior to Performance Testing and Operational Demonstration.

END OF SECTION 018000

SECTION 024100 - DEMOLITION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. It is the intent of this Section that the Contractor shall furnish all labor, materials, equipment, and incidentals necessary to demolish and remove existing process equipment, including existing centrifuges, cake conveyors, associated concrete containment walls, equipment pedestals, 1.5-ton crane, existing sludge feed pumps, selective demolition of the polymer feed and storage equipment, piping, and miscellaneous appurtenances as indicated on the Contract Drawings, specified herein, or as directed by the Owner or Engineer.
- B. Work shall include, but is not limited to, disconnection, dismantling, removal, handling, and transportation of designated equipment and demolition debris off-site for proper disposal.

1.3 JOB CONDITION

- A. The Contractor shall exercise all necessary precautions to protect the structure from falling debris, material, and sections during the demolition process.
- B. The Contractor shall exercise all necessary precautions to protect adjacent process equipment from falling debris, material, and sections during the demolition process.

1.4 SUBMITTALS

- A. The Contractor shall submit to the Engineer before the start of any proposed demolition, a written description of the method proposed, dismantle and remove the existing centrifuges, sludge feed pumps, polymer feed (aging tanks), and auxiliary equipment.

1.5 SCHEDULE

- A. Demolition shall be scheduled and performed in strict conformance with these Specifications and in a manner that will ensure no interruption of the City of Wheeling Water Pollution Control Division (WPCD) Plant operation beyond that provided for and approved by the Owner.
- B. The Contractor shall submit the proposed date and time for commencing demolition activities to the Owner for review. Demolition Work shall not begin until the Contractor has received written approval from the Owner for the scheduled date and time of the specific operation.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 DEMOLITION, REMOVAL AND SALVAGED EQUIPMENT

- A. Owner retains the right of first refusal for all salvaged equipment, at which point Contractor may elect to retain as property of the Contractor.
- B. The Contractor shall be responsible for the demolition, removal, and transportation of designated materials and equipment from the site, all to the satisfaction of the Owner and Engineer, including but not limited to the following:
 - 1. Existing centrifuges and cake conveyors; 1.5-ton crane; sludge feed pumps (P-11 & P-12); polymer feed pumps (P-17, 18 & 19); polymer feed tanks (aging tanks); existing polymer skids; piping; and associated auxiliary equipment as indicated on the Contract Drawings.
 - 2. Polymer feed pumps (P-17, 18 & 19) shall be carefully disconnected, removed, and salvaged for return to the Owner. One polymer feed pump shall be reinstalled, as shown on the Contract Drawings, to transfer polymer from the 330-gallon polymer tote to the 950-gallon Polymer Storage Tank.
 - 3. Selective concrete demolition shall include, but not be limited to, removal of the existing concrete containment curb around the centrifuges, removal of the existing hatch, demolition of the housekeeping pad for the existing electrical equipment, and any additional concrete demolition indicated on the Contract Drawings.

3.2 OWNERSHIP & DISPOSAL OF MATERIALS

- A. All salvaged material shall become the property of the Contractor, except the items listed below, at the Owner's option, which shall remain the property of the Owner and shall be delivered to a location designated by the City of Wheeling WPCD operations personnel:
 - 1. Centrifuges.
 - 2. Existing centrifuge platforms.
 - 3. Polymer feed pumps P-17, 18 & 19. Contractor shall retain and reinstall one of these pumps for the polymer transfer from the tote to the 950-gal Polymer Storage Tank, as indicated on the Drawings.
- B. All materials, whether they may be salvageable or not, shall be promptly removed from the construction site as demolition progresses. The Contractor shall transport all material designated as waste to an approved landfill facility for proper disposal.

END OF SECTION 024100

SECTION 030000 - CAST-IN-PLACE CONCRETE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
 - 1. Section 013319 – Field Testing Requirements

1.2 SUMMARY

- A. Provide all materials and labor necessary to complete all concrete, plain and reinforced, as indicated on Drawings or as specified in these specifications and as required to complete the Project. Work, without limiting the generality thereof, includes:
 - 1. Installation of concrete to provide footings, foundations, foundation walls, slabs on grade, and other incidental concrete Work.
 - 2. Furnishing and installation of admixtures.
 - 3. Work of other trades required to be built into concrete, such as inserts for connections to steel members, waterstops, flashing reglets, anchors, embedded plates, high strength mortar, controlled low strength material, grouting of precast members, and reinforcing dowels.
 - 4. Providing vapor retarder [or waterproofing membrane] below slabs on grade.
 - 5. Finishing of concrete as specified herein or as indicated on Drawings.
- B. This Section specifies cast-in place concrete, including form work, reinforcing, mix design, placement procedures and finishes.
 - 1. Extent of concrete work is shown on drawings.
 - 2. Concrete paving and walks are specified in Division 2.
 - 3. Precast concrete is specified in other Division-3 sections.
 - 4. Mechanical finishes and concrete floor toppings are specified in other Division-3 sections.

1.3 SUBMITTALS

- A. See Section 01 30 00 - Administrative Requirements and 01 33 00 - Submittal Procedures, for submittal procedures.
- B. Product Data: Submit data for proprietary materials and items, including but not limited to, repair mortar, concrete mix design data, Portland cement, fly ash, reinforcement, forms, forming accessories, bonding agent, admixtures, patching compounds, waterstops, joint

systems, high strength repair/patching mortar, control joint/construction joint locations, curing compounds, dry-shake finish materials, and others as requested by Engineer.

1. Mix Design: Submit each proposed concrete mix design. Mix design(s) proposed shall be sealed by a Professional Engineer registered in the state of West Virginia. The concrete mix design shall provide the following data:
 - a. The expected strength.
 - b. Corresponding slump before and after the introduction of mid- or high-range water-reducing admixtures.
 - c. Weights and test results of the ingredients.
 - d. Concrete mix compressive strength test results.
 - e. Other physical properties necessary to review each mix design for conformance with these specifications.
 - f. Indicate proposed mix design complies with requirements of ACI 301, Section 4 - Concrete Mixtures.
 - g. Indicate proposed mix design complies with requirements of ACI 318, Chapter 5 - Concrete Quality, Mixing and Placing.
 2. Manufacturer's Installation Instructions: For concrete accessories, indicate installation procedures and interface required with adjacent construction.
- C. Shop Drawings; Reinforcement: Submit original shop drawings prepared for fabrication, bending, and placement of concrete reinforcement. Comply with ACI Detailing Manual showing bar schedules, stirrup spacing, diagrams of bent bars, arrangement of concrete reinforcement. Include special reinforcement required for openings through concrete structures.
- D. Shop Drawings; Form work: Submit shop drawings prepared by a registered Professional Engineer for fabrication and erection of forms for specific finished concrete surfaces. Show form construction including jointing, special form joint or reveals, location and pattern of form tie placement, and other items which affect exposed concrete visually.
1. Engineer's review is for general architectural applications and features only. Design of form work for structural stability and efficiency is Contractor's responsibility.
- E. Samples: Submit samples of materials as requested by Engineer, including names, sources, and descriptions.
- F. Laboratory Test Reports: Submit laboratory test reports for concrete materials and mix design tests.
1. The proposed mix design submittal(s) shall follow the procedures of Chapter 5, Sections 5.2 to 5.3 of ACI-318.
 2. Reference should be made to ACI-211.5R "Guide for Submittal of Concrete Proportions" for the required submittal information. Sample forms for presenting the necessary information can be found in the addendum at the end of this section. Example Form B should follow a completed Example A in the submittal when laboratory trial batches are used to document a water-cementitious materials ratio curve.

3. Additional data summarizing the past performance records should be an integral part of the submittal if the submittal is based on past performance with the proposed materials and proportions.
 4. Alkali-silica reactivity test results.
- G. Materials Certificates: Provide materials certificates in lieu of materials laboratory test reports when permitted by Engineer. Materials certificates shall be signed by manufacturer and Contractor, certifying that each material item complies with, or exceeds, specified requirements. Provide certification from admixture manufacturers that chloride content complies with specification requirements.

1.4 QUALITY ASSURANCE

- A. Codes and Standards: Comply with provisions of following codes, specifications, and standards, latest revisions, except where more stringent requirements are shown or specified:
1. ACI 301 "Specifications for Structural Concrete for Buildings."
 2. ACI 318 "Building Code Requirements for Reinforced Concrete."
 3. Concrete Reinforcing Steel Institute (CRSI), "Manual of Standard Practice."
 4. ACI 347 "Guide to Form work for Concrete."
 5. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."
 6. ACI 232.3R - Report on High-Volume Fly Ash Concrete for Structural Applications.
 7. ACI 305R - Guide to Hot Weather Concreting.
 8. ACI 305.1 (305.1M) - Specification for Hot Weather Concreting.
 9. ACI 306.1 - Standard Specification for Cold Weather Concreting.
 10. ACI 306R - Guide to Cold Weather Concreting.
 11. ACI 308.1 (308.1M) - Specification for Curing Concrete.
 12. ACI 350.5 (350.5M) - Specifications for Environmental Concrete Structures.
 13. ASTM C31/C31M - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 14. ASTM C33/C33M - Standard Specification for Concrete Aggregates.
 15. ASTM C39/C39M - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens
 16. ASTM C94/C94M - Standard Specification for Ready-Mixed Concrete.
 17. ASTM C143/C143M - Standard Test Method for Slump of Hydraulic-Cement Concrete.
 18. ASTM C150/C150M - Standard Specification for Portland Cement.
 19. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete.
 20. ASTM C172/C172M - Standard Practice for Sampling Freshly Mixed Concrete.

21. ASTM C173/C173M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 22. ASTM C231/C231M - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 23. ASTM C260/C260M - Standard Specification for Air-Entraining Admixtures for Concrete.
 24. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete.
- B. Construct and erect concrete formwork and accessories in accordance with ACI 301, ACI 347 and ACI 350. Perform cast-in-place concrete work in accordance with ACI 301, ACI 318 (for typical structures) and ACI 350 (for environmental structures).
- C. Materials and installed work may require testing and retesting at any time during progress of work. Tests, including retesting of rejected materials for installed work, shall be done at Contractor's expense.
- D. Engage a testing agency acceptable to Engineer to perform initial material evaluation and certification tests for mix designs and to design concrete mixes.
- E. Pre-installation Conference: Conduct conference at project site to comply with requirements of Division 1 Section "Project Meetings" and the following:
1. At least 35 days prior to submitting design mixes, conduct a meeting to review detailed requirements for preparing concrete design mixes and to determine procedures for satisfactory concrete operations. Review requirements for submittals, status of coordinating work, and availability of materials. Establish preliminary work progress schedule and procedures for materials, inspection, testing and certifications. Require representatives of each entity directly concerned with cast-in-place concrete to attend conference, including, but not limited to, the following:
 - a. Contractor's Superintendent
 - b. Agency responsible for concrete design mixes.
 - c. Agency responsible for field quality control.
 - d. Ready-mix concrete producer.
 - e. Concrete Subcontractor
 - f. Primary admixture manufactures.
- F. Concrete Testing Service: Employ and pay an independent testing laboratory, acceptable to the Owner and Architect to perform material evaluation tests and to review concrete mix designs proposed by Contractor to conform to this Specification.
- G. Alkali-Silica Reactivity Testing: Aggregates used in the concrete shall be tested by an independent testing agency for alkali-silica reactivity in accordance with ASTM C1260.

1.5 PROJECT CONDITIONS

- A. Cold-Weather Placement: Comply with ACI 301, ACI 306.1, and as follows:
 - 1. Protect concrete Work from physical damage or reduced strength caused by frost, freezing actions, or low temperatures.
 - 2. When average high and low temperature is expected to fall below 40 deg. F for three successive days, maintain delivered concrete mixture temperature within the temperature range required by ACI 301.
 - 3. Do not use frozen materials or materials containing ice or snow.
 - 4. Do not place concrete in contact with surfaces less than 35 deg. F, other than reinforcing steel.
 - 5. Do not use calcium chloride, salt, or other materials containing antifreeze agents or chemical accelerators unless otherwise specified and approved in mixture designs.
- B. Hot-Weather Placement: Comply with ACI 301 and ACI 305.1, and as follows:
 - 1. Maintain concrete temperature at time of discharge not to exceed 95 deg. F.
 - 2. Fog-spray forms, steel reinforcement, and subgrade just before placing concrete. Keep subgrade uniformly moist without standing water, soft spots, or dry areas.
- C. Protect adjacent finish materials against spatter during concrete placement.

PART 2 - PRODUCTS

2.1 FORM MATERIALS

- A. Forms for Exposed Finish Concrete: Plywood, metal, metal-framed plywood faced, or other acceptable panel-type materials, to provide continuous, straight, smooth, exposed surfaces. Furnish in largest practicable sizes to minimize number of joints and to conform to joint system shown on drawings.
 - 1. Use plywood complying with U.S. Product Standard PS-1 "B-B (Concrete Form) Plywood," Class I, Exterior Grade or better, mill-oiled and edge-sealed, with each piece bearing legible inspection trademark.
- B. Forms for Unexposed Finish Concrete: Plywood, lumber, metal, or other acceptable material. Provide lumber dressed on at least two (2) edges and one side for tight fit.
- C. Form Coatings: Provide commercial formulation form-coating compounds that will not bond with, stain, nor adversely affect concrete surfaces, and will not impair subsequent treatments of concrete surfaces.

- D. Form Ties: Factory-fabricated, adjustable-length, snapoff metal or glass fiber-reinforced plastic form ties, designed to prevent form deflection and to prevent the spalling concrete upon removal. Provide units which will leave no metal closer than 1-1/2" to the exposed surface.
1. Provide ties which, when removed, will leave holes not larger than 1" diameter in concrete surface.
 2. All form ties shall have a factor of safety of two (2) to determine the recommended safe working load.
 3. Form ties for environmental structures shall have a waterstop located within the middle third of the formed concrete.

2.2 REINFORCING MATERIALS

- A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.
- B. Steel Wire: ASTM A 82, plain, cold-drawn steel.
- C. Welded Wire Fabric: ASTM A 185, welded steel wire fabric. (Flat sheets only)
- D. Welded Deformed Steel Wire Fabric: ASTM A 497.
- E. Supports for Reinforcement: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire fabric in place. Use wire bar type supports complying with CRSI specifications.
1. For slabs-on-grade, use supports with sand plates or horizontal runners where base material will not support chair legs.
 2. For exposed-to-view concrete surfaces, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).
 3. For the bottom of slabs that are exposed to sanitary liquids, where legs of supports are in contact with forms, provide supports with legs which are plastic protected (CRSI, Class 1) or stainless steel protected (CRSI, Class 2).

2.3 CONCRETE MATERIALS

- A. Portland Cement: ASTM C 150, Type II, I/II, V low alkali, and ASTM C 595 blended cement Type IP for typical structures and Type HS for environmental structures.
1. Blended cements that include ASTM C 1157 cements shall not be permitted
 2. Use one brand of cement throughout project, unless otherwise acceptable to Engineer.
 - a. Different types of cement shall not be mixed or used alternately without specific written approval by the Engineer.
 - b. Different brands of cement may be used when authorized in writing by the Engineer. A resubmittal will be required if different brands are proposed during the Project.

3. Portland cement shall contain less than 0.60 percent alkalis. Portland-pozzolan cement shall be low alkali.
- B. Concrete mixtures shall include either fly ash or slag as shown below, but within the limits stipulated in 2.4.C, unless the proposed combination of cementitious materials has been tested in accordance with ASTM C 1012 and resulted in expansion of not more than 0.10 percent at 6 months.
1. Fly Ash, conforming to ASTM C618, Class F. Limit use of fly ash to not exceed 30% or less than 20% of cementitious material by weight.
 - a. Fly ash pozzolan shall contain less than 1 percent by weight of carbon and less than 3 percent by weight of sulfur trioxide.
 - b. Alkali content (%Na₂Oeq) less than 3.0%.
 2. Ground Granulated Blast-Furnace Slag: ASTM C989, Grade 100 or 120: Limit use of granulated blast-furnace slag to not exceed 65% or less than 40% of cement content by weight.
 3. The pozzolan supplied during the life of the project shall have been formed at the same single source. The pozzolan color shall not substantially alter the resulting concrete from the normal gray color and appearance.
- C. Normal Weight Aggregates: Fine and coarse aggregates shall conform to ASTM C33. Fine and coarse aggregates shall be regarded as separate ingredients.
1. Aggregates shall be non-reactive and shall be washed before use. Provide aggregates from a single source for exposed concrete.
 2. Tests for size and grading of fine and coarse aggregates shall be in accordance with ASTM C136. Combined aggregates shall be well and uniformly graded from coarse to fine sizes to produce a concrete that has optimum workability and consolidation characteristics. The final combined aggregate gradation shall be established during the design mix.
 3. For exterior exposed surfaces, do not use fine or coarse aggregates containing spalling-causing deleterious substances.
 4. Local aggregates not complying with ASTM C 33, but which have shown by special test or actual service to produce concrete of adequate strength and durability may be used when acceptable to Engineer.
 5. Combined Aggregate Gradation: Well graded from coarsest to finest with not more than 18 percent and not less than 8 percent retained on an individual sieve, except that less than 8 percent may be retained on coarsest sieve and on No. 50 (0.3-mm) sieve, and less than 8 percent may be retained on sieves finer than No. 50 (0.3 mm).
- D. Fine aggregate: Fine aggregate shall be hard, dense, durable particles of either sand or crushed stone regularly graded from coarse to fine. Gradation shall conform to ASTM C33.
- E. Coarse aggregate: Coarse aggregate shall be hard, angular (not river washed), dense and durable gravel or crushed rock free from injurious amounts of soft and friable particles, alkali, and organic matter. Other deleterious substances shall not exceed the limits listed in

ASTM C33, Table 3. Gradation of each coarse aggregate size shall conform TO ASTM C33, Table 2.

- F. Water: Conform with ASTM C94. Water for washing aggregate, for mixing and for curing shall be potable and free from oil and deleterious amounts of acids, alkalis, and organic materials; shall not contain more than 1,000 mg/l of chlorides as Cl, nor more than 1300 mg/l of sulfates as SO₄; and shall not contain an amount of impurities that may cause a change of more than 25 percent in the setting time of the cement nor a reduction of more than 5 percent in the compressive strength of the concrete at 14 days when compared with the result obtained with distilled water. Additionally, water used for curing shall not contain an amount of impurities sufficient to discolor the concrete.
- G. Admixtures shall be compatible with the concrete and with each other. Calcium chloride or admixtures containing calcium chloride are not acceptable. Admixtures shall be used in accordance with the manufacturer's recommendations and shall be added separately to the concrete mix.
 - 1. Prohibited Admixtures: Calcium chloride thiocyanates or admixtures containing more than 0.1 percent chloride ions are not permitted.
- H. Air-Entraining Admixture: ASTM C 260, certified by manufacturer to be compatible with other required admixtures.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Air-Mix"; Euclid Chemical Co.
 - b. "Sika Aer"; Sika Corp.
 - c. "MB-VR or MB-AE"; Master Builders.
- I. Water-Reducing Admixture: ASTM C 494, Type A, and containing not more than 0.1 percent chloride ions.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "WRDA"; W.R. Grace.
 - b. "Eucon WR-75"; Euclid Chemical Co.
 - c. "Pozzolith Normal"; Master Builders.
- J. High-Range Water-Reducing Admixture (Super Plasticizer): ASTM C 494, Type F and containing not more than 0.1 percent chloride ions.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Sikament 300"; Sika Chemical Corp.
 - b. "Eucon 37"; Euclid Chemical Co.
 - c. "Rheobuild or Polyheed"; Master Builders.
- K. Water-Reducing, Non-Chloride Accelerator Admixture: ASTM C 494, Type E, and containing not more than 0.1 percent chloride ions.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Accelguard 80"; Euclid Chemical Co.
 - b. "Pozzutec 20"; Master Builders.
 - c. "Daraset"; W.R. Grace & Co.

- L. Water-Reducing, Retarding Admixture: ASTM C 494, Type D, and containing not more than 0.1 percent chloride ions.
1. Products: Subject to compliance with requirements, provide one of the following:
 - a. "Pozzolith"; Master Builders.
 - b. "Eucon Retarder 75"; Euclid Chemical Co.
 - c. "Plastiment"; Sika Chemical Co.
- M. Antimicrobial crystalline waterproofing admixture: Provide Xypex Bio-San C500 admixture as manufactured by Xypex Chemical Corporation. Dosage rate shall be 1.0% by weight of total cementitious material content in the concrete. No substitution for this admixture shall be acceptable. This admixture shall be incorporated in concrete utilize environmental structures in accordance with manufacturer's recommendations and requirements.
- N. Corrosion-Inhibiting Admixture: Commercially formulated, anodic inhibitor or mixed cathodic and anodic inhibitor; capable of forming a protective barrier and minimizing chloride reactions with steel reinforcement in concrete.
1. Available Products: Subject to compliance with requirements, products that may be incorporated into the Work include, but are not limited to, the following:
 2. Products: Subject to compliance with requirements, provide one of the following:
 - a. Catexol 1000CL; Axim Concrete Technologies.
 - b. MCI 2000 or MCI 2005; Cortec Corporation.
 - c. DCI or DCI-S; W.R. Grace & Co., Construction Products Div.
 - d. Rheocrete 222+; Master Builders, Inc.
 - e. FerroGard-901; Sika Corporation.
- O. Fiber Reinforcement:
1. Synthetic fiber reinforcing shall be added to the concrete for the areas indicated in the drawings. Only fibers designed and manufactured specifically for use in concrete shall be acceptable as secondary reinforcement, complying with ASTM C1116, not less than $\frac{3}{4}$ inch long.
 2. The fibers may be added at the batch plant. The incorporation of said fibers shall be documented on the delivery ticket from the ready-mix producer. Fibers shall be added to the concrete in strict accordance with manufacturer's printed instructions. The minimum dosage rate shall be 1.5 lbs/cubic yard.
 3. Nylon fibers containing 100% virgin nylon monofilaments shall be utilized to impart a "non-hairy" surface to the finished concrete.
 4. Products: Subject to compliance with requirements, provide the following fibrous reinforcement or approved equal:
 - a. Nycon Fiber; Nycon, Inc.
 - b. Nylo-Mono; Forta Corp.
 - c. Fibrasol N; Axim Concrete Technologies

2.4 RELATED MATERIALS

- A. Granular Base: Evenly graded mixture of fine and coarse aggregates to provide, when compacted, a smooth and even surface below slabs on grade.
- B. Non-Shrink Non-metallic Grout: CRD-C 621 and ASTM C-1107, factory pre-mixed grout.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Non-metallic
 - 1) “Set Grout”; Master Builders.
 - 2) “Euco-NS”; Euclid Chemical Co.
 - 3) “Five Star Grout”; U.S. Grout Corp.
- C. Absorptive Cover: Burlap cloth made from jute or kenaf, weighing approximately 9 oz. per sq. yd., complying with AASHTO M 182, Class 2.
- D. Moisture-Retaining Cover: One of the following, complying with ASTM C 171.
 - 1. Waterproof paper.
 - 2. Polyethylene film.
 - 3. Polyethylene-coated burlap.
- E. Liquid Membrane-Forming Curing Compound: Liquid type membrane- forming curing compound complying with ASTM C 309, Type I, Class A. Moisture loss not more than 0.55 kg./sq. m. when applied at 200 sq ft./gal.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. “Masterkure”; Master Builders.
 - b. “Ecocure”; Euclid Chemical Co.
 - c. “Horn Clear Seal”; A.C. Horn, Inc.
- F. Bonding Compound: Epoxy base.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. Sikadur-32 Hi-Mod; Sika USA
 - b. Arimatec-110 EpoCem; Sika USA
 - c. Dural 452 Gel; Euclid Chemical Co.
 - d. Dural 452 MV; Euclid Chemical Co.
 - e. REZI-WELD; W. R. MeadowsEpoxy
- G. Epoxy Adhesive: ASTM C 881, two component material suitable for use on dry or damp surfaces. Provide material “Type,” “Grade,” and “Class” to suit project requirements.
 - 1. Products: Subject to compliance with requirements, provide one of the following:
 - a. “Epoxite Binder 2390”; A.C. Horn, Inc.
 - b. “Sikadur 32 Hi-Mod”; Sika Chemical Corp.
 - c. “Euco Epoxy 452 or 620”; Euclid Chemical Co.

- H. High Strength Repair/Patching Mortar: Contractor can, either provide a batch/site mix or a premanufactured bag mix. See Table I for a batch/site mix.
1. Premanufactured bag mix shall be polymer modified shrinkage compensated, rapid setting, high strength mortar specifically formulated to make structural repairs in vertical and overhead applications.
 2. Bag mix shall conform to ASTM C928 R2 for structural concrete repair and have a 28-day strength of at least 6,000 psi.
 3. Bag mix may be extended with aggregate if approved by manufacturer.
 4. The following are approved manufacturers:
 - a. Sika Chemical Corp.
 - b. Five Star Products. Inc
 - c. Euclid Chemical Company
 - d. CTS Cement Manufacturing Corp.
 - e. Dayton Superior Corporation
 - f. SpecChem

2.5 PROPORTIONING AND DESIGN OF MIXES

- A. Prepare design mixes for each type and strength of concrete by either laboratory trial batch or field experience methods as specified in ACI 301 and ACI 211. If the trial batch method is used, use an independent testing facility acceptable to Engineer for preparing and reporting proposed mix designs. The testing facility shall not be the same as used for field quality control testing unless otherwise acceptable to Engineer.
1. Concrete shall be normal weight concrete composed of specified cement, pozzolan, admixtures, aggregates and water proportioned and mixed to produce workable, strong, dense, and impermeable concrete.
 2. The Contractor may substitute Portland-pozzolan cement conforming to ASTM C595, containing the specified pozzolan content, in lieu of separately batching Portland cement and pozzolan. Pozzolan may be omitted from concrete exposed only to normal atmospheric conditions and from concrete not in contact with soil or liquid. The maximum water-cementitious materials ratio shall be based on the combined weight of cement and pozzolan in the concrete mixture.
 3. Controlled Low Strength Material (CLSM) shall be a flowable concrete slurry mix, consisting of cement, pozzolan, water, coarse and fine aggregate. The concrete slurry mix shall be produced by a ready-mix concrete supplier.
- B. Submit written reports to Engineer and Structural Engineer of each proposed mix for each class of concrete at least 15 days prior to start of work. Do not begin concrete production until mixes have been reviewed by Engineer.

- C. Design mixes to provide normal weight concrete with the following properties, as indicated in Table I.:

TABLE 1
CONCRETE REQUIREMENTS

Concrete Class	ASTM Coarse Aggregate Size	Maximum Water/Cement Ratio	Pozzolan, Percent by Weight of Cementitious Materials ^a	Minimum Air Content (Percent)	Minimum ^b 28-Day Compressive Strength, PSI	Slump Range Min-Max /Admix ^c (Inches)
A	57	0.4	20-28	5.5 ^c	5000	3-4/8
B	467 ^d	0.45	20-28	5.5 ^c	3500	4-5/8
C	8	0.48	20-28	5.5	3000	5-6/9
D	57	0.42	20-28	5.5 ^c	5000	3-4/8
G	78 ^j	0.45	-	-	3000	7 ^j
M	78 ^j	0.40	5-25	5.5	5500	3-4/5
F	57 ^h	1.33 ^h	10-30 ^h	15 ^h	100 ⁱ	8 ^h

- a Pozzolan content may be included in cementitious fraction. Based on the fly ash ratios, for GGBFS pozzolan shall be multiplied by 1.75.
- b Compressive strength shall be determined at the end of 28 days based on test cylinders made and tested in accordance with ASTM C39.
- c Plus or minus 1.5 percent.
- d ASTM coarse aggregate gradation 57 may be substituted at Contractor's option.
- e Min and max represent slump due to water only. Admix refers to recommended maximum slump for the mix after the incorporation of water reducing admixtures.
- h Contractor to determine.
- i Plus or minus 25 psi.
- j Contractor may submit proposed substitutions for Engineer's approval.

1. Typical cast-in-place structural concrete shall be Class A, except as otherwise specified or shown on the drawings.
2. Sitework, non-structural concrete (sidewalks, curbs, pavers, etc.) shall be Class B unless otherwise noted on the drawings.
3. Class C shall be used for grouting manhole inverts, as a topping for sloping slabs, forming manhole benches, etc.
4. Cast-in-place concrete for environmental structures shall be Class D, except as otherwise specified or shown on the drawings.
5. Masonry grout, for bond beams, grouting cells and precast planks shall be class G.
6. High strength repair mortar shall be class M.
7. Controlled Low Strength Material shall be Class F.

- D. Adjustment to Concrete Mixes: Mix design adjustments may be requested by Contractor when characteristics of materials, job conditions, weather, test results, or other circumstances warrant; at no additional cost to Owner and as accepted by Engineer. Laboratory test data for revised mix design and strength results must be submitted to and accepted by Engineer before using in work.

E. Admixtures:

1. Use high range water-reducing admixture (super plasticizer) in Classes A and D concrete unless noted otherwise.
2. Use non-chloride accelerating admixture in concrete slabs placed at ambient temperatures below 50 deg F (10 deg C).
3. Use air-entraining admixture in all concrete, unless otherwise indicated. Add air-entraining admixture at manufacturer's prescribed rate to result in concrete at point of placement having total air content within limits shown in Table I.
4. Use antimicrobial crystalline waterproofing admixture in Class environmental structures concrete.
5. Use admixtures for water-reducing and set-control in strict compliance with manufacturer's directions.
6. Slump Limits: Proportion and design mixes to result in concrete slump at point of placement as shown in Table I:
 - a. Concrete containing HRWR admixture (super-plasticizer): Not more than 8" after addition of HRWR to site-verified 2"-3" slump concrete.

2.6 CONCRETE MIXING

- A. Job-Site Mixing: Mix materials for concrete in appropriate drum type batch machine mixer. For mixers of one cu. yd., or smaller capacity, continue mixing at least 1-1/2 minutes, but not more than 5 minutes after ingredients are in mixer, before any part of batch is released. For mixers of capacity larger than one cu. yd., increase minimum 1-1/2 minutes of mixing time by 15 seconds for each additional cu. yd., or fraction thereof.
1. Provide batch ticket for each batch discharged and used in work, indicating project identification name and number, date, mix type, mix time, quantity, and amount of water introduced.
- B. Ready-Mix Concrete: Comply with requirements of ASTM C 94, and as herein specified.
1. During hot weather, or under conditions contributing to rapid setting of concrete, a shorter mixing time than specified in ASTM C 94 may be required.
 - a. When air temperature is between 85 deg F (30 deg C) and 90 deg F (32 deg C), reduce mixing and delivery time from 1-1/2 hours to 75 minutes, and when air temperature is above 90 deg F (32 deg C), reduce mixing and delivery time to 60 minutes.
- C. Prepare design mixtures for each type of concrete required.
1. The inclusion of either fly ash or slag in the concrete mix is mandatory.
 2. Where fly ash is used:
 - a. The minimum fly ash content shall be 20 percent, and the maximum shall be 30% of cementitious material by weight.
 - b. Additional fly ash shall not be included in concrete mixed with blended cements.
 1. Where slag is used:

- a. The minimum slag content shall be 50 percent and the maximum shall be 65% of cementitious material by weight.
- b. Additional slag shall not be included in concrete mixed with blended cements.

2.7 WATERSTOPS

A. POLYVINYL CHLORIDE (PVC):

1. PVC waterstops shall be manufactured from virgin polyvinyl chloride conforming to the Corps of Engineers Specification No. CRD-C572. Unless otherwise specified or noted on the drawings, waterstops in construction joints shall be 6-inch flat center/ribbed sides/0.375 inch thick, Greenstreak 679, Vinylex R6-38, or equal. Waterstops in expansion joints shall be 9-inch center-bulb/ribbed sides/0.375 inch thick, Greenstreak 696, Vinylex RB9-38H, or equal. All waterstop tees, crosses, and elbows must be factory made; all field fabricated joints will be rejected.

B. EXPANDING (HYDROPHILIC) WATERSTOPS:

1. Expanding waterstops shall be bentonite-free and made from unvulcanized rubber. Acceptable products include Adeka. Equivalents approved by the Engineer are acceptable. These are allowable for use only where indicated on the drawings or accepted in writing by the Engineer. Provide adhesive approved by the waterstop manufacturer where required due to geometry, irregular surface conditions, or as recommended by the manufacturer. Unless otherwise shown on the drawings, use Adeka MC-2010MN at all Hydrophilic Waterstop identified locations or approved equal.

2.8 PRODUCT DATA

A. MANUFACTURER'S DATA:

1. Copies of manufacturer's data shall be provided for the following:
 - a. Cement
 - b. As-delivered concrete strength, slump, temperature, and air content
 - c. Final laboratory report.

B. READY-MIXED CONCRETE TRUCK DELIVERY TICKETS:

1. Each load of ready-mixed concrete delivered to the job site shall be accompanied by a delivery ticket showing the information listed in ASTM C94, Section 16.
2. With each load of concrete delivered to the job there shall be furnished by the ready mixed concrete producer duplicate delivery tickets, one for the Contractor and one for the Engineer. Delivery tickets shall provide the following information:
 - a. Date and serial number of tickets;
 - b. Name of ready mixed concrete plant;
 - c. Job location;
 - d. Contractor;
 - e. Type and brand name of cement;
 - f. Mix number or specified cement content in bags per cubic yard of concrete;
 - g. Truck number;

- h. Time dispatched stamped by a time clock;
- i. Amount of concrete in load in cubic yards;
- j. Admixtures in concrete, if any;
- k. Maximum size of aggregate;
- l. Water added to the job, if any;
- m. Slump of concrete ordered

PART 3 - EXECUTION

3.1 GENERAL

- A. Coordinate the installation of joint materials and vapor retarders with placement of forms and reinforcing steel.

3.2 FORMS

- A. Design, erect, support, brace, and maintain form work to support vertical and lateral, static, and dynamic loads that might be applied until such loads can be supported by concrete structure. Construct form work so concrete members and structures are of correct size, shape, alignment, elevation, and position. Maintain form work construction tolerances complying with ACI 347.
- B. Design form work to be readily removable without impact, shock, or damage to cast-in-place concrete surfaces and adjacent materials.
- C. Construct forms to sizes, shapes, lines, and dimensions shown, and to obtain accurate alignment, location, grades, level and plumb work in finished structures. Provide for openings, offsets, sinkages, keyways, recesses, moldings, rustications, reglets, chamfers, blocking, screeds, bulkheads, anchorages and inserts, and other features required in work. Use selected materials to obtain required finishes. Solidly butt joints and provide back-up at joints to prevent leakage of cement paste.
- D. Fabricate forms for easy removal without hammering or prying against concrete surfaces. Provide crush plates or wrecking plates where stripping may damage cast concrete surfaces. Provide top forms for inclined surfaces where slope is too steep to place concrete with bottom forms only. Kerf wood inserts for forming keyways, reglets, recesses, and the like, to prevent swelling and for easy removal.
- E. Provide temporary openings where interior area of form work is inaccessible for cleanout, for inspection before concrete placement, and for placement of concrete. Securely brace temporary openings and set tightly to forms to prevent loss of concrete mortar. Locate temporary openings on forms at inconspicuous locations.
- F. Chamfer exposed corners and edges as indicated, using wood, metal, PVC, or rubber chamfer strips fabricated to produce uniform smooth lines and tight edge joints.

- G. Provisions for Other Trades: Provide openings in concrete form work to accommodate work of other trades. Determine size and location of openings, recesses, and chases from trades providing such items. Accurately place and securely support items built into forms.
- H. Cleaning and Tightening: Thoroughly clean forms and adjacent surfaces to receive concrete. Remove chips, wood, sawdust, dirt, or other debris just before concrete is placed. Retightening forms and bracing after concrete placement if required to eliminate mortar leaks and maintain proper alignment.

3.3 VAPOR RETARDER INSTALLATION

- A. Following leveling and tamping of granular base for slabs on grade, place vapor retarder sheeting with longest dimension parallel with direction of pour.
- B. Lap joints 6" and seal with manufacturer's recommended mastic or pressure-sensitive tape.

3.4 PLACING REINFORCEMENT

- A. Comply with Concrete Reinforcing Steel Institute's recommended practice for "Placing Reinforcing Bars," for details and methods of reinforcement placement and supports, and as herein specified.
 - 1. Avoiding cutting or puncturing vapor retarder during reinforcement placement and concreting operations. Repair damages before placing concrete.
- B. Clean reinforcement of loose rust and mill scale, earth, ice, and other materials which reduce or destroy bond with concrete.
- C. Accurately position, support, and secure reinforcement against displacement by form work, construction, or concrete placement operations. Locate and support reinforcing by metal chairs, runners, bolsters, spacers, and hangers, as required.
- D. Place reinforcement to obtain at least minimum coverages for concrete protection. Arrange, space, and securely tie bars and bar supports to hold reinforcement in position during concrete placement operations. Set wire ties so ends are directed into concrete, not toward exposed concrete surfaces.
- E. Install welded wire fabric in longest lengths as practicable. Lap adjoining pieces at least one full mesh and lace splices with wire. Offset end laps in adjacent widths to prevent continuous laps in either direction.

3.5 JOINTS

- A. Construction Joints: Locate and install construction joints as indicated or, if not indicated, locate so as not to impair strength and appearance of the structure, as acceptable to Engineer.
 - 1. Provide a roughen interface with a 1/4", min, amplitude at construction joints in walls, slabs, and between walls and footings.

2. Place construction joints perpendicular to main reinforcement. Continue reinforcement across construction joints, except as otherwise indicated.
- B. Waterstops: Provide waterstops in construction joints as indicated. Install waterstops to form continuous diaphragm in each joint. Make provisions to support and protect exposed waterstops during progress of work. Fabricate field joints in waterstops in accordance with manufacturer's printed instructions.
- C. Isolation Joints in Slabs-on-Ground: Construct isolation joints in slabs-on-ground at points of contact between slabs-on-ground and vertical surfaces, such as column pedestals, foundation walls, grade beams, and elsewhere as indicated.
 1. Joint filler and sealant materials are specified in Section 030000.02 of these specifications.
- D. Contraction (Control) Joints in Slabs-on-Ground: Construct contraction joints in slabs-on-ground to form panels of patterns as shown. Use inserts 1/4 of slab depth, unless otherwise indicated.
 1. Form contraction joints by inserting premolded plastic strips into fresh concrete until top surface of strip is flush with slab surface.
 2. Follow the directions of Insert Manufacturer for finishing the slab and joints.
- E. If joint pattern not shown, provide joints not exceeding 15' in either direction and located to conform to bay spacing wherever possible (at column centerlines, half bays, third-bays).
 1. Joint sealant material is specified in Section 030000.02 of these specifications.

3.6 INSTALLATION OF EMBEDDED ITEMS

- A. General: Set and build into work anchorage devices and other embedded items required for other work that is attached to, or supported by, cast-in-place concrete. Use setting drawings, diagrams, instructions, and directions provided by suppliers of items to be attached thereto. Electrical conduit shall not be embedded in concrete.
- B. Install reglets to receive top edge of foundation sheet waterproofing, and to receive thru-wall flashings in outer face of concrete frame at exterior walls, where flashing is shown at lintels, relieving angles, and other conditions.
- C. Edge Forms and Screed Strips for Slabs: Set edge forms or bulkheads and intermediate screed strips for slabs to obtain required elevations and contours in finished slab surface. Provide and secure units to support screed strips using strike-off templates or compacting type screeds.

3.7 PREPARATION OF FORM SURFACES

- A. Clean re-used forms of concrete matrix residue, repair and patch as required to return forms to acceptable surface condition.
- B. Coat contact surfaces of forms with an approved, nonresidual, low-VOC, form-coating compound before placing reinforcement.

- C. Thin form-coating compounds only with thinning agent of type, amount, and under conditions of form-coating compound manufacturer's directions. Do not allow excess form-coating material to accumulate in forms or to come into contact with in-place concrete surfaces against which fresh concrete will be placed. Apply in compliance with manufacturer's instructions.
- D. Coat steel forms with a non-staining, rust-preventative form oil or otherwise protect against rusting. Rust-stained steel form work is not acceptable.

3.8 CONCRETE PLACEMENT

- A. Preplacement Inspection: Before placing concrete, inspect and complete form work installation, reinforcing steel, and items to be embedded or cast-in. Notify other crafts to permit installation of their work; cooperate with other trades in setting such work. Moisten wood forms immediately before placing concrete where form coatings are not used.
 - 1. Apply temporary protective covering to lower 2' of finished walls adjacent to poured floor slabs and similar conditions and guard against spattering during placement.
- B. General: Comply with ACI 304 "Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete," and as herein specified.
 - 1. Deposit concrete continuously or in layers of such thickness that no concrete will be placed on concrete which has hardened sufficiently to cause the formation of seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as herein specified. Deposit concrete as nearly as practicable to its final location to avoid segregation.
- C. Placing Concrete in Forms: Deposit concrete in forms in horizontal layers not deeper than 24" and in a manner to avoid inclined construction joints. Where placement consists of several layers, place each layer while preceding layer is still plastic to avoid cold joints.
 - 1. Consolidate placed concrete by mechanical vibrating equipment supplemented by hand-spading, rodding, or tamping. Use equipment and procedures for consolidation of concrete in accordance with ACI 309.
 - 2. Do not use vibrators to transport concrete inside forms. Insert and withdraw vibrators vertically at uniformly spaced locations not farther than visible effectiveness of machine. Place vibrators to rapidly penetrate placed layer and at least 6" into preceding layer. Do not insert vibrators into lower layers of concrete that have begun to set. At each insertion limit duration of vibration to time necessary to consolidate concrete and complete embedment of reinforcement and other embedded items without causing segregation of mix.
- D. Placing Concrete Slabs: Deposit and consolidate concrete slabs in a continuous operation, within limits of construction joints, until the placing of a panel or section is completed.
 - 1. Consolidate concrete during placing operations so that concrete is thoroughly worked around reinforcement and other embedded items and into corners.

2. Bring slab surfaces to correct level with straightedge and strikeoff. Use bull floats or darbies to smooth surface, free of humps or hollows. Do not disturb slab surfaces prior to beginning finishing operations.
 3. Maintain reinforcing in proper position on chairs during concrete placement operations.
- E. Cold Weather Placing: Protect concrete work from physical damage or reduced strength which could be caused by frost, freezing actions, or low temperatures, in compliance with ACI 306 and as herein specified.
1. When air temperature has fallen to or is expected to fall below 40 deg F (4 deg C), uniformly heat water and aggregates before mixing to obtain a concrete mixture temperature of not less than 50 deg F (10 deg C), and not more than 80 deg F (27 deg C) at point of placement.
 - a. The concrete shall be maintained within this temperature range for not less than seven (7) days.
 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 or against cold reinforcing steel.
 3. Do not use calcium chloride, salt, and other materials containing antifreeze agents or chemical accelerators, unless otherwise accepted in mix designs.
- F. Hot Weather Placing: When hot weather conditions exist that would seriously impair quality and strength of concrete, place concrete in compliance with ACI 305 and as herein specified.
1. Cool ingredients before mixing to maintain concrete temperature at time of placement below 90 deg F (32 deg C). Mixing water may be chilled, or chopped ice may be used to control temperature provided water equivalent of ice is calculated to total amount of mixing water. Use of liquid nitrogen to cool concrete is Contractor's option.
 2. Cover reinforcing steel with water-soaked burlap if it becomes too hot, so that steel temperature will not exceed the ambient air temperature immediately before embedment in concrete.
 3. Fog spray forms, reinforcing steel, and subgrade just before concrete is placed.
 4. Use water-reducing retarding admixture when required by high temperatures, low humidity, or other adverse placing conditions, as acceptable to Engineers.

3.9 FINISH OF FORMED SURFACES

- A. Rough Form Finish: For formed concrete surfaces not exposed-to- view in the finish work or by other construction, unless otherwise indicated. This is the concrete surface having texture imparted by form facing material used, with tie holes and defective areas repaired and patched and fins and other projections exceeding 1/4" in height rubbed down or chipped off.

- B. Smooth Form Finish: For formed concrete surfaces exposed-to-view, or that are to be covered with a coating material applied directly to concrete, or a covering material applied directly to concrete, such as waterproofing, dampproofing, veneer plaster, painting, or other similar system. This is an as-cast concrete surface obtained with selected form facing material, arranged orderly and symmetrically with a minimum of seams. Repair and patch defective areas with fins or other projections completely removed and smoothed; provide smooth rubbed finish to smooth form finish. Refer to "Concrete Surface Repairs."
- C. Smooth Rubbed Finish: Provide smooth rubbed finish to scheduled concrete surfaces, which have received smooth form finish treatment.
1. Scarify or roughen entire surface by grinding or similar effective means.
 2. Combine one part of Portland cement with 1-1/2 parts fine sand by volume and a 50:50 mixture of acrylic or styrene butadiene-based bonding admixture and water to form the consistency of thick paint. Blend standard Portland cement and white Portland cement, amounts determined by trial patches, so that final color of dry grout will match adjacent surfaces.
 3. Thoroughly wet concrete surfaces and apply grout to coat surfaces and fill small holes. Remove excess grout by scraping and rubbing with clean burlap. Keep damp by fog spray for at least 36 hours after rubbing.
 4. Repeat the above process if necessary to fill voids or bug holes and obtain a consistent match to adjacent surfaces, subject to acceptance of the Engineer.
- D. Grout Cleaned Finish: Provide grout cleaned finish on scheduled concrete surfaces which have received smooth form finish treatment.
1. Scarify or roughen entire surface by grinding or similar effective means.
 2. Apply Thoroseal plaster mix coating by Thoro System Products or approved equivalent with an approximate thickness of 1/8-inch to 1/4-inch.
 3. Follow the manufacturer's recommendations and guidelines regarding surface preparation, application methods and curing.
 4. Repeat the above process if necessary to fill voids or bug holes and obtain a consistent match to adjacent surfaces, subject to acceptance of the Engineer.
- E. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces occurring adjacent to formed surfaces, strike-off smoothly and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces, unless otherwise indicated.

3.10 MONOLITHIC SLAB FINISHES

- A. Scratch Finish: Apply scratch finish to monolithic slab surfaces that are to receive concrete floor topping or mortar setting beds for tile, Portland cement terrazzo, and other bonded applied cementitious finish flooring material, and as otherwise indicated.
1. After placing slabs, plane surface to tolerances for floor flatness F(F) 15 and floor levelness F(L) 13, measured according to ASTM E 1155. Slope surfaces uniformly

to drains where required. After leveling, roughen surface before final set, with stiff brushes, brooms, or rakes.

- B. Float Finish: Apply float finish to monolithic slab surfaces to receive trowel finish and other finishes as hereinafter specified, and slab surfaces which are to be covered with membrane or elastic waterproofing, membrane or elastic roofing, or sand-bed terrazzo, and as otherwise indicated.
 - 1. After screeding, consolidating, and leveling concrete slabs, do not work surface until ready for floating. Begin floating when surface water has disappeared or when concrete has stiffened sufficiently to permit operation of power-driven floats, or both. Consolidate surface with power-driven floats, or by hand-floating if area is small or inaccessible to power units. Check and level surface plane to tolerances of F(F) 18 F(L) 15. Cut down high spots and fill low spots. Uniformly slope surfaces to drains. Immediately after leveling, refloat surface to a uniform, smooth, granular texture.
- C. Trowel Finish: Apply trowel finish to monolithic slab surfaces to be exposed-to-view, and slab surfaces to be covered with resilient flooring, carpet, ceramic or quarry tile, paint, or other thin film finish coating system.
 - 1. After floating, begin first trowel finish operation using a power-driven trowel. Begin final troweling when surface produces a ringing sound as trowel is moved over surface. Consolidate concrete surface by final hand-troweling operation, free of trowel marks, uniform in texture and appearance, and with surface leveled to tolerances of F(F), 20 and F(L) 17, measured according to ASTM E1155. Grind smooth surface defects which would telegraph through applied floor covering system.
- D. Trowel and Fine Broom Finish: Where ceramic or quarry tile is to be installed with thin-set mortar, apply trowel finish as specified, then immediately follow with slightly scarifying surface by fine brooming.
- E. Non-Slip Broom Finish: Apply non-slip broom finish to exterior concrete platforms, steps, and ramps, and elsewhere as indicated.
 - 1. Immediately after float finishing, slightly roughen concrete surface by brooming with fiber bristle broom perpendicular to main traffic route. Coordinate required final finish with Engineer before application.
- F. Non-slip Aggregate Finish: Apply non-slip aggregate finish to concrete stair treads, platforms, ramps, sloped walks, and elsewhere as indicated.
 - 1. After completion of float finishing, and before starting trowel finish, uniformly spread 25 lbs. of dampened non-slip aggregate per 100 sq. ft. of surface. Tamp aggregate flush with surface using a steel trowel, but do not force below surface. After broadcasting and tamping, apply trowel finishing as herein specified.
 - 2. After curing, lightly work surface with a steel wire brush, or an abrasive stone, and water to expose non-slip aggregate.
- G. Colored Wear-Resistant Finish: Provide colored wear-resistant finish to monolithic slab surface indicated.

1. Apply dry shake materials for colored wear-resistant finish at rate of not less than 100 lbs. per 100 sq. ft., unless greater amount is recommended by material manufacturer.
2. Immediately following first floating operation, uniformly distribute approximately 2/3 of required weight of dry shake material over concrete surface, and embed by means of power floating. Follow floating operation with second shake application, uniformly distributing remainder of dry shake material with overlapping applications, and embed by power floating.
3. After completion of broadcasting and floating, apply trowel finish as herein specified. Cure slab surface with curing compound recommended by dry shake hardener manufacturer. Apply curing compound immediately after final finishing.

3.11 CONCRETE CURING AND PROTECTION

- A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Protect concrete from rapid moisture loss before and during finishing operations.
 1. The evaporation graph, Figure 1, of ACI 308 - Curing Concrete, shall be used to determine the evaporation rate during concrete placement. If the rate of evaporation equals or exceeds 0.2 lbs/sq.ft./hr., steps shall be taken to prevent excessive evaporation from the surface.
 2. Start initial curing as soon as free water has disappeared from concrete surface after placing and finishing.
 - a. Initial curing may be any of the methods listed herein that maintain a satisfactory moisture content and temperature.
 3. Begin final curing procedures, if they differ from initial curing, immediately following initial curing and before concrete has dried. Continue curing for at least seven (7) days in accordance with ACI 301 procedures. Avoid rapid drying at end of final curing period.
- B. Curing Methods: Perform curing of all structural concrete as herein specified.
 1. Provide moisture curing by following methods.
 - a. Keep concrete surface continuously wet by covering with water.
 - b. Continuous water-fog spray.
 - c. Cover concrete surface with specified absorptive cover, thoroughly saturating cover with water and keeping continuously wet. Place absorptive cover to provide coverage of concrete surfaces and edges, with 4" lap over adjacent absorptive covers.
 2. Provide moisture-cover curing as follows:
 - a. Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width with sides and ends lapped at least 3" and sealed by waterproof tape or adhesive. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
- C. Provide curing and sealing compound to pavement, walks, and curbs only, as follows:

1. Apply specified curing and sealing compound to concrete slabs as soon as final finishing operations are complete (within 2 hours) and after surface water sheen has disappeared. Apply uniformly in continuous operation by power-spray or roller in accordance with manufacturer's directions. Recoat areas subjected to heavy rainfall within three (3) hours after initial application. Maintain continuity of coating and repair damage during curing period.
- D. Curing Formed Surfaces: Cure formed concrete surfaces, including undersides of beams, supported slabs, and other similar surfaces by moist curing with forms in place for full curing period or until forms are removed. If forms are removed, continue curing by methods specified above, as applicable.
- E. Curing Unformed Surfaces: Cure unformed surfaces, such as slabs, floor topping, and other flat surfaces by moist curing methods.
 1. Final cure concrete surfaces to receive liquid floor hardener or finish flooring by use of moisture-retaining cover, unless otherwise directed.

3.12 SHORES AND SUPPORTS

- A. Comply with ACI 347 for shoring and reshoring in multistory construction, and as herein specified.
- B. Extend shoring from ground to roof for structures four (4) stories or less, unless otherwise permitted.
- C. Extend shoring at least three (3) floors under floor or roof being placed for structures over four (4) stories. Shore floor directly under floor or roof being placed, so that loads from construction above will transfer directly to these shores. Space shoring in stories below this level in such a manner that no floor or member will be excessively loaded or will induce tensile stress in concrete members where no reinforcing steel is provided. Extend shores beyond minimums to ensure proper distribution of loads throughout structure.
- D. Remove shores and reshore in a planned sequence to avoid damage to partially cured concrete. Locate and provide adequate reshoring to safely support work without excessive stress or deflection.
 1. Keep reshores in place a minimum of 15 days after placing upper tier, and longer if required, until concrete has attained its required 28-day strength and heavy loads due to construction operations have been removed.

3.13 REMOVAL OF FORMS

- A. Formwork not supporting weight of concrete, such as sides of beams, walls, columns, and similar parts of the work, may be removed after cumulatively curing at not less than 50 deg F (10 deg C) for five (5) days after placing concrete, provided concrete is sufficiently hard to not be damaged by form removal operations, and provided curing and protection operations are maintained.

- B. Formwork supporting weight of concrete, such as beam soffits, joists, slabs, and other structural elements, may not be removed in less than 14 days or until concrete has attained at least 75 percent of design minimum compressive strength at 28 days. Determine potential compressive strength of in-place concrete by testing field-cured specimens representative of concrete location or members. Lab cured cylinders will not be considered.
- C. Form facing material may be removed five (5) days after placement, only if shores and other vertical supports have been arranged to permit removal of form facing material without loosening or disturbing shores and supports.

3.14 RE-USE OF FORMS

- A. Clean and repair surfaces of forms to be re-used in work. Split, frayed, delaminated, or otherwise damaged form facing material will not be acceptable for exposed surfaces. Apply new form coating compound as specified for new form work.
- B. When forms are extended for successive concrete placement, thoroughly clean surfaces, remove fins and laitance, and tighten forms to close joints. Align and secure joint to avoid offsets. Do not use "patched" forms for exposed concrete surfaces, except as acceptable to Engineer.

3.15 MISCELLANEOUS CONCRETE ITEMS

- A. Filling-In: Fill-in holes and openings left in concrete structures for passage of work by other trades, unless otherwise shown or directed, after work of other trades is in place. Mix, place, and cure concrete as herein specified, to blend with in-place construction. Provide other miscellaneous concrete filling shown or required to complete work.
- B. Curbs: Provide monolithic finish to interior curbs by stripping forms while concrete is still green and steel-troweling surfaces to a hard, dense finish with corners, intersections, and terminations slightly rounded.
- C. Equipment Bases and Foundations: Provide machine and equipment bases and foundations, as shown on drawings. Set anchor bolts for machines and equipment with template at correct elevations, complying with certified diagrams or templates of manufacturer furnishing machines and equipment.
 - 1. Grout base plates and foundations as indicated, using specified non-shrink grout. Use non-metallic grout for exposed conditions, unless otherwise indicated.
- D. Steel Pan Stairs: Provide concrete fill for steel pan stair treads and landings and associated items. Cast-in safety inserts and accessories as shown on drawings. Screed, tamp, and finish concrete surfaces as scheduled. Cure concrete as herein specified.
- E. Reinforced Masonry: Provide concrete grout conforming to ASTM C476 for reinforced masonry lintels and bond beams where indicated on drawings and as scheduled. Maintain accurate location of reinforcing steel during concrete placement.

3.16 CONCRETE SURFACE REPAIRS

- A. Patching Defective Areas: Repair and patch defective areas with cement mortar immediately after removal of forms, when acceptable to Engineer.
1. Saw-cut out honeycomb, rock pockets, voids over 1/4" in any dimension, down to solid concrete but, in no case to a depth of less than 1." Make edges of cuts slightly undercut to the concrete surface. Thoroughly clean, dampen with water, and brush-coat the area to be patched with specified bonding agent. Place patching mortar after bonding compound has dried.
 2. For exposed-to-view surfaces, blend white Portland cement and standard Portland cement so that, when dry, patching mortar will match surrounding color. Provide test areas at inconspicuous location to verify mixture and color match before proceeding with patching. Compact mortar in place and strike-off slightly higher than surrounding surface.
- B. Repair of Formed Surfaces: Remove and replace concrete having defective surfaces if defects cannot be repaired to satisfaction of Engineer. Surface defects, as such, include color and texture irregularities, cracks, spalls, air bubbles, honeycomb, rock pockets; fins and other projections on surface; and stains and other discolorations that cannot be removed by cleaning. Flush out form tie holes, fill with Portland Cement patching mortar, or precast cement cone plugs secured in place with bonding agent. When other materials are used, apply them in accordance with manufacturer's recommendations.
1. Repair concealed formed surfaces, where possible, that contain defects that affect the durability of concrete. If defects cannot be repaired, remove and replace concrete.
 2. Repair of Unformed Surfaces: Test unformed surfaces, such as monolithic slabs, for smoothness and verify surface plane to tolerances specified for each surface and finish. Correct low and high areas as herein specified. Test unformed surfaces sloped to drain for trueness of slope, in addition to smoothness using a template having required slope.
 3. Repair finished unformed surfaces that contain defects which affect durability of concrete. Surface defects, as such, include crazing, cracks in excess of 0.01" wide or which penetrate to reinforcement or completely through non-reinforced sections regardless of width, spalling, pop-outs, honeycomb, rock pockets, and other objectionable conditions.
 4. Correct high areas in unformed surfaces by grinding, after concrete has cured at least 14 days.
 5. Correct low areas in unformed surfaces during or immediately after completion of surface finishing operations by cutting out low areas and replacing with fresh concrete. Finish repaired areas to blend into adjacent concrete. Proprietary patching compounds may be used when acceptable to Engineer.
 6. Repair defective areas, except random cracks and single holes not exceeding 1" diameter, by cutting out and replacing with fresh concrete. Remove defective areas to sound concrete with clean, square cuts and expose reinforcing steel with at least 3/4" clearance all around. Dampen concrete surfaces in contact with patching concrete and apply bonding compound. Mix patching concrete of same materials to provide concrete of same type or class as original concrete. Place, compact, and

finish to blend with adjacent finished concrete. Cure in same manner as adjacent concrete.

7. Repair isolated random cracks and single holes not over 1" in diameter by dry-pack method. Groove top of cracks and cut-out holes to sound concrete and clean of dust, dirt, and loose particles. Dampen cleaned concrete surfaces and apply bonding compound. Mix dry-pack, consisting of one part Portland cement to 2-1/2 parts fine aggregate passing a No. 16 mesh sieve, using only enough water as required for handling and placing. Place dry pack after bonding compound has dried. Compact dry-pack mixture in place and finish to match adjacent concrete. Keep patched area continuously moist for not less than 72 hours.
8. Perform structural repairs with prior approval of Engineer or Structural Engineer for method and procedure, using specified epoxy adhesive and mortar.
9. Repair methods not specified above may be used, subject to acceptance of Engineer.
10. Underlayment Application: Leveling of floors for subsequent finishes may be achieved by use of specified underlayment material.

3.17 THROUGH SECTION CONCRETE CRACK REPAIRS

A. Sealing through wall or slab cracks.

1. Seal cracks for a water-tight or structurally bonded repair with epoxy or chemical grouting procedures.
 - a. The Contractor shall make proper repairs with epoxy injection or chemical injection with a moisture reactive hydrophilic polyurethane foam grout, as directed by the Engineer.

ADDENDUM
EXAMPLE FORM A

CONCRETE SUPPLIER: _____

PROJECT: _____ CONTRACTOR: _____

MIXTURE ID: _____ SPECIFIED f_c : _____ PSI

MATERIAL MIXTURE PROPORTIONS lbs-mass/cu.yd. (pcy)

1.0 Cement Type _____ Source: _____

Sp. Gr. _____ pcy _____ cu. ft.

1.1 Other Cementitious Materials: _____ Class: _____ Source: _____

Sp. Gr. _____ pcy _____ cu. ft.

2.0 Aggregate (No. 1) Type: _____ Size: _____ Source: _____

SSD Sp. Gr. _____ pcy _____ cu. ft.

Dry Rodded Unit Wt.: _____ pcf

Alternate (No. 1) Lightweight Aggregate Type: _____ Size: _____ Source: _____

Sp. Gr. Factor _____ over dry pcy _____ cu. ft.

Loose Unit Wt. _____ pcf Estimated Wet _____ pcf

2.1 Aggregate (No. 2) Type: _____ Size: _____ Source: _____

SSD Sp. Gr. _____ pcy _____ cu. ft.

Dry Rodded Unit Wt.: _____ pcf (If Fine Sized - FM _____)

2.2 Aggregate (Nos. 3, 4, n) Type: _____ Size: _____ Source: _____

SSD Sp. Gr. _____ pcy _____ cu. ft.

Dry Rodded Unit Wt.: _____ pcf

3.0 Water: _____ gal. _____ pcy _____ cu. ft.

EXAMPLE FORM A (CONTINUED)

4.0 Admixtures expressed as fluid ounces/cubic yard, and estimated range

Source: _____ Name: _____ Type _____ oz

Source: _____ Name: _____ Type _____ oz

Source: _____ Name: _____ Type _____ oz

Total Admixture Liquid Vol. _____ cu. ft.

(*) Note: Show volume in 4.0 if not included in cubic feet of air or water.

5.0 Other Materials - fibers, color pigment or other additions

Sp. Gr. _____ pcy _____ cu. ft.

Total Mixture Mass and Volume: _____ pcy _____ cu. ft.

Fresh Concrete Properties

Coarse & Fine Aggregate Gradation

Percent Passing

Slump _____ +/- _____ in.	Sieve Size	Aggregate No.				
		1	2	3	4	Combined
Unit Weight _____ pcf	2 in.	_____	_____	_____	_____	_____
Air Content _____ +/- _____ %	1-1/2 in.	_____	_____	_____	_____	_____
	1 in.	_____	_____	_____	_____	_____
	3/4 in.	_____	_____	_____	_____	_____
	1/2 in.	_____	_____	_____	_____	_____
If Trail Batch Data -	3/8 in.	_____	_____	_____	_____	_____
Identify Batch No. _____	No. 4	_____	_____	_____	_____	_____
Batch Date _____	No. 8	_____	_____	_____	_____	_____
Concrete Temp. _____ °F	No. 16	_____	_____	_____	_____	_____
Comp. Strength-Average _____ °F	No. 30	_____	_____	_____	_____	_____

EXAMPLE FORM A (CONTINUED)

7 day avg. _____ psi

No. 50 _____

28 day avg. _____ psi

No. 100 _____

No. 200 _____

Comments: _____

Signature: _____ Date: _____

Title: _____

Organization: _____

EXAMPLE FORM B

CONCRETE SUPPLIER: _____

MATERIAL TRAIL BATCH NUMBER - proportions per cubic yard

1 2 3 4

1.0 Cement Source: _____

Type _____ lb lb lb lb

1.1 Other Cementitious Material Sources: _____

Type _____ lb lb lb lb

2.0 Aggregate No. 1 Size _____ Source: _____

SSD _____ lb lb lb lb

Alternate No. 1 Lightweight Aggregates Type _____ Source: _____

Sp. Gr. Factor _____

Oven Dry lb lb lb lb

Wet lb lb lb lb

2.1 Aggregate No. 2 Size _____ Source: _____

SSD _____ lb lb lb lb

2.2 Aggregate Nos. 3, 4, n) Size _____ Source: _____

SSD _____ lb lb lb lb

3.0 Water lb lb lb lb

4.0 Admixtures Source: _____

_____ Type _____ oz oz oz oz

_____ Type _____ oz oz oz oz

_____ Type _____ oz oz oz oz

EXAMPLE FORM B (CONTINUED)

5.0 Other Materials

_____ Type _____ lb _____ lb _____ lb _____ lb

Total Mass: _____ lb _____ lb _____ lb _____ lb

Total Mass/cy: _____ pcy _____ pcy _____ pcy _____ pcy

Relative Cubic Yard Volume: _____ cy _____ cy _____ cy _____ cy

Water-Cementitious Material Ratio:

Fresh Concrete Properties

TRAIL BATCH NUMBER

	<u>## -1</u>	<u>## -2</u>	<u>## -3</u>	<u>## -4</u>
Slump-inches	_____	_____	_____	_____
Air-Content %	_____	_____	_____	_____
Unit Wt. pcf	_____	_____	_____	_____
Concrete Temp. °F	_____	_____	_____	_____
Compressive Strength Results (ASTM C192, C39) or Other Specified Test Requirements				
7 days	_____	_____	_____	_____
	_____	_____	_____	_____
	_____	_____	_____	_____
Average (7 day)	_____	_____	_____	_____

EXAMPLE FORM B (CONTINUED)

28 days

_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Average (28 day)

_____	_____	_____	_____

Water-Cementitious Material Ratio:

_____	_____	_____	_____

Signature: _____ Date: _____

Title: _____

Organization: _____

END OF SECTION 030000

SECTION 055200 – ALUMINUM HANDRAILS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. The Contractor, under this section, shall provide and install all aluminum handrailing as shown on the Drawings or as directed. Unless otherwise shown on the Drawings, all handrailing shall be aluminum.
- B. It is the intent of this Contract that the final installation shall be complete in all respects, and the Contractor will be responsible for all minor details, whether or not shown on the Drawings or specifically included in these Specifications.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Submit manufacturer's certificates indicating the meeting of all OSHA requirements.
- B. The Contractor shall furnish for approval complete shop drawings showing all handrails and all connections/anchors to concrete or masonry.
 - 1. Design: Design of handrail members, connections, and anchorages shall be performed by a Professional Engineer, registered in the state of the project, experienced in similar design, retained by the manufacturer. Submit handrail engineering calculations, sealed by the engineer responsible for the design.
 - 2. Design Loads: non concurrent, 50 PLF or 200 pounds concentrated load to be applied along the top rail in any direction.
- C. Samples for Initial Selection: For products involving selection of color, texture, or design, including mechanical finishes.
- D. Samples for Verification: For each type of exposed finish required.
 - 1. Sections of each distinctly different linear railing type, including handrails, top rails, posts, and balusters.
 - 2. Fittings and brackets.

3. Assembled Sample of railing system, made from full-size components, including top rail, post, handrail, and infill. Sample need not be full height.
 - a. Show method of connecting members at intersections.

PART 2 - PRODUCTS

2.1 HANDRAILING

- A. Aluminum pipe rails and posts shall be 1-1/2 in. nominal diameter pipe made of alloy 6063-T6. Aluminum handrail shall be anodized. The color shall be selected by the Engineer. Railing components, fastenings, and complete structure shall meet all requirements of OSHA. All rails and posts shall be Schedule 40, unless noted otherwise..
- B. All handrails, unless otherwise shown on the Drawings, shall be as follows:
 1. All bottom mounted rails should be 3 ft.-6 in. high, measured from the floor to the top of the rail, with intermediate rail on the posts. Posts shall be placed at a maximum of 4 ft. and at each change in direction. Posts shall be attached to the top of the walkway or curb as shown on the Drawings. Posts into the walkway shall be provided with a floor flange to present a pleasing appearance.
 2. Bends, where called for, shall be shop formed and present pleasing appearance.
 3. The top surface of the top railing shall be smooth and shall not be interrupted by a projecting fitting.
 4. All openings in the railing shall be spanned with a 1/4 in. type 304 stainless steel chain with snap hook at one end and fixed to post at other end. Hooks and eyes shall be stainless steel.
 5. Toe plates conform to OSHA Standards. Toe plates shall not be pop-riveted to posts.
 6. Provide exterior railings that allow for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, overstressing of components, failure of connections, and other detrimental effects. Base engineering calculation on surface temperatures of materials due to both solar and heat gain and nighttime-sky heat loss.
 - a. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 PAINTING

- A. Direct contact between aluminum components and any dissimilar metals shall be prevented by painting the dissimilar metal with primer or asphalt paint.
- B. Direct contact between aluminum components and concrete or mortar shall be prevented by painting exposed aluminum surfaces with bituminous paint or water white methacrylate lacquer.

- C. Mechanical finishing shall be in accordance with NAAMM Finishes Manual. Electro-chemical, chemical, organic finishes on metal shall conform to industry standards.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. All work performed shall be in accordance with the manufacturer's recommendation for installation.
- B. All work shall be free from defects of any type which affect durability, strength, or appearance.
- C. Support brackets shall be securely anchored into the wall by anchor bolts or wedge type expansion bolts.
- D. Posts shall be set in approved floor flanges attached to the floor or curb by stainless steel concrete anchor bolts in new concrete or holes bored into existing concrete and secured in the new sockets or holes. The boring of holes in existing concrete shall be included in this Item.
- E. All erection shall meet OSHA requirements and the manufacturer's recommendations.
- F. Upon completion of railing installation all work shall be cleaned to make it acceptable for final inspection.
- G. For protection from temperature induced stresses an expansion joint and gap shall be provided in every top rail on a maximum of 24 feet. Top rails only shall have expansion joints between the fixed points. Use 1/8-inch gap between bottom rail and each fitting.

END OF SECTION 055200

SECTION 055213 - PIPE AND TUBE RAILINGS

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Steel railings.

1.2 ACTION SUBMITTALS

A. Product Data:

1. Manufacturer's product lines of mechanically connected railings.
2. Shop primer.
3. Intermediate coats and topcoats.
4. Bituminous paint.
5. Nonshrink, nonmetallic grout.
6. Anchoring cement.
7. Metal finishes.
8. Paint products.

B. Shop Drawings: Include plans, elevations, sections, details, and attachments to other work.

C. Delegated Design Submittal: For railings, including analysis data signed and sealed by the qualified professional engineer responsible for their preparation.

1.3 INFORMATIONAL SUBMITTALS

A. Qualification Data: For delegated design professional engineer.

B. Welding certificates.

C. Product Test Reports: For tests on railings performed by a qualified testing agency, in accordance with ASTM E894 and ASTM E935.

1.4 QUALITY ASSURANCE

A. Welding Qualifications: Qualify procedures and personnel in accordance with the following:

1. AWS D1.1/D1.1M, "Structural Welding Code - Steel."

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design railings, including attachment to building construction.
- B. Structural Performance: Railings, including attachment to building construction, withstand the effects of gravity loads and the following loads and stresses within limits and under conditions indicated:
 1. Handrails and Top Rails of Guards:
 - a. Uniform load of 50 lbf/ ft. applied in any direction.
 - b. Concentrated load of 200 lbf applied in any direction.
 - c. Uniform and concentrated loads need not be assumed to act concurrently.
 2. Infill of Guards:
 - a. Concentrated load of 50 lbf applied horizontally on an area of 1 sq. ft.
 - b. Infill load and other loads need not be assumed to act concurrently.

2.2 METALS, GENERAL

- A. Metal Surfaces, General: Provide materials with smooth surfaces, without seam marks, roller marks, rolled trade names, stains, discolorations, or blemishes.
- B. Brackets, Flanges, and Anchors: Cast or formed metal of same type of material and finish as supported rails unless otherwise indicated.
 1. Provide type of bracket with flange tapped for concealed anchorage to threaded hanger bolt and that provides 1-1/2-inch clearance from inside face of handrail to finished wall surface.

2.3 STEEL RAILINGS

- 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. Hollaender Mfg. Co.
 2. Kee Safety, Inc.
 3. TrueNorth Steel.
 4. Wagner Companies (The); R&B Wagner, Inc.

- B. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- C. Tubing: ASTM A500/A500M (cold formed) or ASTM A513/A513M, Type 5.
- D. Pipe: ASTM A53/A53M, Type F or Type S, Grade A, Standard Weight (Schedule 40), unless another grade and weight are required by structural loads.
 - 1. Provide galvanized finish for exterior installations and where indicated.
- E. Plates, Shapes, and Bars: ASTM A36/A36M.

2.4 FASTENERS

- A. Fastener Materials:
 - 1. Ungalvanized-Steel Railing Components: Plated steel fasteners complying with ASTM F1941/ASTM F1941M, Class Fe/Zn 5 for zinc coating.
 - 2. Hot-Dip Galvanized Railing Components: Type 304 stainless steel or hot-dip zinc-coated steel fasteners complying with ASTM A153/A153M or ASTM F2329/F2329M for zinc coating.
- B. Post-Installed Anchors: Fastener systems with working capacity greater than or equal to the design load, according to an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC193 or ICC-ES AC308.
 - 1. Material for Interior Locations: Carbon-steel components zinc-plated to comply with ASTM B633 or ASTM F1941/F1941M, Class Fe/Zn 5, unless otherwise indicated.
 - 2. Material for Exterior Locations and Where Stainless Steel Is Indicated: Alloy Group 2 stainless steel bolts, ASTM F593, and nuts, ASTM F594.

2.5 MISCELLANEOUS MATERIALS

- A. Welding Rods and Bare Electrodes: Select in accordance with AWS specifications for metal alloy welded.
- B. Etching Cleaner for Galvanized Metal: Complying with MPI#25.
- C. Galvanizing Repair Paint: High-zinc-dust-content paint, complying with SSPC-Paint 20 and compatible with paints specified to be used over it.
- D. Universal Shop Primer: Fast-curing, lead- and chromate-free, universal modified-alkyd primer complying with MPI#79 and compatible with topcoat.
 - 1. Use primer containing pigments that make it easily distinguishable from zinc-rich primer.

- E. Shop Primer for Galvanized Steel: Primer formulated for exterior use over zinc-coated metal and compatible with finish paint systems indicated.
- F. Epoxy Intermediate Coat: Complying with MPI #77 and compatible with primer and topcoat.
- G. Polyurethane Topcoat: Complying with MPI #72 and compatible with undercoat.
- H. Bituminous Paint: Cold-applied asphalt emulsion, complying with ASTM D1187/D1187M.
- I. Nonshrink, Nonmetallic Grout: Factory-packaged, nonstaining, noncorrosive, nongaseous grout, complying with ASTM C1107/C1107M. Provide grout specifically recommended by manufacturer for interior and exterior applications.
- J. Anchoring Cement: Factory-packaged, nonshrink, nonstaining, hydraulic-controlled expansion cement formulation for mixing with water at Project site to create pourable anchoring, patching, and grouting compound.
 - 1. Water-Resistant Product: At exterior locations and where indicated on Drawings, provide formulation that is resistant to erosion from water exposure without needing protection by a sealer or waterproof coating and that is recommended by manufacturer for exterior use.

2.6 FABRICATION

- A. Cut, drill, and punch metals cleanly and accurately.
 - 1. Remove burrs and ease edges to a radius of approximately 1/32 inch unless otherwise indicated.
 - 2. Remove sharp or rough areas on exposed surfaces.
- B. Form work true to line and level with accurate angles and surfaces.
- C. Welded Connections: Cope components at connections to provide close fit, or use fittings designed for this purpose. Weld all around at connections, including at fittings.
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove flux immediately.
 - 4. At exposed connections, finish exposed welds to comply with NOMMA's "Voluntary Joint Finish Standards" for Finish #3 welds; utilitarian appearance not subject to view, partially dressed weld with spatter removed.
- D. Nonwelded Connections: Connect members with concealed mechanical fasteners and fittings. Fabricate members and fittings to produce flush, smooth, rigid, hairline joints.

- E. Form changes in direction as follows:
 - 1. By bending or by inserting prefabricated elbow fittings.
- F. Bend members in jigs to produce uniform curvature for each configuration required. Maintain cross section of member throughout entire bend without buckling, twisting, cracking, or otherwise deforming exposed surfaces of components.
- G. Close exposed ends of hollow railing members with prefabricated cap and end fittings of same metal and finish as railings.
- H. Provide inserts and other anchorage devices for connecting railings to concrete or masonry work.
 - 1. Fabricate anchorage devices capable of withstanding loads imposed by railings.
 - 2. Coordinate anchorage devices with supporting structure.
- I. For railing posts set in concrete, provide stainless steel sleeves not less than 6 inches long with inside dimensions not less than 1/2 inch greater than outside dimensions of post, with metal plate forming bottom closure.
- J. Toe Boards: Where indicated, provide toe boards at railings around openings and at edge of open-sided floors and platforms. Fabricate to dimensions and details indicated.

2.7 STEEL AND IRON FINISHES

- A. Galvanized Railings:
 - 1. Hot-dip galvanize steel railings, including hardware, after fabrication.
 - 2. Comply with ASTM A123/A123M for hot-dip galvanized railings.
 - 3. Comply with ASTM A153/A153M for hot-dip galvanized hardware.
- B. For galvanized railings, provide hot-dip galvanized fittings, brackets, fasteners, sleeves, and other ferrous components.
- C. Preparing Galvanized Railings for Shop Priming: After galvanizing, thoroughly clean railings of grease, dirt, oil, flux, and other foreign matter, and treat with etching cleaner and as follows.
 - 1. Comply with SSPC-SP 16.
- D. For nongalvanized-steel railings, provide nongalvanized ferrous-metal fittings, brackets, fasteners, and sleeves; however, hot-dip galvanize anchors to be embedded in exterior concrete or masonry.
- E. Preparation for Shop Priming: Prepare uncoated ferrous-metal surfaces to comply with requirements indicated below:

1. Exterior Railings: SSPC-SP 6/NACE No. 3.
 2. Railings Indicated to Receive Zinc-Rich Primer: SSPC-SP 6/NACE No. 3.
 3. Railings Indicated to Receive Primers Specified in Section 099600 "High-Performance Coatings": SSPC-SP 6/NACE No. 3.
 4. Other Railings: SSPC-SP 3.
- F. Primer Application: Apply shop primer to prepared surfaces of railings unless otherwise indicated. Comply with requirements in SSPC-PA 1 for shop painting. Primer need not be applied to surfaces to be embedded in concrete or masonry.
1. Shop prime uncoated railings with universal shop primer unless zinc-rich primer is indicated.
 2. Do not apply primer to galvanized surfaces.
- G. Shop-Painted Finish: Comply with
1. Color: As indicated by manufacturer's designations.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Perform cutting, drilling, and fitting required for installing railings.
1. Fit exposed connections together to form tight, hairline joints.
 2. Install railings level, plumb, square, true to line; without distortion, warp, or rack.
 3. Set railings accurately in location, alignment, and elevation; measured from established lines and levels.
 4. Do not weld, cut, or abrade surfaces of railing components that are coated or finished after fabrication and that are intended for field connection by mechanical or other means without further cutting or fitting.
 5. Set posts plumb within a tolerance of 1/16 inch in 3 feet.
 6. Align rails so variations from level for horizontal members and variations from parallel with rake of steps and ramps for sloping members do not exceed 1/4 inch in 12 feet.
- B. Control of Corrosion: Prevent galvanic action and other forms of corrosion by insulating metals and other materials from direct contact with incompatible materials.

3.2 ATTACHING RAILINGS

- A. Attach handrails to walls with wall brackets, except where end flanges are used. Provide brackets with 1-1/2-inch clearance from inside face of handrail and finished wall surface.

B. Secure wall brackets and railing end flanges to building construction as follows:

1. For concrete and solid masonry anchorage, use drilled-in expansion shields and hanger or lag bolts.
2. For hollow masonry anchorage, use toggle bolts.

C. Touchup Painting:

1. Immediately after erection, clean field welds, bolted connections, and abraded areas of shop paint, and paint exposed areas with the same material used for shop painting to comply with SSPC-PA 1 for touching up shop-painted surfaces.

3.3 CLEANING

A. Galvanized Surfaces: Clean field welds, bolted connections, and abraded areas, and repair galvanizing to comply with ASTM A780/A780M.

END OF SECTION 055213

SECTION 055300 – ALUMINUM FLOOR GRATING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. This section includes the furnishing and the installing of all aluminum floor gratings as shown on the Drawings and necessary to complete the work of this contract. Gratings include all clips, spacers, frames, supports, fasteners, and other incidental materials needed for a complete installation.
- B. Floor grating and frames shall be as detailed on Drawings.

1.3 QUALITY ASSURANCE

- A. In addition to requirements of these specifications, comply with manufacturer's instructions and recommendations for work.

1.4 SUBMITTALS

- A. Samples of each type of floor gratings proposed shall be submitted for approval prior to placement of purchase orders.
- B. Manufacturer's catalog data showing:
 - 1. Dimensions, spacing, and construction of grating.
 - 2. Design tables showings limits for span length and deflection under various uniform and concentrated loads.
 - 3. Materials of construction.
- C. Detail shop drawings showing:
 - 1. Dimensions of each grating.
 - 2. Sectional assembly.
 - 3. Location and identification mark.
 - 4. Size and type of supporting frames required.

PART 2 - PRODUCTS

2.1 ALUMINUM FLOOR GRATING

- A. Material for aluminum floor gratings shall be aluminum alloy 6061-T6 and 6063-T5 for structural supports and frames in accordance with the latest ASTM Specification B221.
- B. Gratings shall be furnished with a standard mill finish.
- C. Aluminum bar gratings shall be designed for a live load of 300 lbs./sq. ft., except that when located in a roadway it shall be designed to carry a truck rear axle load of 24,000 lbs. Maximum deflection under 100 lbs./sq. ft. load shall not exceed 1/4-in. or 1/180th of the span, whichever is least. Gratings shall be 1-1/2 in. deep with spacer bars spaced not more than 4 in. unless otherwise shown, specified or required.
- D. Banding of the ends of bearing bars and around openings through the panels shall be provided by 1/4-in. aluminum bars of the same depth as the panels.
- E. Grating shall be fabricated from field dimensions taken after facilities requiring passage through the gratings are in place.
- F. Individual grating panels shall not exceed a total weight of 125 lbs. unless otherwise shown or specified.
- G. Grating frames shall conform to details on the Drawings. Frames shall be shop welded with full strength welds and all exposed welds ground flush.
- H. In a case where frames would be large and bending could occur, field jointing shall be allowed using mechanical joints. All frames shall be adequately braced and strapped to wood blocking during shipment and installation to prevent damage.

2.2 PAINTING

- A. Direct contact between aluminum components and any dissimilar metals shall be prevented by painting the dissimilar metal with primer or asphalt paint.
- B. Direct contact between aluminum components and concrete or mortar shall be prevented by painting aluminum contact surfaces with bituminous paint or water white methacrylate lacquer.
- C. Provide mill finish as fabricated in accordance with NAAMM Finishes Manual.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The gratings shall be installed in angle frames set in the floor or fastened thereto to support the gratings. The tops of the gratings shall be set flush with the surface of the floor in which it is installed. No panel shall rock when any part of it is stepped on.
- B. A maximum spacing of 1/4 in. shall be maintained between the grating and adjacent surfaces.
- C. Type 304 stainless steel fasteners shall be installed where indicated on the Drawings or required.

END OF SECTION 055300

SECTION 061000 - ROUGH CARPENTRY

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Wood products.
2. Wood-preservative-treated lumber.
3. Fire-retardant-treated lumber.
4. Dimension lumber framing.
5. Miscellaneous lumber.
6. Plywood backing panels.

B. Related Requirements:

1. Section 061600 "Sheathing" for sheathing, subflooring, and underlayment.

1.2 DEFINITIONS

- A. Boards or Strips: Lumber of less than 2 inches nominal size in least dimension.
- B. Dimension Lumber: Lumber of 2 inches nominal size or greater but less than 5 inches nominal size in least dimension.
- C. Exposed Framing: Framing not concealed by other construction.
- D. SBX: An inorganic boron used to prevent termites and fungal decay.
- E. Lumber grading agencies, and abbreviations used to reference them, include the following:
1. NeLMA: Northeastern Lumber Manufacturers' Association.
 2. NLGA: National Lumber Grades Authority.
 3. SPIB: The Southern Pine Inspection Bureau.

1.3 ACTION SUBMITTALS

A. Product Data: For each type of product. Indicate component materials and dimensions and include construction and application details.

1. Include data for wood-preservative treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Indicate type of preservative used and net amount of preservative retained.

2. Include data for fire-retardant treatment from chemical treatment manufacturer and certification by treating plant that treated materials comply with requirements. Include physical properties of treated materials based on testing by a qualified independent testing agency.
3. For fire-retardant treatments, include physical properties of treated lumber both before and after exposure to elevated temperatures, based on testing by a qualified independent testing agency in accordance with ASTM D5664.
4. For products receiving a waterborne treatment, include statement that moisture content of treated materials was reduced to levels specified before shipment to Project site.

1.4 INFORMATIONAL SUBMITTALS

A. Material Certificates:

1. For dimension lumber specified to comply with minimum allowable unit stresses. Indicate species and grade selected for each use and design values approved by the ALSC Board of Review.
2. For preservative-treated wood products. Indicate type of preservative used and net amount of preservative retained.

1.5 DELIVERY, STORAGE, AND HANDLING

- ##### A.
- Stack wood products flat with spacers beneath and between each bundle to provide air circulation. Protect wood products from weather by covering with waterproof sheeting, securely anchored. Provide for air circulation around stacks and under coverings.

PART 2 - PRODUCTS

2.1 WOOD PRODUCTS

- ##### A.
- Lumber: Comply with DOC PS 20 and applicable rules of grading agencies indicated. If no grading agency is indicated, comply with the applicable rules of any rules-writing agency certified by the ALSC Board of Review. Grade lumber by an agency certified by the ALSC Board of Review to inspect and grade lumber under the rules indicated.
1. Factory mark each piece of lumber with grade stamp of grading agency.
 2. Where nominal sizes are indicated, provide actual sizes required by DOC PS 20 for moisture content specified. Where actual sizes are indicated, they are minimum dressed sizes for dry wood products.
 3. Dress lumber, S4S, unless otherwise indicated.
- ##### B.
- Maximum Moisture Content:
1. Boards: 19 percent.
 2. Dimension Lumber: 19 percent unless otherwise indicated.

2.2 WOOD-PRESERVATIVE-TREATED LUMBER

- A. Wood-Preservative-Treated Lumber by Pressure Process: AWP A U1, use categories as follows:
 - 1. UC2, Interior/Damp: Interior construction protected from weather, but may be subject to sources of moisture. Include the following items:
 - a. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.
 - 2. UC3A, Above Ground, Protected (All Other Commodity Specifications): Wood products in exterior construction not in contact with ground, exposed to all weather cycles but either coated and installed in a manner that prevents prolonged wetting, or fully protected from liquid water by building design and construction. Include the following items:
 - a. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
 - b. Wood framing members that are less than 18 inches above the ground in crawlspaces or unexcavated areas.
- B. Kiln-dry lumber after treatment to a maximum moisture content of 19 percent. Do not use material that is warped or that does not comply with requirements for untreated material.
- C. Application: Treat all rough carpentry unless otherwise indicated.

2.3 FIRE-RETARDANT-TREATED LUMBER

- A. General: Where fire-retardant-treated materials are indicated, materials are to comply with requirements in this article, that are acceptable to authorities having jurisdiction, and with fire-test-response characteristics specified as determined by testing identical products per test method indicated by a qualified testing agency.
- B. Fire-Retardant-Treated Lumber and Plywood by Pressure Process: Products with a flame-spread index of 25 or less when tested in accordance with ASTM E84, and with no evidence of significant progressive combustion when the test is extended an additional 20 minutes, and with the flame front not extending more than 10.5 ft. beyond the centerline of the burners at any time during the test.
 - 1. Treatment is not to promote corrosion of metal fasteners.
 - 2. Exterior Type: Treated materials are to comply with requirements specified above for fire-retardant-treated lumber and plywood by pressure process after being subjected to accelerated weathering in accordance with ASTM D2898. Use for exterior locations and where indicated.
 - 3. Interior Type A: Treated materials are to have a moisture content of 28 percent or less when tested in accordance with ASTM D3201/D3201M at 92 percent relative humidity. Use where exterior type is not indicated.
 - 4. Design Value Adjustment Factors: Treated lumber is to be tested in accordance

with ASTM D5664 and design value adjustment factors are to be calculated in accordance with ASTM D6841.

- C. Kiln-dry lumber after treatment to maximum moisture content of 19 percent.
- D. Identify fire-retardant-treated wood with appropriate classification marking of qualified testing agency and other information required by authorities having jurisdiction.
 - 1. For exposed lumber indicated to receive a stained or natural finish, mark end or back of each piece.
- E. For exposed items indicated to receive a stained or natural finish, chemical formulations are not to bleed through, contain colorants, or otherwise adversely affect finishes.
- F. Application: Treat items indicated on Drawings, and the following:
 - 1. Concealed blocking.
 - 2. Wood cants, nailers, curbs, equipment support bases, blocking, and similar members in connection with roofing.
 - 3. Plywood backing panels.

2.4 MISCELLANEOUS LUMBER

- A. Provide miscellaneous lumber indicated and lumber for support or attachment of other construction, including the following:
 - 1. Blocking.
 - 2. Nailers.
 - 3. Rooftop equipment bases and support curbs.
 - 4. Cants.
 - 5. Furring.
 - 6. Grounds.
 - 7. Utility shelving.
- B. Dimension Lumber Items:
 - 1. Grade: Construction or No. 2.
 - 2. Species: Any of the following species:
 - a. Hem-fir (north); NLGA.
 - b. Mixed southern pine or southern pine; SPIB.
 - c. Spruce-pine-fir; NLGA.
 - d. Hem-fir; WCLIB or WWPA.
 - e. Spruce-pine-fir (south); NeLMA, WCLIB, or WWPA.
 - f. Northern species; NLGA.
 - g. Eastern softwoods; NeLMA.

C. Utility Shelving:

1. Lumber Moisture Content: 19 percent maximum.
2. Species and Grade:
 - a. Eastern white pine, Idaho white, lodgepole, ponderosa, or sugar pine; Standard or No. 3 Common grade; NeLMA or NLGA.
 - b. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - c. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA.
 - d. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA or NLGA.

D. Concealed Boards:

1. Lumber Moisture Content: 19 percent maximum.
2. Species and Grade: Any of the following:
 - a. Mixed southern pine or southern pine; No. 2 grade; SPIB.
 - b. Hem-fir or hem-fir (north); Construction or No. 2 Common grade; NLGA.
 - c. Spruce-pine-fir (south) or spruce-pine-fir; Construction or No. 2 Common grade; NeLMA or NLGA.
 - d. Eastern softwoods; No. 2 Common grade; NeLMA.
 - e. Northern species; No. 2 Common grade; NLGA.

E. Roofing Nailers: Structural- or No. 2-grade lumber or better; kiln-dried Douglas fir, southern pine, or wood having similar decay-resistant properties.

F. Wood Blocking: For blocking not used for attachment of other construction, Utility, Stud, or No. 3 grade lumber of any species may be used provided that it is cut and selected to eliminate defects that will interfere with its attachment and purpose.

G. Wood Furring: For furring strips for installing plywood or hardboard paneling, select boards with no knots capable of producing bent-over nails and damage to paneling.

2.5 PLYWOOD BACKING PANELS

A. Equipment Backing Panels: Plywood, DOC PS 1.

1. Grade: Exterior, A-C, fire-retardant treated.
2. Thickness: As indicated on the drawings or, if not indicated, not less than 3/4-inch nominal thickness.

2.6 FASTENERS

A. General: Fasteners are to be of size and type indicated and comply with requirements specified in this article for material and manufacture. Provide nails or screws, in sufficient length, to penetrate not less than 1-1/2 inches into wood substrate.

1. Where rough carpentry is exposed to weather, in ground contact, pressure-preservative treated, or in area of high relative humidity, provide fasteners of Type 304 stainless steel.

- B. Nails, Brads, and Staples: ASTM F1667.
- C. Power-Driven Fasteners: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC70.
- D. Post-Installed Anchors: Fastener systems with an evaluation report acceptable to authorities having jurisdiction, based on ICC-ES AC01, ICC-ES AC58, ICC-ES AC193, or ICC-ES AC308, as appropriate for the substrate.

2.7 ACCESSORIES

- A. Flexible Flashing: Composite, self-adhesive, flashing product consisting of a pliable compound, bonded to a high-density polyethylene film, aluminum foil, or spunbonded polyolefin to produce an overall thickness of not less than 0.025 inch.
 - 1. Compound Material: Butyl rubber or rubberized asphalt.
- B. Adhesives for Gluing Furring and Sleepers to Concrete or Masonry: Formulation complying with ASTM D3498 that is approved for use indicated by adhesive manufacturer.
- C. Water-Repellent Preservative: Formulation containing 3-iodo-2-propynyl butylcarbamate, combined with an insecticide containing chlorpyrifos as its active ingredient.

PART 3 - EXECUTION

3.1 INSTALLATION OF ROUGH CARPENTRY, GENERAL

- A. Framing Standard: Comply with AF&PA's WCD 1, "Details for Conventional Wood Frame Construction," unless otherwise indicated.
- B. Set work to required levels and lines, with members plumb, true to line, cut, and fitted. Fit rough carpentry accurately to other construction. Locate furring, nailers, blocking, grounds, and similar supports to comply with requirements for attaching other construction.
- C. Plywood Backing Panels: Install backing panels by fastening to studs; coordinate locations with utilities requiring backing panels. Install fire-retardant-treated plywood backing panels with classification marking of testing agency exposed to view.
- D. Metal Framing Anchors: Install anchors to comply with manufacturer's written instructions. Install fasteners through each fastener hole.
- E. Do not splice structural members between supports unless otherwise indicated.
- F. Provide blocking and framing as indicated and as required to support facing materials, fixtures, specialty items, and trim.

- G. Provide fire blocking in furred spaces, stud spaces, and other concealed cavities as indicated and as follows:
 - 1. Fire block furred spaces of walls, at ceiling, and at not more than 96 inches o.c. with solid wood blocking or noncombustible materials accurately fitted to close furred spaces.
- H. Sort and select lumber so that natural characteristics do not interfere with installation or with fastening other materials to lumber. Do not use materials with defects that interfere with function of member or pieces that are too small to use with minimum number of joints or optimum joint arrangement.
- I. Field Application of Preservative Treatment: Comply with AWPAC M4 for applying field treatment to cut surfaces of preservative-treated lumber.
 - 1. Use inorganic boron (SBX) for items that are continuously protected from liquid water.
 - 2. Use copper naphthenate for items not continuously protected from liquid water.
- J. Flexible Flashing: Where wood-preservative-treated lumber is installed adjacent to metal decking, install continuous flexible flashing separator between wood and metal decking.
- K. Securely attach rough carpentry work to substrate by anchoring and fastening as indicated, complying with the following:
 - 1. Table 2304.10.1, "Fastening Schedule," in ICC's "International Building Code" (IBC).
 - 2. ICC-ES evaluation report for fastener.
- L. Use steel common nails unless otherwise indicated. Select fasteners of size that will not fully penetrate members where opposite side will be exposed to view or will receive finish materials. Make tight connections between members. Install fasteners without splitting wood. Drive nails snug but do not countersink nail heads unless otherwise indicated.

3.2 INSTALLATION OF ROOFING NAILERS

- A. Install roofing nailers where indicated on Drawings and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Securely attach roofing nailers to substrates by anchoring and fastening to withstand bending, shear, or other stresses imparted by Project wind loads and fastener-resistance loads as designed in accordance with ASCE/SEI 7.
- C. Securely attach roofing nailers to substrate to resist the designed outward and upward wind loads indicated on Drawings and in accordance with SPRI ED-1, Tables A6 and A7.

3.3 INSTALLATION OF WOOD BLOCKING

- A. Install wood blocking where indicated on Drawings and where required for attaching other work. Form to shapes indicated and cut as required for true line and level of attached work. Coordinate locations with other work involved.
- B. Provide permanent grounds of dressed, pressure-preservative-treated, key-beveled lumber not less than 1-1/2 inches wide and of thickness required to bring face of ground to exact thickness of finish material. Remove temporary grounds when no longer required.

3.4 INSTALLATION OF WOOD FURRING

- A. Install wood furring level and plumb with closure strips at edges and openings. Shim with wood as required for tolerance of finish work.

3.5 PROTECTION

- A. Protect wood that has been treated with inorganic boron (SBX) from weather. If, despite protection, inorganic boron-treated wood becomes wet, apply EPA-registered borate treatment. Apply borate solution by spraying to comply with EPA-registered label.

END OF SECTION 061000

SECTION 079100 - PREFORMED JOINT SEALS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 079200 "Joint Sealants" for liquid sealants applied over preformed seals in dual-seal systems.

1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Preformed, foam joint seals.
2. Extruded-silicone joint seals.

- ##### B. Samples for Initial Selection: Manufacturer's color sheets, showing full range of available colors for each type of exposed preformed joint seal.

- ##### C. Samples for Verification: Actual samples of each type and color of exposed preformed joint seal.

1. Size: 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint seals.

- ##### D. Preformed Joint Seal Schedule: Include the following information:

1. Joint seal location and designation.
2. Joint width and movement capability.
3. Joint seal manufacturer and product name.
4. Joint seal color.

1.4 INFORMATIONAL SUBMITTALS

A. Test and Evaluation Reports:

1. Product Test Reports: For each preformed joint seal, for tests performed by manufacturer and witnessed by a qualified testing agency.

- ##### B. Sample warranties.

1.5 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace preformed joint seals that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish preformed joint seals to repair or replace those that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. For preformed joint seals, obtain each color, type, and variety of joint seal from single source with resources to provide products of consistent quality in appearance and physical properties.

2.2 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by preformed joint seal manufacturer for joint substrates indicated.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to preformed joint seal manufacturer, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces, and formulated to promote best adhesion to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with preformed joint seals and surfaces adjacent to joints.
- D. Sealant for Adhering Extruded-Silicone Joint Seals: Silicone adhesive sealant recommended by extruded-silicone joint seal manufacturer.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive preformed joint seals, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting preformed joint seal performance.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. **Surface Cleaning of Joints:** Clean out joints immediately before installing preformed joint seals to comply with preformed joint seal manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of preformed joint seal, including dust, paints (except for permanent protective coatings tested and approved for seal adhesion and compatibility by seal manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimal bond with preformed joint seals. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint seals. Nonporous joint substrates include the following:
 - a. Metal.
 - b. Glazed surfaces of ceramic tile.
- B. **Joint Priming:** Prime joint substrates where recommended by preformed joint seal manufacturer or as indicated by tests or prior experience. Apply primer to comply with joint seal manufacturer's written instructions. Confine primers to areas of joint seal bond; do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of adhesive or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 PROTECTION

- A. Protect preformed joint seals from damage resulting from construction operations or other causes so seals are without deterioration or damage at time of Substantial Completion.
- B. Cut out, remove, and repair damaged or deteriorated seals so repaired areas are indistinguishable from original work.

END OF SECTION 079100

SECTION 079200 - JOINT SEALANTS

PART 1 - GENERAL

1.1 SUMMARY

A. Related Requirements:

1. Section 079100 "Preformed Joint Seals" for preformed compressible foam and precured joint seals.

1.2 PREINSTALLATION MEETINGS

- ##### A. Preinstallation Conference: Conduct conference at Project site.

1.3 ACTION SUBMITTALS

A. Product Data:

1. Silicone joint sealants.
2. Nonstaining silicone joint sealants.
3. Urethane joint sealants.
4. Immersible joint sealants.
5. Silane-modified polymer joint sealants.
6. Mildew-resistant joint sealants.
7. Polysulfide joint sealants.
8. Butyl joint sealants.
9. Latex joint sealants.

- ##### B. Samples for Initial Selection: Manufacturer's standard color charts consisting of strips of cured sealants showing the full range of colors available for each product exposed to view.

- ##### C. Samples for Verification: For each type and color of joint sealant required, provide Samples with joint sealants in 1/2-inch- wide joints formed between two 6-inch- long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Joint-Sealant Schedule: Include the following information:

1. Joint-sealant application, joint location, and designation.
2. Joint-sealant manufacturer and product name.
3. Joint-sealant formulation.
4. Joint-sealant color.

1.4 INFORMATIONAL SUBMITTALS

- A. Preconstruction Laboratory Test Schedule: Include the following information for each joint sealant and substrate material to be tested:
 - 1. Joint-sealant location and designation.
 - 2. Manufacturer and product name.
 - 3. Type of substrate material.
 - 4. Proposed test.
 - 5. Number of samples required.
- B. Preconstruction Laboratory Test Reports: For each joint sealant and substrate material to be tested from sealant manufacturer, indicating the following:
 - 1. Materials forming joint substrates and joint-sealant backings have been tested for compatibility and adhesion with joint sealants.
 - 2. Interpretation of test results and written recommendations for primers and substrate preparation are needed for adhesion.
- C. Preconstruction Field-Adhesion-Test Reports: Indicate which sealants and joint preparation methods resulted in optimum adhesion to joint substrates based on testing specified in "Preconstruction Testing" Article.
- D. Field Quality-Control Reports: For field-adhesion-test reports, for each sealant application tested.
- E. Sample warranties.

1.5 CLOSEOUT SUBMITTALS

- A. Manufacturers' special warranties.
- B. Installer's special warranties.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: Authorized representative who is trained and approved by manufacturer.
- B. Testing Agency Qualifications: Qualified in accordance with ASTM C1021 to conduct the testing indicated.

1.7 PRECONSTRUCTION TESTING

- A. Preconstruction Laboratory Testing: Submit to joint-sealant manufacturers, for testing indicated below, samples of materials that will contact or affect joint sealants.
 - 1. Adhesion Testing: Use ASTM C794 to determine whether priming and other

specific joint preparation techniques are required to obtain rapid, optimum adhesion of joint sealants to joint substrates.

2. Compatibility Testing: Use ASTM C1087 to determine sealant compatibility when in contact with glazing and gasket materials.
3. Stain Testing: Use ASTM C1248 to determine stain potential of sealant when in contact with masonry substrates.
4. Submit manufacturer's recommended number of pieces of each type of material, including joint substrates, joint-sealant backings, and miscellaneous materials.
5. Schedule sufficient time for testing and analyzing results to prevent delaying the Work.
6. For materials failing tests, obtain joint-sealant manufacturer's written instructions for corrective measures, including use of specially formulated primers.
7. Testing will not be required if joint-sealant manufacturers submit data that are based on previous testing, not older than 24 months, of sealant products for adhesion to, staining of, and compatibility with joint substrates and other materials matching those submitted.

B. Preconstruction Field-Adhesion Testing: Before installing sealants, field test their adhesion to Project joint substrates as follows:

1. Locate test joints where indicated on Project or, if not indicated, as directed by Architect.
2. Conduct field tests for each kind of sealant and joint substrate.
3. Notify Architect seven days in advance of dates and times when test joints will be erected.
4. Arrange for tests to take place with joint-sealant manufacturer's technical representative present.
5. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - a. For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
6. Report whether sealant failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. For sealants that fail adhesively, retest until satisfactory adhesion is obtained.
7. Evaluation of Preconstruction Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing, in absence of other indications of noncompliance with requirements, will be considered satisfactory. Do not use sealants that fail to adhere to joint substrates during testing.

1.8 FIELD CONDITIONS

A. Do not proceed with installation of joint sealants under the following conditions:

1. When ambient and substrate temperature conditions are outside limits permitted by joint-sealant manufacturer or are below 40 deg F.
2. When joint substrates are wet.
3. Where joint widths are less than those allowed by joint-sealant manufacturer for applications indicated.
4. Where contaminants capable of interfering with adhesion have not yet been removed from joint substrates.

1.9 WARRANTY

- A. Special Installer's Warranty: Installer agrees to repair or replace joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Two years from date of Substantial Completion.
- B. Special Manufacturer's Warranty: Manufacturer agrees to furnish joint sealants to repair or replace those joint sealants that do not comply with performance and other requirements specified in this Section within specified warranty period.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Special warranties specified in this article exclude deterioration or failure of joint sealants from the following:
 1. Movement of the structure caused by stresses on the sealant exceeding sealant manufacturer's written specifications for sealant elongation and compression.
 2. Disintegration of joint substrates from causes exceeding design specifications.
 3. Mechanical damage caused by individuals, tools, or other outside agents.
 4. Changes in sealant appearance caused by accumulation of dirt or other atmospheric contaminants.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain joint sealants from single manufacturer for each sealant type.

2.2 JOINT SEALANTS, GENERAL

- A. Compatibility: Provide joint sealants, backings, and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by joint-sealant manufacturer, based on testing and field experience.
- B. Colors of Exposed Joint Sealants: As selected by A/E from manufacturer's full range.

2.3 NONSTAINING SILICONE JOINT SEALANTS

- A. Nonstaining Joint Sealants: No staining of substrates when tested in accordance with ASTM C1248.

2.4 MILDEW-RESISTANT JOINT SEALANTS

- A. Mildew-Resistant Joint Sealants: Formulated for prolonged exposure to humidity with fungicide to prevent mold and mildew growth.

2.5 JOINT-SEALANT BACKING

- A. Cylindrical Sealant Backings: ASTM C1330, or any type, as approved in writing by joint-sealant manufacturer for joint application indicated, and of size and density to control sealant depth and otherwise contribute to producing optimum sealant performance.
- B. Bond-Breaker Tape: Polyethylene tape or other plastic tape recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint-filler materials or joint surfaces at back of joint. Provide self-adhesive tape where applicable.

2.6 MISCELLANEOUS MATERIALS

- A. Primer: Material recommended by joint-sealant manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint-sealant-substrate tests and field tests.
- B. Cleaners for Nonporous Surfaces: Chemical cleaners acceptable to manufacturers of sealants and sealant backing materials, free of oily residues or other substances capable of staining or harming joint substrates and adjacent nonporous surfaces in any way, and formulated to promote optimum adhesion of sealants to joint substrates.
- C. Masking Tape: Nonstaining, nonabsorbent material compatible with joint sealants and surfaces adjacent to joints.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for joint configuration, installation tolerances, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. **Surface Cleaning of Joints:** Clean out joints immediately before installing joint sealants to comply with joint-sealant manufacturer's written instructions and the following requirements:
1. Remove all foreign material from joint substrates that could interfere with adhesion of joint sealant, including dust, paints (except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer), old joint sealants, oil, grease, waterproofing, water repellents, water, surface dirt, and frost.
 2. Clean porous joint substrate surfaces by brushing, grinding, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining after cleaning operations above by vacuuming or blowing out joints with oil-free compressed air. Porous joint substrates include the following:
 - a. Concrete.
 - b. Masonry.
 - c. Unglazed surfaces of ceramic tile.
 3. Remove laitance and form-release agents from concrete.
 4. Clean nonporous joint substrate surfaces with chemical cleaners or other means that do not stain, harm substrates, or leave residues capable of interfering with adhesion of joint sealants. Nonporous joint substrates include the following:
 - a. Metal.
- B. **Joint Priming:** Prime joint substrates where recommended by joint-sealant manufacturer or as indicated by preconstruction joint-sealant-substrate tests or prior experience. Apply primer to comply with joint-sealant manufacturer's written instructions. Confine primers to areas of joint-sealant bond; do not allow spillage or migration onto adjoining surfaces.
- C. **Masking Tape:** Use masking tape where required to prevent contact of sealant or primer with adjoining surfaces that otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.3 INSTALLATION OF JOINT SEALANTS

- A. **General:** Comply with joint-sealant manufacturer's written installation instructions for products and applications indicated, unless more stringent requirements apply.
- B. **Sealant Installation Standard:** Comply with recommendations in ASTM C1193 for use of joint sealants as applicable to materials, applications, and conditions indicated.
- C. **Install sealant backings** of type indicated to support sealants during application and at position required to produce cross-sectional shapes and depths of installed sealants relative to joint widths that allow optimum sealant movement capability.
1. Do not leave gaps between ends of sealant backings.

2. Do not stretch, twist, puncture, or tear sealant backings.
 3. Remove absorbent sealant backings that have become wet before sealant application, and replace them with dry materials.
- D. Install bond-breaker tape behind sealants where sealant backings are not used between sealants and backs of joints.
- E. Install sealants using proven techniques that comply with the following and at the same time backings are installed:
1. Place sealants so they directly contact and fully wet joint substrates.
 2. Completely fill recesses in each joint configuration.
 3. Produce uniform, cross-sectional shapes and depths relative to joint widths that allow optimum sealant movement capability.
- F. Tooling of Nonsag Sealants: Immediately after sealant application and before skinning or curing begins, tool sealants in accordance with requirements specified in subparagraphs below to form smooth, uniform beads of configuration indicated; to eliminate air pockets; and to ensure contact and adhesion of sealant with sides of joint.
1. Remove excess sealant from surfaces adjacent to joints.
 2. Use tooling agents that are approved in writing by sealant manufacturer and that do not discolor sealants or adjacent surfaces.
 3. Provide concave joint profile in accordance with Figure 8A in ASTM C1193 unless otherwise indicated.

3.4 FIELD QUALITY CONTROL

- A. Testing Agency: Engage a qualified testing agency to perform tests and inspections.
- B. Tests and Inspections:
1. Field-Adhesion Testing: Field test joint-sealant adhesion to joint substrates as follows:
 - a. Extent of Testing: Test completed and cured sealant joints as follows:
 - 1) Perform 10 tests for the first 1000 ft. of joint length for each kind of sealant and joint substrate.
 - 2) Perform one test for each 1000 ft. of joint length thereafter or one test per each floor per elevation.
 - b. Test Method: Test joint sealants in accordance with Method A, Tail Procedure, in ASTM C1521.
 - 1) For joints with dissimilar substrates, verify adhesion to each substrate separately; extend cut along one side, verifying adhesion to opposite side. Repeat procedure for opposite side.
 - c. Inspect tested joints and report on the following:
 - 1) Whether sealants filled joint cavities and are free of voids.
 - 2) Whether sealant dimensions and configurations comply with specified requirements.

- 3) Whether sealants in joints connected to pulled-out portion failed to adhere to joint substrates or tore cohesively. Include data on pull distance used to test each kind of product and joint substrate. Compare these results to determine if adhesion complies with sealant manufacturer's field-adhesion hand-pull test criteria.
 - d. Record test results in a field-adhesion-test log. Include dates when sealants were installed, names of persons who installed sealants, test dates, test locations, whether joints were primed, adhesion results and percent elongations, sealant material, sealant configuration, and sealant dimensions.
 - e. Repair sealants pulled from test area by applying new sealants following same procedures used originally to seal joints. Ensure that original sealant surfaces are clean and that new sealant contacts original sealant.
 - 2. Evaluation of Field-Adhesion-Test Results: Sealants not evidencing adhesive failure from testing or noncompliance with other indicated requirements will be considered satisfactory. Remove sealants that fail to adhere to joint substrates during testing or to comply with other requirements. Retest failed applications until test results prove sealants comply with indicated requirements.
- C. Prepare test and inspection reports.

3.5 CLEANING

- A. Clean off excess sealant or sealant smears adjacent to joints as the Work progresses by methods and with cleaning materials approved in writing by manufacturers of joint sealants and of products in which joints occur.

3.6 PROTECTION

- A. Protect joint sealants during and after curing period from contact with contaminating substances and from damage resulting from construction operations or other causes so sealants are without deterioration or damage at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out, remove, and repair damaged or deteriorated joint sealants immediately so installations with repaired areas are indistinguishable from original work.

END OF SECTION 079200

SECTION 08 11 13 - HOLLOW METAL DOORS AND FRAMES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Borrowed lite frames.
- B. Related Requirements:
 - 1. Section 087100 "Door Hardware" for door hardware for hollow metal doors.

1.2 COORDINATION

- A. Coordinate installing anchors for hollow metal frames, including sleeves, concrete inserts, and anchor bolts.
- B. Coordinate requirements for installing door hardware, including electrified door hardware, and access control and security systems.

1.3 DEFINITIONS

- A. Minimum Steel Sheet Thickness: Minimum thickness of base metal without coatings in accordance with ANSI/SDI A250.8.

1.4 PREINSTALLATION MEETINGS

- A. Preinstallation Conference: Conduct conference at Project site.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, core descriptions, and finishes.
 - 2. Include information indicating compliance with performance requirements indicated.
- B. Shop Drawings:
 - 1. Elevations of each door type.
 - 2. Details of doors, including vertical- and horizontal-edge details and base-metal thicknesses.
 - 3. Frame details for each frame type, including dimensioned profiles and base-metal thicknesses.
 - 4. Locations of reinforcement and preparations for hardware.

5. Details of each wall opening condition.
 6. Details of electrical raceway and preparation for electrified hardware, access control systems, and security systems.
 7. Details of frame anchors, joints, field splices, and connections.
 8. Details of accessories.
 9. Details of moldings, removable stops, and glazing.
- C. Samples for Initial Selection: Manufacturer's standard color sheets, showing full range of available colors for doors and frames with factory-applied color finishes.
- D. Product Schedule: For hollow metal doors and frames, prepared by or under the supervision of supplier, using same reference numbers for details and openings used on the Drawings and in schedules. Coordinate with final door hardware schedule.
- E. Sustainable Design Submittals:
1. Third-Party Certifications: For each product.
 2. Third-Party-Certified Life-Cycle Assessment: For each product.

1.6 INFORMATIONAL SUBMITTALS

- A. Field Quality-Control Reports: For hollow metal doors and frames.
- B. Qualification Statements: For field testing and inspecting agency.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver hollow metal doors and frames palletized, packaged, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic, canvas, or other material that can entrap moisture.
 1. Provide additional protection to prevent damage to factory-applied color finishes.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store hollow metal doors and frames vertically under cover at Project site with head up. Place on minimum 4-inch- high wood blocking. Provide minimum 1/4-inch space between each stacked door to permit air circulation.
- D. Immediately remove and replace damaged or wet packaging or protective material.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain hollow metal doors and frames from single manufacturer.

2.2 ACCESSORIES

- A. Door Vision Lite Frames: Steel sheet matching door face material; minimum 0.032-inch base-metal thickness.
 - 1. Profile: Flush type, with beveled stops.
 - 2. Corner Construction: Mitered and welded.
 - 3. Fasteners: Countersunk.
 - 4. Fixed-Stop Location: Secure (key) side of door.
 - 5. Fire-Rated Doors: Comply with requirements in NFPA 80.
- B. Hollow Metal Infill Panels: Match materials, construction, and finish of adjacent door.
- C. Frame Anchors: ANSI/SDI 250.4; steel sheet; minimum base-metal thickness required by door and frame standard indicated.
 - 1. Interior Locations: ASTM A1008/A1008M or ASTM A1011/A1011M; hot-dip galvanized in accordance with ASTM A153/A153M, Class B.
 - 2. Exterior-Wall Anchors: ASTM A653/653M, A60 metallic coating.
 - 3. Jamb Anchors: Of minimum size and type required by door and frame standard indicated, and suitable for performance level indicated.
 - a. Quantity: Minimum of three anchors per jamb, with one additional anchor for frames with no floor anchor. Provide one additional anchor for each 24 inches of frame height above 7 ft..
 - b. Postinstalled Expansion Anchor: Minimum 3/8-inch- diameter bolts with expansion shields or inserts, with manufacturer's standard pipe spacer.
 - 4. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor.
 - 5. Floor Anchors for Concrete Slabs with Underlayment: Adjustable-type anchors with extension clips that allow 2-inch height adjustment. Terminate bottom of frames at top of underlayment.

2.3 MATERIALS

- A. Recycled Content of Steel Products: Postconsumer recycled content plus one-half of preconsumer recycled content not less than 25 percent.
- B. Cold-Rolled Steel Sheet: ASTM A1008/A1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- C. Hot-Rolled Steel Sheet: ASTM A1011/A1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- D. Metallic-Coated Steel Sheet: ASTM A653/A653M, Commercial Steel (CS), Type B.
- E. Inserts, Bolts, and Fasteners: Hot-dip galvanized in accordance with ASTM A153/A153M.

- F. Power-Actuated Fasteners in Concrete: Fastener system of type suitable for application indicated, fabricated from corrosion-resistant materials, with clips or other accessory devices for attaching hollow metal frames of type indicated.
- G. Mineral-Fiber Insulation: ASTM C665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E136 for combustion characteristics.

2.4 FABRICATION

- A. Door Astragals: Provide overlapping astragal on one leaf of pairs of doors where required by NFPA 80 for fire-performance rating indicated. Extend minimum 3/4 inch beyond edge of door on which astragal is mounted or as required to comply with published listing of qualified testing agency.
- B. Hollow Metal Frames:
 - 1. Welded Frames: Fabricate in one piece except where handling and shipping limitations require multiple sections. Where frames are fabricated in sections, provide alignment plates or angles, at each joint, fabricated from metal of same or greater thickness as frames.
 - 2. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners unless otherwise indicated.
 - 3. Door Silencers: Except on weather-stripped frames, drill stops to receive door silencers. Keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
- C. Hardware Preparation: Factory prepare hollow metal doors and frames to receive templated mortised hardware, and electrical wiring; include cutouts, reinforcement, mortising, drilling, and tapping in accordance with ANSI/SDI A250.6, the door hardware required, and templates.
 - 1. Reinforce doors and frames to receive non-templated, mortised, and surface-mounted door hardware.
 - 2. Comply with ANSI/SDI A250.14 for preparing hollow metal doors and frames for hardware.
- D. Door Vision Lite Frames:
 - 1. Multiple Glazed Lites: Provide fixed and removable stops and moldings so that each glazed lite is capable of being removed independently.
 - 2. Rabbets: Coordinate width between fixed and removable stops with glazing and installation types indicated.
 - 3. Fastener Spacing: Not more than 9 inches o.c. and not more than 2 inches from each corner.

2.5 STEEL FINISHES

- A. Prime Finish: Clean, pretreat, and apply manufacturer's standard primer.
 - 1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI/SDI A250.10; recommended by primer manufacturer for substrate; compatible with substrate and field-applied coatings despite prolonged exposure.
- B. Factory Finish: Clean, pretreat, and apply manufacturer's standard two-coat, baked-on finish consisting of prime coat and thermosetting topcoat, complying with ANSI/SDI A250.3.
 - 1. Color and Gloss: As selected by A/E from manufacturer's full range.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions, with Installer present, for compliance with requirements and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory. Restore exposed finish by grinding, filling, and dressing, as required to make repaired area smooth, flush, and invisible on exposed faces. Touch up factory-applied finishes where spreaders are removed.
- B. Drill and tap doors and frames to receive non-templated, mortised, and surface-mounted door hardware.

3.3 INSTALLATION OF BORROWED LITE FRAMES

- A. Install in accordance with ANSI/SDI A250.8 and ANSI/SDI A250.11.
- B. Mineral-Fiber Insulation: Solidly pack mineral-fiber insulation inside frames.
- C. Glazing: Comply with installation requirements in Section 088000 "Glazing" and with hollow metal door and frame manufacturer's written instructions.

3.4 FIELD QUALITY CONTROL

- A. Inspection Agency: Engage a qualified inspector to perform tests and inspections and to furnish reports to Architect.

- B. Fire-Rated Door Acceptance Testing: Test and inspect fire-rated doors in accordance with NFPA 80.
- C. Smoke- and Draft-Control Door Acceptance Testing: Test and inspect smoke- and draft-control door assemblies in accordance with NFPA 105.
- D. Egress-Door Acceptance Testing: Test and inspect egress doors in accordance with NFPA 101.
- E. Repair or remove and replace installations where testing and inspections indicate noncompliance with specified requirements.
- F. Reinspect repaired or replaced installations to determine if replaced or repaired door assembly installations comply with specified requirements.
- G. Inspection Report: Prepared and submitted in writing to Architect and Contractor within 24 hours after testing.

3.5 ADJUSTING

- A. Remove and replace defective work, including frames that are warped, bowed, or otherwise defective.
- B. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat and apply touchup of compatible air-drying, rust-inhibitive primer.
- C. Metallic-Coated Surface Touchup: Clean abraded areas and repair with galvanizing repair paint in accordance with manufacturer's written instructions.
- D. Factory-Applied Color Finish Touchup: Clean abraded areas and repair with same material used for factory finish in accordance with manufacturer's written instructions.

END OF SECTION 081113

SECTION 087100 - DOOR HARDWARE

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.2 SUMMARY

- A. Section Includes:

1. Hinges.
2. Lock and latch sets.
3. Bolts.
4. Exit devices and auxiliary items.
5. Operating trim.
6. Astragals.
7. Closers.
8. Wall- and floor-mounted stops.
9. Door gasketing.
10. Thresholds.
11. Auxiliary door hardware.

- B. Related Requirements:

1. Section 081113 "Hollow Metal Doors and Frames".
2. Section 083323 "Overhead Coiling Doors" for door hardware provided as part of overhead coiling door assemblies.

1.3 COORDINATION

- A. Installation Templates: Distribute for doors, frames, and other work specified to be factory prepared. Check Shop Drawings of other work to confirm that adequate provisions are made for locating and installing door hardware to comply with indicated requirements.
- B. Security: Coordinate installation of door hardware, keying, and access control with Owner.
- C. Electrical System Roughing-In: Coordinate layout and installation of electrified door hardware with connections to power supplies and building safety and security systems.

- D. Existing Openings: Where hardware components are scheduled for application to existing construction or where modifications to existing door hardware are required, field-verify existing conditions and coordinate installation of door hardware to suit opening conditions and to provide proper door operation.

1.4 ACTION SUBMITTALS

- A. Product Data Submittals: Manufacturers' technical product data for each item of door hardware, installation instructions, maintenance of operating parts and finish, and other information necessary to show compliance with requirements.
- B. Door Hardware Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant. Coordinate door hardware schedule with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of door hardware.
 - 1. Submittal Sequence: Submit door hardware schedule concurrent with submissions of product data, Samples, and Shop Drawings. Coordinate submission of door hardware schedule with scheduling requirements of other work to facilitate the fabrication of other work that is critical in Project construction schedule.
 - 2. Format: Use same scheduling sequence and format and use same door numbers as in door hardware schedule in the Contract Documents.
 - 3. Content: Include the following information:
 - a. Identification number, location, hand, fire rating, size, and material of each door and frame.
 - b. Locations of each door hardware set, cross-referenced to Drawings on floor plans and to door and frame schedule.
 - c. Complete designations, including name and manufacturer, type, style, function, size, quantity, function, and finish of each door hardware product.
 - d. Fastenings and other installation information.
 - e. Explanation of abbreviations, symbols, and designations contained in door hardware schedule.
 - f. Mounting locations for door hardware.
 - g. List of related door devices specified in other Sections for each door and frame.
- C. Keying Schedule: Prepared by or under the supervision of Installer's Architectural Hardware Consultant, detailing Owner's final keying instructions for locks. Include schematic keying diagram and index each key set to unique door designations that are coordinated with the Contract Documents.

1.5 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and Architectural Hardware Consultant.
- B. Sample Warranty: For special warranty.

1.6 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For each type of door hardware to include in maintenance manuals.
- B. Schedules: Final door hardware and keying schedule.

1.7 MAINTENANCE MATERIAL SUBMITTALS

- A. 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.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Supplier of products and an employer of workers trained and approved by product manufacturers and of an Architectural Hardware Consultant who is available during the course of the Work to consult Contractor, Architect, and Owner about door hardware and keying.
 - 1. Warehousing Facilities: In Project's vicinity.
 - 2. Scheduling Responsibility: Preparation of door hardware and keying schedule.
- B. Architectural Hardware Consultant Qualifications: A person who is experienced in providing consulting services for door hardware installations that are comparable in material, design, and extent to that indicated for this Project and who is currently certified by DHI as an Architectural Hardware Consultant (AHC).

1.9 DELIVERY, STORAGE, AND HANDLING

- A. Inventory door hardware on receipt and provide secure lockup for door hardware delivered to Project site.
- B. Tag each item or package separately with identification coordinated with the final door hardware schedule, and include installation instructions, templates, and necessary fasteners with each item or package.
- C. Deliver keys to manufacturer of key control system for subsequent delivery to Owner.

1.10 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of door hardware that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Structural failures, including excessive deflection, cracking, or breakage.
 - b. Faulty operation of doors and door hardware.
 - c. Deterioration of metals, metal finishes, and other materials beyond normal weathering and use.

PART 2 - PRODUCTS

2.1 SOURCE LIMITATIONS

- A. Obtain each type of door hardware from single manufacturer.

2.2 PERFORMANCE REQUIREMENTS

- A. Fire-Rated Door Assemblies: Where fire-rated doors are indicated, provide door hardware complying with NFPA 80 that is listed and labeled by a qualified testing agency, for fire-protection ratings indicated, based on testing at positive pressure in accordance with NFPA 252 or UL 10C.
- B. Means of Egress Doors: Latches do not require more than 15 lbf to release the latch. Locks do not require use of a key, tool, or special knowledge for operation.
- C. Accessibility Requirements: For door hardware on doors in an accessible route, comply with ICC A117.1.
 - 1. Provide operating devices that do not require tight grasping, pinching, or twisting of the wrist and that operate with a force of not more than 5 lbf.
 - 2. Comply with the following maximum opening-force requirements:
 - a. Interior, Non-Fire-Rated Hinged Doors: 5 lbf applied perpendicular to door.
 - b. Fire Doors: Minimum opening force allowable by authorities having jurisdiction.
 - 3. Bevel raised thresholds with a slope of not more than 1:2. Provide thresholds not more than 1/2 inch high.
 - 4. Adjust door closer sweep periods so that, from an open position of 90 degrees, the door will take at least 5 seconds to move to a position of 12 degrees from the latch.

2.3 HINGES

- A. Hinges: ANSI/BHMA A156.1. Provide template-produced hinges for hinges installed on hollow-metal doors and hollow-metal frames.
 - 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. Bommer Industries, Inc
 - b. Cal-Royal Products, Inc
 - c. Hager Companies.
 - d. Lawrence Hardware Inc.
 - e. McKinney Products Company.
 - f. STANLEY; dormakaba USA, Inc.

2.4 MECHANICAL LOCKS AND LATCHES

- A. Lock Functions: As indicated in door hardware schedule.
- B. Lock Throw: Comply with testing requirements for length of bolts required for labeled fire doors, and as follows:
 - 1. Bored Locks: Minimum 1/2-inch latchbolt throw.
 - 2. Mortise Locks: Minimum 3/4-inch latchbolt throw.
 - 3. Deadbolts: Minimum 1-inch bolt throw.
- C. Lock Backset: 2-3/4 inches unless otherwise indicated.
- D. Strikes: Provide manufacturer's standard strike for each lock bolt or latchbolt complying with requirements indicated for applicable lock or latch and with strike box and curved lip extended to protect frame; finished to match lock or latch.
 - 1. Flat-Lip Strikes: For locks with three-piece antifriction latchbolts, as recommended by manufacturer.
- E. Mortise Locks: ANSI/BHMA A156.13, Operational Grade 2; stamped steel case with steel or brass parts; Series 1000.
 - 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. Adams Rite Manufacturing Company.
 - b. Arrow USA.
 - c. BEST Access Solutions, Inc.
 - d. Corbin Russwin, Inc.
 - e. Hager Companies.
 - f. Lawrence Hardware Inc.
 - g. SARGENT Manufacturing Company.
 - h. STANLEY.
 - i. Yale Security Inc.

2.5 LOCK CYLINDERS

- A. Standard Lock Cylinders: ANSI/BHMA A156.5, Grade 1 permanent cores; face finished to match lockset.
 - 1. Core Type: Removable.
- B. Construction Cores: Provide construction cores that are replaceable by permanent cores. Provide 10 construction master keys.

2.6 KEYING

- A. Keying System: Factory registered, complying with guidelines in ANSI/BHMA A156.28, appendix. Provide one extra key blank for each lock.

1. Existing System:
 - a. Master key or grand master key locks to Owner's existing system.
- B. Keys: Nickel silver.
 1. Stamping: Permanently inscribe each key with a visual key control number and include the following notation:
 - a. Notation: Information to be furnished by Owner.

2.7 OPERATING TRIM

- A. Operating Trim: ANSI/BHMA A156.6; stainless steel unless otherwise indicated.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Burns Manufacturing Incorporated.
 - b. Hager Companies.
 - c. Rockwood Manufacturing Company.
 - d. Trimco.

2.8 ACCESSORIES FOR PAIRS OF DOORS

- A. Coordinators: ANSI/BHMA A156.3; consisting of active-leaf, hold-open lever, and inactive-leaf release trigger; fabricated from steel with nylon-coated strike plates; with built-in, adjustable safety release.
- B. Carry-Open Bars: ANSI/BHMA A156.3; prevent the inactive leaf from opening before the active leaf; provide polished brass or bronze carry-open bars with strike plate for inactive leaves of pairs of doors unless automatic or self-latching bolts are used.
- C. Astragals: ANSI/BHMA A156.22.

2.9 SURFACE CLOSERS

- A. Surface Closers: ANSI/BHMA A156.4; rack-and-pinion hydraulic type with adjustable sweep and latch speeds controlled by key-operated valves and forged-steel main arm. Comply with manufacturer's written instructions for size of door closers depending on size of door, exposure to weather, and anticipated frequency of use. Provide factory-sized closers, adjustable to meet field conditions and requirements for opening force.
 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. Arrow USA.
 - b. Corbin Russwin, Inc.
 - c. dormakaba USA Inc.
 - d. Hager Companies.
 - e. Norton Door Controls.
 - f. Rixson Specialty Door Controls.

- g. SARGENT Manufacturing Company.
- h. STANLEY.
- i. Yale Security Inc.

2.10 MECHANICAL STOPS AND HOLDERS

A. Wall- and Floor-Mounted Stops: ANSI/BHMA A156.16.

- 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. Architectural Builders Hardware Mfg., Inc.
 - b. ASI-American Specialties, Inc.
 - c. Baldwin.
 - d. Burns Manufacturing Incorporated.
 - e. Hager Companies.
 - f. Rockwood Manufacturing Company.

2.11 DOOR GASKETING

A. Door Gasketing: ANSI/BHMA A156.22; with resilient or flexible seal strips that are easily replaceable and readily available from stocks maintained by manufacturer.

- 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. Hager Companies.
 - b. Legacy Manufacturing.
 - c. National Guard Products, Inc.
 - d. Pemko Manufacturing Company Inc.
 - e. Reese Enterprises, Inc.
 - f. Sealeze.
 - g. Zero International.

B. Maximum Air Leakage: When tested in accordance with ASTM E283/E283M with tested pressure differential of 0.3 inch wg, as follows:

- 1. Gasketing on Single Doors: 0.3 cfm/sq. ft. of door opening.
- 2. Gasketing on Double Doors: 0.50 cfm per ft. of door opening.

2.12 THRESHOLDS

A. Thresholds: ANSI/BHMA A156.21; fabricated to full width of opening indicated.

- 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Hager Companies.
 - b. Legacy Manufacturing.
 - c. M-D Building Products, Inc.

- d. National Guard Products, Inc.
- e. Pemko Manufacturing Company Inc.
- f. Reese Enterprises, Inc.
- g. Rixson Specialty Door Controls.
- h. Sealeze.
- i. Zero International.

2.13 FABRICATION

- A. Base Metals: Produce door hardware units of base metal indicated, fabricated by forming method indicated, using manufacturer's standard metal alloy, composition, temper, and hardness. Furnish metals of a quality equal to or greater than that of specified door hardware units and ANSI/BHMA A156.18.
- B. Fasteners: Provide door hardware manufactured to comply with published templates prepared for machine, wood, and sheet metal screws. Provide screws that comply with commercially recognized industry standards for application intended; however, aluminum fasteners are not permitted. Provide Phillips flat-head screws with finished heads to match surface of door hardware unless otherwise indicated.
 - 1. Fire-Rated Applications:
 - a. Machine Screws: For the following:
 - 1) Hinges mortised to doors or frames.
 - 2) Strike plates to frames.
 - 3) Closers to doors and frames.
 - b. Steel Through Bolts: For the following unless door blocking is provided:
 - 1) Surface hinges to doors.
 - 2) Closers to doors and frames.
 - 3) Surface-mounted exit devices.
 - 2. Spacers or Sex Bolts: For through bolting of hollow-metal doors.
 - 3. Gasketing Fasteners: Provide noncorrosive fasteners for exterior applications and elsewhere as indicated.

2.14 FINISHES

- A. Provide finishes complying with ANSI/BHMA A156.18 as indicated in door hardware schedule.
- B. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- C. Appearance of Finished Work: Variations in appearance of abutting or adjacent pieces are acceptable if they are within one-half of the range of approved Samples. Noticeable variations in the same piece are not acceptable. Variations in appearance of other components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine doors and frames, with Installer present, for compliance with requirements for installation tolerances, labeled fire-rated door assembly construction, wall and floor construction, and other conditions affecting performance of the Work.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Steel Doors and Frames: For surface-applied door hardware, drill and tap doors and frames in accordance with ANSI/SDI A250.6.
- B. Wood Doors: Comply with door and hardware manufacturers' written instructions.

3.3 INSTALLATION

- A. Mounting Heights: Mount door hardware units at heights to comply with the following unless otherwise indicated or required to comply with governing regulations.
 - 1. Standard Steel Doors and Frames: ANSI/SDI A250.8.
 - 2. Custom Steel Doors and Frames: HMMA 831.
 - 3. Wood Doors: DHI's "Recommended Locations for Architectural Hardware for Wood Flush Doors."
- B. Install each door hardware item to comply with manufacturer's written instructions. Where cutting and fitting are required to install door hardware onto or into surfaces that are later to be painted or finished in another way, coordinate removal, storage, and reinstallation of surface protective trim units with finishing work. Do not install surface-mounted items until finishes have been completed on substrates involved.
 - 1. Set units level, plumb, and true to line and location. Adjust and reinforce attachment substrates as necessary for proper installation and operation.
 - 2. Drill and countersink units that are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- C. Hinges: Install types and in quantities indicated in door hardware schedule, but not fewer than the number recommended by manufacturer for application indicated or one hinge for every 30 inches of door height, whichever is more stringent, unless other equivalent means of support for door, such as spring hinges or pivots, are provided.
- D. Intermediate Offset Pivots: Where offset pivots are indicated, provide intermediate offset pivots in quantities indicated in door hardware schedule, but not fewer than one intermediate offset pivot per door and one additional intermediate offset pivot for every 30 inches of door height greater than 90 inches.
- E. Lock Cylinders: Install construction cores to secure building and areas during

construction period.

1. Furnish permanent cores to Owner for installation.

F. Key Control System:

1. Key Control Cabinet: Tag keys and place them on markers and hooks in key control system cabinet, as determined by final keying schedule.
2. Key Lock Boxes: Install where indicated or approved by Architect to provide controlled access for fire and medical emergency personnel.

G. Thresholds: Set thresholds for exterior doors and other doors indicated in full bed of sealant complying with requirements specified in Section 079200 "Joint Sealants."

H. Stops: Provide floor stops for doors unless wall or other type stops are indicated in door hardware schedule. Do not mount floor stops where they will impede traffic.

I. Perimeter Gasketing: Apply to head and jamb, forming seal between door and frame.

1. Do not notch perimeter gasketing to install other surface-applied hardware.

J. Meeting Stile Gasketing: Fasten to meeting stiles, forming seal when doors are closed.

K. Door Bottoms: Apply to bottom of door, forming seal with threshold when door is closed.

3.4 FIELD QUALITY CONTROL

A. Independent Architectural Hardware Consultant: Engage a qualified independent Architectural Hardware Consultant to perform inspections and to prepare inspection reports.

1. Independent Architectural Hardware Consultant will inspect door hardware and state in each report whether installed work complies with or deviates from requirements, including whether door hardware is properly installed and adjusted.

3.5 ADJUSTING

A. Initial Adjustment: Adjust and check each operating item of door hardware and each door to ensure proper operation or function of every unit. Replace units that cannot be adjusted to operate as intended. Adjust door control devices to compensate for final operation of heating and ventilating equipment and to comply with referenced accessibility requirements.

1. Door Closers: Adjust sweep period to comply with accessibility requirements and requirements of authorities having jurisdiction.
2. Spring Hinges: Adjust to achieve positive latching when door is allowed to close freely from an open position of 70 degrees and so that closing time complies with accessibility requirements of authorities having jurisdiction.

B. Occupancy Adjustment: Approximately six months after date of Substantial

Completion, Installer's Architectural Hardware Consultant is to examine and readjust each item of door hardware, including adjusting operating forces, as necessary to ensure function of doors, door hardware, and electrified door hardware.

3.6 CLEANING AND PROTECTION

- A. Clean adjacent surfaces soiled by door hardware installation.
- B. Clean operating items as necessary to restore proper function and finish.
- C. Provide final protection and maintain conditions that ensure that door hardware is without damage or deterioration at time of Substantial Completion.

3.7 MAINTENANCE SERVICE

- A. Maintenance Tools and Instructions: Furnish a complete set of specialized tools and maintenance instructions for Owner's continued adjustment, maintenance, and removal and replacement of door hardware.

3.8 DOOR HARDWARE SCHEDULE

- A. Hardware Set L1:
 - Hinges
 - Passage set
 - Wall stop
- B. Hardware Set L2:
 - [Not used]
- C. Hardware Set L3:
 - [Not used]
- D. Hardware Set L4:
 - Hinges
 - Push bar/offset pull bar
 - Dead/hook latch with interior thumbturn
 - Astragal
 - Closer
 - Threshold
 - Weatherstripping
 - Floor stop
- E. Hardware Set L5:
 - [Not used]
- F. Hardware Set L6:
 - Hinges
 - Privacy lockset
 - Wall stop

- G. Hardware Set L7:
[Not used]
- H. Hardware Set L8:
Hinges
Office lockset
Wall stop
- I. Hardware Set L9:
Hinges
Entry lockset
Deadbolt with interior thumbturn
Closer
Threshold
Weatherstripping
Floor stop

END OF SECTION 087100

SECTION 092216 - NON-STRUCTURAL METAL FRAMING

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Framing systems.
 - 2. Suspension systems.

1.2 ACTION SUBMITTALS

- A. Product Data: For each product.

1.3 INFORMATIONAL SUBMITTALS

- A. Product Certificates: For each type of code-compliance certification for studs and tracks.
- B. Evaluation reports for high-strength steel studs and tracks post-installed anchors and power-actuated fasteners.

1.4 QUALITY ASSURANCE

- A. Code-Compliance Certification of Studs and Tracks: Provide documentation that framing members are certified according to the product-certification program of the Steel Framing Industry Association the Steel Stud Manufacturers Association or the Supreme Steel Framing System Association.

PART 2 - PRODUCTS

2.1 FRAMING SYSTEMS

- A. Framing Members, General: Comply with AISI S220 and ASTM C645, Section 10 for conditions indicated.
 - 1. Steel Sheet Components: Comply with AISI S220 and ASTM C645, Section 10 requirements for metal unless otherwise indicated
 - 2. Protective Coating: Comply with AISI S220; ASTM A653/A653M, G40; or coating with equivalent corrosion resistance. Galvannealed products are unacceptable.
 - a. Coating demonstrates equivalent corrosion resistance with an evaluation report acceptable to authorities having jurisdiction.
- B. Studs and Track: AISI S220 and ASTM C645, Section 10.

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. ClarkDietrich.
 - b. Steel Network, Inc. (The).
 2. Minimum Base-Steel Thickness: As required by performance requirements for horizontal deflection 0.0329 inch.
 3. Depth: As indicated on Drawings.
- C. High-Strength Steel Studs and Tracks: Roll-formed with surface deformations to stiffen the framing members.
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. ClarkDietrich.
 - b. Steel Network, Inc. (The).
 2. Minimum Base-Steel Thickness: As required by horizontal deflection performance requirements 0.0147 inch.
 3. Depth: As indicated on Drawings.
- D. Slip-Type Head Joints: Where indicated, provide the following:
1. Deflection Track: Steel sheet top track manufactured to prevent cracking of finishes applied to interior partition framing resulting from deflection of structure above; in thickness not less than indicated for studs and in width to accommodate depth of studs.
 - 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) ClarkDietrich.
 - 2) Steel Network, Inc. (The).
- E. Flat Strap and Backing Plate: Steel sheet for blocking and bracing in length and width indicated.
1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. ClarkDietrich.
 - b. Steel Network, Inc. (The).
 2. Minimum Base-Steel Thickness: 0.0329 inch.
- F. Cold-Rolled Channel Bridging: Steel, 0.0538-inch minimum base-steel thickness, with minimum 1/2-inch wide flanges.
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. ClarkDietrich.
 - b. Marino\WARE.
 - c. MBA Building Supplies.
 - d. MRI Steel Framing, LLC.
 - e. SCAFCO Steel Stud Company; Stone Group of Companies.
 - f. Steel Construction Systems; Stone Group of Companies.
- 2. Depth: As indicated on Drawings.
 - 3. Clip Angle: Not less than 1-1/2 by 1-1/2 inches, 0.068-inch- thick, galvanized steel.

G. Hat-Shaped, Rigid Furring Channels:

- 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. ClarkDietrich.
 - b. Jaimes Industries.
 - c. Marino\WARE.
 - d. MBA Building Supplies.
 - e. MRI Steel Framing, LLC.
 - f. SCAFCO Steel Stud Company; Stone Group of Companies.
 - g. Steel Construction Systems; Stone Group of Companies.
- 2. Minimum Base-Steel Thickness: As indicated on Drawings.
- 3. Depth: As indicated on Drawings.

H. Resilient Furring Channels: 1/2-inch deep, steel sheet members designed to reduce sound transmission.

- 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. ClarkDietrich.
 - b. Marino\WARE.
 - c. MBA Building Supplies.
 - d. MRI Steel Framing, LLC.
 - e. SCAFCO Steel Stud Company; Stone Group of Companies.
 - f. Steel Construction Systems; Stone Group of Companies.
- 2. Configuration: hat shaped.

2.2 SUSPENSION SYSTEMS

- A. Tie Wire: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.062-inch diameter wire, or double strand of 0.048-inch diameter wire.
- B. Wire Hangers: ASTM A641/A641M, Class 1 zinc coating, soft temper, 0.16 inch in diameter.

- C. Carrying Channels (Main Runners): Cold-rolled, commercial-steel sheet with a base-steel thickness of 0.0538 inch and minimum 1/2-inch-wide flanges.
 - 1. Depth: As indicated on Drawings.
- D. Furring Channels (Furring Members):
 - 1. Hat-Shaped, Rigid Furring Channels: 7/8 inch deep.
 - a. Minimum Base-Steel Thickness: 0.0179 inch.

2.3 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards.
 - 1. Fasteners for Steel Framing: Of type, material, size, corrosion resistance, holding power, and other properties required to fasten steel members to substrates.
- B. Isolation Strip at Exterior Walls: Provide one of the following:
 - 1. Asphalt-Saturated Organic Felt: ASTM D226/D226M, Type I (No. 15 asphalt felt), nonperforated.
 - 2. Foam Gasket: Adhesive-backed, closed-cell vinyl foam strips that allow fastener penetration without foam displacement, 1/8 inch thick, in width to suit steel stud size.

PART 3 - EXECUTION

3.1 INSTALLATION, GENERAL

- A. Installation Standard: ASTM C754.
 - 1. Gypsum Plaster Assemblies: Also comply with requirements in ASTM C841 that apply to framing installation.
 - 2. Portland Cement Plaster Assemblies: Also comply with requirements in ASTM C1063 that apply to framing installation.
 - 3. Gypsum Veneer Plaster Assemblies: Also comply with requirements in ASTM C844 that apply to framing installation.
 - 4. Gypsum Board Assemblies: Also comply with requirements in ASTM C840 that apply to framing installation.
- B. Install framing and accessories plumb, square, and true to line, with connections securely fastened.
- C. Install supplementary framing, and blocking to support fixtures, equipment services, heavy trim, grab bars, toilet accessories, furnishings, or similar construction.
- D. Install bracing at terminations in assemblies.

- E. Do not bridge building control and expansion joints with non-load-bearing steel framing members. Frame both sides of joints independently.

3.2 INSTALLATION OF FRAMING SYSTEMS

- A. Install framing system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Where studs are installed directly against exterior masonry walls or dissimilar metals at exterior walls, install isolation strip between studs and exterior wall.
- C. Install studs so flanges within framing system point in same direction.
- D. Install tracks at floors and overhead supports. Extend framing full height to structural supports or substrates above suspended ceilings except where partitions are indicated to terminate at suspended ceilings. Continue framing around ducts that penetrate partitions above ceiling.
 - 1. Slip-Type Head Joints: Where framing extends to overhead structural supports, install to produce joints at tops of framing systems that prevent axial loading of finished assemblies.
 - 2. Door Openings: Screw vertical studs at jambs to jamb anchor clips on door frames; install track section (for cripple studs) at head and secure to jamb studs.
 - a. Install two studs at each jamb unless otherwise indicated.
 - b. Install cripple studs at head adjacent to each jamb stud, with a minimum 1/2-inch clearance from jamb stud to allow for installation of control joint in finished assembly.
 - c. Extend jamb studs through suspended ceilings and attach to underside of overhead structure.
 - 3. Other Framed Openings: Frame openings other than door openings the same as required for door openings unless otherwise indicated. Install framing below sills of openings to match framing required above door heads.
 - 4. Fire-Resistance-Rated Partitions: Install framing to comply with fire-resistance-rated assembly indicated and support closures and to make partitions continuous from floor to underside of solid structure.
 - a. Firestop Track: Where indicated, install to maintain continuity of fire-resistance-rated assembly indicated.
 - 5. Sound-Rated Partitions: Install framing to comply with sound-rated assembly indicated.
- E. Direct Furring:
 - 1. Screw to wood framing.
 - 2. Attach to concrete or masonry with stub nails, screws designed for masonry attachment, or powder-driven fasteners spaced 24 inches o.c.
- F. Installation Tolerance: Install each framing member so fastening surfaces vary not more than 1/8 inch from the plane formed by faces of adjacent framing.

3.3 INSTALLATION OF SUSPENSION SYSTEMS

- A. Install suspension system components according to spacings indicated, but not greater than spacings required by referenced installation standards for assembly types.
- B. Isolate suspension systems from building structure where they abut or are penetrated by building structure to prevent transfer of loading imposed by structural movement.
- C. Suspend hangers from building structure as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structural or suspension system.
 - a. Splay hangers only where required to miss obstructions and offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 - 2. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with locations of hangers required to support standard suspension system members, install supplemental suspension members and hangers in the form of trapezes or equivalent devices.
 - a. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced installation standards.
 - 3. Wire Hangers: Secure by looping and wire tying, either directly to structures or to inserts, eye screws, or other devices and fasteners that are secure and appropriate for substrate, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 4. Flat Hangers: Secure to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices and fasteners that are secure and appropriate for structure and hanger, and in a manner that will not cause hangers to deteriorate or otherwise fail.
 - 5. Do not attach hangers to steel roof deck.
 - 6. Do not attach hangers to permanent metal forms. Furnish cast-in-place hanger inserts that extend through forms.
 - 7. Do not attach hangers to rolled-in hanger tabs of composite steel floor deck.
 - 8. Do not connect or suspend steel framing from ducts, pipes, or conduit.

3.4 FIELD QUALITY CONTROL

- A. Installation Tolerances: Install suspension systems that are level to within 1/8 inch in 12 feet measured lengthwise on each member that will receive finishes and transversely between parallel members that will receive finishes.

END OF SECTION 092216

SECTION 092900 - GYPSUM BOARD

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Interior gypsum board.
 - 2. Tile backing panels.

1.2 ACTION SUBMITTALS

- A. Product data.

PART 2 - PRODUCTS

2.1 GYPSUM BOARD, GENERAL

- A. Size: Provide maximum lengths and widths available that will minimize joints in each area and that correspond with support system indicated.

2.2 INTERIOR GYPSUM BOARD

- A. Gypsum Wallboard: ASTM C1396/C1396M.
 - 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. Armstrong Ceiling & Wall Solutions.
 - b. CertainTeed; SAINT-GOBAIN.
 - c. Georgia-Pacific Gypsum LLC.
 - d. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - e. USG Corporation.
 - 2. Thickness: 1/2 inch.
 - 3. Long Edges: Tapered.
- B. Mold-Resistant Gypsum Board: ASTM C1396/C1396M. With moisture- and mold-resistant core and paper surfaces.
 - 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. CertainTeed; SAINT-GOBAIN.
 - b. Georgia-Pacific Gypsum LLC.

- c. Gold Bond Building Products, LLC provided by National Gypsum Company.
 - d. USG Corporation.
- 2. Core: Manufacturer's standard.
- 3. Long Edges: Tapered.
- 4. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.3 TILE BACKING PANELS

- A. Cementitious Backer Units: ANSI A118.9 and ASTM C1288 or ASTM C1325, with manufacturer's standard edges.
 - 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. FinPan, Inc.
 - b. PermaBASE Building Products, LLC provided by National Gypsum Company.
 - c. USG Corporation.
 - 2. Thickness: 5/8".
 - 3. Mold Resistance: ASTM D3273, score of 10 as rated in accordance with ASTM D3274.

2.4 TRIM ACCESSORIES

- A. Interior Trim: ASTM C1047.
 - 1. Material: Galvanized or aluminum-coated steel sheet, rolled zinc, plastic, or paper-faced galvanized-steel sheet.
 - 2. Shapes:
 - a. Cornerbead.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound.
 - c. U-Bead: J-shaped; exposed short flange does not receive joint compound.
 - d. Expansion (control) joint.

2.5 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C475/C475M.
- B. Joint Tape:
 - 1. Interior Gypsum Board: Paper.
 - 2. Exterior Gypsum Soffit Board: Paper.
 - 3. Glass-Mat Gypsum Sheathing Board: 10-by-10 glass mesh.
 - 4. Tile Backing Panels: As recommended by panel manufacturer.

- C. Joint Compound for Interior Gypsum Board: For each coat, use formulation that is compatible with other compounds applied on previous or for successive coats.
 - 1. Prefilling: At open joints, rounded or beveled panel edges, and damaged surface areas, use setting-type taping compound.
 - 2. Embedding and First Coat: For embedding tape and first coat on joints, fasteners, and trim flanges, use drying-type, all-purpose compound.
 - a. Use setting-type compound for installing paper-faced metal trim accessories.
 - 3. Fill Coat: For second coat, use drying-type, all-purpose compound.
 - 4. Finish Coat: For third coat, use setting-type, sandable topping compound.
 - 5. Skim Coat: For final coat of Level 5 finish, use setting-type, sandable topping compound.
- D. Joint Compound for Tile Backing Panels:
 - 1. Glass-Mat, Water-Resistant Backing Panel: As recommended by backing panel manufacturer.
 - 2. Cementitious Backer Units: As recommended by backer unit manufacturer.

2.6 AUXILIARY MATERIALS

- A. Provide auxiliary materials that comply with referenced installation standards and manufacturer's written instructions.
- B. Steel Drill Screws: ASTM C1002 unless otherwise indicated.
 - 1. Use screws complying with ASTM C954 for fastening panels to steel members from 0.033 to 0.112 inch thick.
 - 2. For fastening cementitious backer units, use screws of type and size recommended by panel manufacturer.
- C. Sound-Attenuation Blankets: ASTM C665, Type I (blankets without membrane facing) produced by combining thermosetting resins with mineral fibers manufactured from glass, slag wool, or rock wool.
 - 1. Fire-Resistance-Rated Assemblies: Comply with mineral-fiber requirements of assembly.

PART 3 - EXECUTION

3.1 INSTALLATION OF PANELS

- A. Examine panels before installation. Reject panels that are wet, moisture damaged, and mold damaged.
- B. Comply with ASTM C840.

- C. Isolate perimeter of gypsum board applied to non-load-bearing partitions at structural abutments. Provide 1/4- to 1/2-inch- wide spaces at these locations and trim edges with edge trim where edges of panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- D. For trim with back flanges intended for fasteners, attach to framing with same fasteners used for panels. Otherwise, attach trim according to manufacturer's written instructions.

3.2 FINISHING OF GYPSUM BOARD

- A. Prefill open joints and damaged surface areas.
- B. Apply joint tape over gypsum board joints, except for trim products specifically indicated as not intended to receive tape.
- C. Gypsum Board Finish Levels: Finish panels to levels indicated below and in accordance with ASTM C840:
 - 1. Level 1: Ceiling plenum areas, concealed areas, and where indicated.
 - 2. Level 4: At panel surfaces that will be exposed to view unless otherwise indicated.
 - a. Primer and its application to surfaces are specified in Section 099123 "Interior Painting."
- D. Cementitious Backer Units: Finish according to manufacturer's written instructions.

3.3 PROTECTION

- A. Protect installed products from damage from weather, condensation, direct sunlight, construction, and other causes during remainder of the construction period.
- B. Remove and replace panels that are wet, moisture damaged, and mold damaged.

END OF SECTION 092900

SECTION 096513 - RESILIENT BASE AND ACCESSORIES

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Vinyl base.

1.2 ACTION SUBMITTALS

A. Product Data: For each type of product.

1. Include manufacturer's written data on physical characteristics, durability, and fade resistance.
2. Include manufacturer's written installation instructions for each type of substrate.

B. Samples for Initial Selection: For each type of exposed product.

C. Product Schedule: For resilient base and accessory products.

1.3 INFORMATIONAL SUBMITTALS

A. Product Test Reports: For resilient base and accessory products, for tests performed by a qualified testing agency.

1.4 MAINTENANCE MATERIAL SUBMITTALS

A. Extra Stock Material: Furnish extra materials, from the same production run, to Owner that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Furnish not less than 10 linear ft. for every or fraction thereof, of each type, color, pattern, and size of resilient product installed.

1.5 DELIVERY, STORAGE, AND HANDLING

A. Store resilient products and installation materials in dry spaces protected from the weather, with ambient temperatures maintained within range recommended by manufacturer, but not less than 50 deg F or more than 90 deg F.

1.6 FIELD CONDITIONS

A. Maintain ambient temperatures within range recommended by manufacturer, but not less than 70 deg F or more than 95 deg F, in spaces to receive resilient products during the following periods:

1. 48 hours before installation.

2. During installation.
 3. 48 hours after installation.
- B. After installation and until Substantial Completion, maintain ambient temperatures within range recommended by manufacturer, but not less than 55 deg F or more than 95 deg F.
- C. Install resilient products after other finishing operations, including painting, have been completed.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Fire-Test-Response Characteristics: As determined by testing identical products in accordance with ASTM E648 or ASTM E662 by a qualified testing agency.
1. Critical Radiant Flux Classification: Class I, not less than 0.45 W/sq. cm.

2.2 RESILIENT BASE

- A. Vinyl Base:
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. Flexco Corporation
 - b. Mannington Mills, Inc
 - c. Mohawk Group
 - d. Roppe Corporation; Roppe Holding Company
 - e. Shaw Industries Group, Inc.; Berkshire Hathaway Company
 - f. Tarkett USA
 - g. VPI Corporation
 2. Classification: ASTM F1861, Type TV (vinyl, thermoplastic), Group I (solid, homogeneous).
 3. Minimum Thickness: 0.125 inch>.
 4. Height: 4 inches.
 5. Lengths: Cut lengths 48 inches long or coils in manufacturer's standard length.
 6. Outside Corners: Job formed or preformed.
 7. Inside Corners: Job formed or preformed.
 8. Colors and Patterns: As indicated by manufacturer's designations.

2.3 INSTALLATION MATERIALS

- A. Adhesives: Water-resistant type recommended in writing by resilient-product manufacturer for resilient products and substrate conditions indicated.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, with Installer present, for compliance with requirements for maximum moisture content and other conditions affecting performance of the Work.
 - 1. Verify that finishes of substrates comply with tolerances and other requirements specified in other Sections and that substrates are free of cracks, ridges, depressions, scale, and foreign deposits that might interfere with adhesion of resilient products.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.
 - 1. Installation of resilient products indicates acceptance of surfaces and conditions.

3.2 PREPARATION

- A. Prepare substrates in accordance with manufacturer's written instructions to ensure adhesion of resilient products.
- B. Fill cracks, holes, and depressions in substrates with trowelable leveling and patching compound; remove bumps and ridges to produce a uniform and smooth substrate.
- C. Do not install resilient products until materials are the same temperature as space where they are to be installed.
 - 1. At least 48 hours in advance of installation, move resilient products and installation materials into spaces where they will be installed.
- D. Immediately before installation, sweep and vacuum clean substrates to be covered by resilient products.

3.3 INSTALLATION OF RESILIENT BASE

- A. Comply with manufacturer's written instructions for installing resilient base.
- B. Apply resilient base to walls, columns, pilasters, casework and cabinets in toe spaces, and other permanent fixtures in rooms and areas where base is required.
- C. Install resilient base in lengths as long as practical without gaps at seams and with tops of adjacent pieces aligned.
- D. Tightly adhere resilient base to substrate throughout length of each piece, with base in continuous contact with horizontal and vertical substrates.

- E. Do not stretch resilient base during installation.
- F. On masonry surfaces or other similar irregular substrates, fill voids along top edge of resilient base with manufacturer's recommended adhesive filler material.
- G. Preformed Corners: Install preformed corners before installing straight pieces.
- H. Job-Formed Corners:
 - 1. Outside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Form without producing discoloration (whitening) at bends.
 - 2. Inside Corners: Use straight pieces of maximum lengths possible and form with returns not less than 3 inches in length.
 - a. Miter or cope corners to minimize open joints.

3.4 CLEANING AND PROTECTION

- A. Comply with manufacturer's written instructions for cleaning and protecting resilient products.
- B. Perform the following operations immediately after completing resilient-product installation:
 - 1. Remove adhesive and other blemishes from surfaces.
 - 2. Sweep and vacuum horizontal surfaces thoroughly.
 - 3. Damp-mop horizontal surfaces to remove marks and soil.
- C. Protect resilient products from mars, marks, indentations, and other damage from construction operations and placement of equipment and fixtures during remainder of construction period.
- D. Cover resilient products subject to wear and foot traffic until Substantial Completion.

END OF SECTION 096513

SECTION 099100 - PAINTING

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes surface preparation and field painting of exposed exterior and interior items and surfaces.
 - 1. Surface preparation, priming, and finish coats specified in this Section are in addition to shop priming and surface treatment specified in other Sections.
- B. Do not paint prefinished items, concealed surfaces, finished metal surfaces, operating parts, and labels.
- C. Prefinished items include the following factory-finished components:
 - a. Finished mechanical and electrical equipment.

1.3 DEFINITIONS

- A. General: Standard coating terms defined in ASTM D16 apply to this Section.
 - 1. Flat refers to a lusterless or matte finish with a gloss range below 15 when measured at an 85-degree meter.
 - 2. Low Luster (Eggshell) refers to low-sheen finish with a gloss range between 20 and 35 when measured at a 60-degree meter.
 - 3. Semigloss refers to medium-sheen finish with a gloss range between 35 and 70 when measured at a 60-degree meter.
 - 4. Full gloss refers to high-sheen finish with a gloss range more than 70 when measured at a 60-degree meter.

1.4 SUBMITTALS

- A. Product Data: For each paint system indicated. Include block fillers and primers.
 - 1. Material List: An inclusive list of required coating materials. Indicate each material and cross-reference specific coating, finish system, and application. Identify each material by manufacturer's catalog number and general classification.

2. Manufacturer's Information: Manufacturer's technical information, including label analysis and instructions for handling, storing, and applying each coating material.
- B. Samples for Initial Selection: For each type of finish-coat material indicated.
1. After color selection, Architect will furnish color chips for surfaces to be coated.
- C. Samples for Verification: For each color and material to be applied, with texture to simulate actual conditions, on representative Samples of the actual substrate.
1. Provide 12-inch square Samples, defining each separate coat, including block fillers and primers. Use representative colors when preparing Samples for review. Resubmit until required sheen, color, and texture are achieved.

1.5 QUALITY ASSURANCE

- A. Applicator Qualifications: A firm or individual experienced in applying paints and coatings similar in material, design, and extent to those indicated for this Project, whose work has resulted in applications with a record of successful in-service performance.
- B. Source Limitations: Obtain block fillers and primers for each coating system from the same manufacturer as the finish coats.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to Project site in manufacturer's original, unopened packages and containers bearing manufacturer's name and label and the following information:
1. Product name or title of material.
 2. Product description (generic classification or binder type).
 3. Manufacturer's stock number and date of manufacture.
 4. Contents by volume, for pigment and vehicle constituents.
 5. Thinning instructions.
 6. Application instructions.
 7. Color name and number.
- B. Store materials not in use in tightly covered containers in a well-ventilated area at a minimum ambient temperature of 45 deg F. Maintain storage containers in a clean condition, free of foreign materials and residue.
1. Protect from freezing. Keep storage area neat and orderly. Remove oily rags and waste daily.

1.7 PROJECT CONDITIONS

- A. Apply waterborne paints only when temperatures of surfaces to be painted and surrounding air are between 50 and 90 deg F.
- B. Do not apply paint in snow, rain, fog, or mist; or when relative humidity exceeds 85 percent; or at temperatures less than 5 deg F above the dew point; or to damp or wet surfaces.

1.8 EXTRA MATERIALS

- A. Provide extra paint applied to surfaces. Deliver extra materials to Owner.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Products: Subject to compliance with requirements, provide one of the products listed.
- B. Manufacturers' Names: Shortened versions (shown in parentheses) of the following manufacturers' names are used in other Part 2 articles:
 - 1. Benjamin Moore & Co. (Benjamin Moore).
 - 2. PPG Industries, Inc. (Pittsburgh Paints).
 - 3. Sherwin-Williams Co. (Sherwin-Williams).
 - 4. Tnemec.

2.2 PAINT MATERIALS, GENERAL

- A. Material Compatibility: Provide block fillers, primers, and finish-coat materials that are compatible with one another and with the substrates indicated under conditions of service and application, as demonstrated by manufacturer based on testing and field experience.
- B. Material Quality: Provide manufacturer's best-quality paint material of the various coating types specified that are factory formulated and recommended by manufacturer for application indicated. Paint-material containers not displaying manufacturer's product identification will not be acceptable.
 - 1. Proprietary Names: Use of manufacturer's proprietary product names to designate colors or materials is not intended to imply that products named are required to be used to the exclusion of equivalent products of other manufacturers. Furnish manufacturer's material data and certificates of performance for proposed substitutions.

2.3 CONCRETE UNIT MASONRY BLOCK FILLERS

- A. Concrete Unit Masonry Block Filler: Factory-formulated high-performance latex block fillers.
 - 1. Benjamin Moore; Moorcraft Super Craft Latex Block Filler No. 285: Applied at a dry film thickness of not less than 8.1 mils.
 - 2. Benjamin Moore; Moore's IMC Latex Block Filler No. M88: Applied at a dry film thickness of not less than 8.1 mils.
 - 3. Pittsburgh Paints; 6-7 SpeedHide Interior/Exterior Masonry Latex Block Filler: Applied at a dry film thickness of not less than 6.0 to 12.5 mils.
 - 4. Sherwin-Williams; PrepRite Interior/Exterior Block Filler B25W25: Applied at a dry film thickness of not less than 8.0 mils.

2.4 EXTERIOR PRIMERS (guard rails on the roof)

- A. Exterior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex primer for exterior application.
 - 1. Benjamin Moore; Moore's Acrylic Masonry Sealer No. 066: Applied at a dry film thickness of not less than 0.7 mils.
 - 2. Benjamin Moore; Moore's Alkyd Masonry Sealer No. 077: Applied at a dry film thickness of not less than 2.7 mils.
 - 3. Pittsburgh Paints; 6-603 SpeedHide Interior/Exterior Acrylic Latex Alkali Resistant Primer: Applied at a dry film thickness of not less than 1.5 mils.
 - 4. Sherwin-Williams; Loxon Exterior Masonry Acrylic Primer A24W300: Applied at a dry film thickness of not less than 3.0 mils.
 - 5. Sherwin-Williams; A-100 Latex Exterior Wood Primer B42W41: Applied at a dry film thickness of not less than 1.4 mils.
- B. Exterior Wood Primer for Acrylic Enamels: Factory-formulated alkyd or latex wood primer for exterior applications.
 - 1. Benjamin Moore; Moorcraft Super Spec Alkyd Exterior Primer No. 176: Applied at a dry film thickness of not less than 1.8 mils.
 - 2. Pittsburgh Paints; 6-609 SpeedHide Exterior House & Trim Wood Primer 100 Percent Acrylic Latex: Applied at a dry film thickness of not less than 1.6 mils.
 - 3. Sherwin-Williams; A-100 Exterior Latex Wood Primer B42W41: Applied at a dry film thickness of not less than 1.4 mils.
- C. Exterior Galvanized Metal Primer: Factory-formulated galvanized metal primer for exterior application.
 - 1. Benjamin Moore; Moore's IMC Acrylic Metal Primer No. M04: Applied at a dry film thickness of not less than 2.0 mils.
 - 2. Pittsburgh Paints; 90-709 Pitt-Tech One Pack Interior/Exterior Primer/Finish DTM Industrial Enamel: at a dry film thickness of not less than 3.0 mils.

3. Sherwin-Williams; primer not required over this substrate.
4. Sherwin-Williams; Galvite HS Paint B50WZ3: Applied at a dry film thickness of not less than 2.0 mils.

2.5 INTERIOR PRIMERS

- A. Interior Concrete and Masonry Primer: Factory-formulated alkali-resistant acrylic-latex interior primer for interior application.
 1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
 2. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil.
 3. Sherwin-Williams; PrepRite Masonry Primer B28W300: Applied at a dry film thickness of not less than 3.0 mils.
- B. Interior Gypsum Board Primer: Factory-formulated latex-based primer for interior application.
 1. Benjamin Moore; Moorcraft Super Spec Latex Enamel Undercoater & Primer Sealer No. 253: Applied at a dry film thickness of not less than 1.2 mils.
 2. Pittsburgh Paints; 6-2 SpeedHide Interior Quick-Drying Latex Sealer: Applied at a dry film thickness of not less than 1.0 mil.
 3. Sherwin-Williams; PrepRite 200 Latex Wall Primer B28W200 Series: Applied at a dry film thickness of not less than 1.6 mils.

2.6 EXTERIOR FINISH COATS (guard rails)

- A. Exterior Semigloss Acrylic Enamel: Factory-formulated semigloss waterborne acrylic-latex enamel for exterior application.
 1. Benjamin Moore; Moorcraft Super Spec Latex House & Trim Paint No. 170: Applied at a dry film thickness of not less than 1.1 mils.
 2. Pittsburgh Paints; 6-900 Series SpeedHide Exterior House & Trim Semi-Gloss Acrylic Latex Paint: Applied at a dry film thickness of not less than 1.5 mils.
 3. Sherwin-Williams; A-100 Latex Gloss A8 Series: Applied at a dry film thickness of not less than 1.3 mils.
- B. Exterior Full-Gloss Acrylic Enamel for Ferrous and Other Metals: Factory-formulated full-gloss waterborne acrylic-latex enamel for exterior application.
 1. Benjamin Moore; Moore's IMC Acrylic Gloss Enamel M28: Applied at a dry film thickness of not less than 2.0 mils.
 2. Pittsburgh Paints; 90-300 Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamels: Applied at a dry film thickness of not less than 3.0 mils.

3. Sherwin-Williams; DTM Acrylic Coating Gloss (Waterborne) B66W100 Series: Applied at a dry film thickness of not less than 2.4 mils.

2.7 INTERIOR FINISH COATS

- A. Interior Low-Luster Acrylic Enamel: Factory-formulated eggshell acrylic-latex interior enamel.
 1. Benjamin Moore; Moorcraft Super Spec Latex Eggshell Enamel No. 274: Applied at a dry film thickness of not less than 1.3 mils.
 2. Pittsburgh Paints; 6-400 Series SpeedHide Eggshell Acrylic Latex Enamel: Applied at a dry film thickness of not less than 1.25 mils.
 3. Sherwin-Williams; ProMar 200 Interior Latex Egg-Shell Enamel B20W200 Series: Applied at a dry film thickness of not less than 1.6 mils.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Applicator present, for compliance with requirements for paint application. Comply with procedures specified in PDCA P4.
 1. Proceed with paint application only after unsatisfactory conditions have been corrected and surfaces receiving paint are thoroughly dry.
 2. Start of painting will be construed as Applicator's acceptance of surfaces and conditions within a particular area.
- B. Coordination of Work: Review other Sections in which primers are provided to ensure compatibility of the total system for various substrates. On request, furnish information on characteristics of finish materials to ensure use of compatible primers.
 1. Notify Architect about anticipated problems when using the materials specified over substrates primed by others.

3.2 PREPARATION

- A. General: Remove hardware and hardware accessories, plates, machined surfaces, lighting fixtures, and similar items already installed that are not to be painted. If removal is impractical or impossible because of size or weight of the item, provide surface-applied protection before surface preparation and painting.
 1. After completing painting operations in each space or area, reinstall items removed using workers skilled in the trades involved.
- B. Cleaning: Before applying paint or other surface treatments, clean substrates of substances that could impair bond of the various coatings. Remove oil and grease before cleaning.

1. Schedule cleaning and painting so dust and other contaminants from the cleaning process will not fall on wet, newly painted surfaces.
- C. Surface Preparation: Clean and prepare surfaces to be painted according to manufacturer's written instructions for each particular substrate condition and as specified.
1. Provide barrier coats over incompatible primers or remove and reprime.
 2. Cementitious Materials: Prepare concrete, concrete unit masonry, cement plaster, and mineral-fiber-reinforced cement panel surfaces to be painted. Remove efflorescence, chalk, dust, dirt, grease, oils, and release agents. Roughen as required to remove glaze. If hardeners or sealers have been used to improve curing, use mechanical methods of surface preparation.
 - a. Use abrasive blast-cleaning methods if recommended by paint manufacturer.
 - b. Determine alkalinity and moisture content of surfaces by performing appropriate tests. If surfaces are sufficiently alkaline to cause the finish paint to blister and burn, correct this condition before application. Do not paint surfaces if moisture content exceeds that permitted in manufacturer's written instructions.
 - c. Clean concrete floors to be painted with a 5 percent solution of muriatic acid or other etching cleaner. Flush the floor with clean water to remove acid, neutralize with ammonia, rinse, allow to dry, and vacuum before painting.
 3. Ferrous Metals: Clean ungalvanized ferrous-metal surfaces that have not been shop coated; remove oil, grease, dirt, loose mill scale, and other foreign substances. Use solvent or mechanical cleaning methods that comply with SSPC's recommendations.
 - a. Blast steel surfaces clean as recommended by paint system manufacturers and according to SSPC-SP 6/NACE No. 3.
 - b. Treat bare and sandblasted or pickled clean metal with a metal treatment wash coat before priming.
 - c. Touch up bare areas and shop-applied prime coats that have been damaged. Wire-brush, clean with solvents recommended by paint manufacturers, and touch up with same primer as the shop coat.
 4. Galvanized Surfaces: Clean galvanized surfaces with nonpetroleum-based solvents so surface is free of oil and surface contaminants. Remove pretreatment from galvanized sheet metal fabricated from coil stock by mechanical methods.
- D. Material Preparation: Mix and prepare paint materials according to manufacturer's written instructions.
1. Maintain containers used in mixing and applying paint in a clean condition, free of foreign materials and residue.
 2. Stir material before application to produce a mixture of uniform density. Stir as required during application. Do not stir surface film into material. If necessary, remove surface film and strain material before using.

3. Use only thinners approved by paint manufacturers and only within recommended limits.
- E. Tinting: Tint each undercoat a lighter shade to simplify identification of each coat when multiple coats of same material are applied. Tint undercoats to match the color of the finish coat but provide sufficient differences in shade of undercoats to distinguish each separate coat.

3.3 APPLICATION

- A. General: Apply paint according to manufacturer's written instructions. Use applicators and techniques best suited for substrate and type of material being applied.
1. Paint colors, surface treatments, and finishes are indicated in the paint schedules.
 2. Do not paint over dirt, rust, scale, grease, moisture, scuffed surfaces, or conditions detrimental to formation of a durable paint film.
 3. Provide finish coats that are compatible with primers used.
 4. The term "exposed surfaces" includes areas visible when permanent or built-in fixtures, grilles, convector covers, covers for finned-tube radiation, and similar components are in place. Extend coatings in these areas, as required, to maintain system integrity and provide desired protection.
 5. Paint surfaces behind movable equipment and furniture the same as similar exposed surfaces. Before final installation of equipment, paint surfaces behind permanently fixed equipment or furniture with prime coat only.
 6. Paint interior surfaces of ducts with flat, nonspecular black paint where visible through registers or grilles.
 7. Paint back sides of access panels and removable or hinged covers to match exposed surfaces.
 8. Finish exterior doors on tops, bottoms, and side edges the same as exterior faces.
 9. Finish interior of wall and base cabinets and similar field-finished casework to match exterior.
 10. Sand lightly between each succeeding enamel or varnish coat.
- B. Scheduling Painting: Apply first coat to surfaces that have been cleaned, pretreated, or otherwise prepared for painting as soon as practicable after preparation and before subsequent surface deterioration.
1. The number of coats and film thickness required are the same regardless of application method. Do not apply succeeding coats until previous coat has cured as recommended by manufacturer. If sanding is required to produce a smooth, even surface according to manufacturer's written instructions, sand between applications.
 2. Omit primer over metal surfaces that have been shop primed and touchup painted.
 3. If undercoats, stains, or other conditions show through final coat of paint, apply additional coats until paint film is of uniform finish, color, and appearance. Give

special attention to ensure that edges, corners, crevices, welds, and exposed fasteners receive a dry film thickness equivalent to that of flat surfaces.

4. Allow sufficient time between successive coats to permit proper drying. Do not recoat surfaces until paint has dried to where it feels firm, and does not deform or feel sticky under moderate thumb pressure, and until application of another coat of paint does not cause undercoat to lift or lose adhesion.
- C. Application Procedures: Apply paints and coatings by brush, roller, spray, or other applicators according to manufacturer's written instructions.
1. Brushes: Use brushes best suited for type of material applied. Use brush of appropriate size for surface or item being painted.
 2. Rollers: Use rollers of carpet, velvet-back, or high-pile sheep's wool as recommended by manufacturer for material and texture required.
 3. Spray Equipment: Use airless spray equipment with orifice size as recommended by manufacturers for material and texture required.
- D. Minimum Coating Thickness: Apply paint materials no thinner than manufacturer's recommended spreading rate to achieve dry film thickness indicated. Provide total dry film thickness of the entire system as recommended by manufacturer.
- E. Mechanical and Electrical Work: Painting of mechanical and electrical work is limited to items exposed in equipment rooms and occupied spaces.
- F. Block Fillers: Apply block fillers to concrete masonry block at a rate to ensure complete coverage with pores filled.
- G. Prime Coats: Before applying finish coats, apply a prime coat, as recommended by manufacturer, to material that is required to be painted or finished and that has not been prime coated by others. Recoat primed and sealed surfaces where evidence of suction spots or unsealed areas in first coat appears, to ensure a finish coat with no burn-through or other defects due to insufficient sealing.
- H. Pigmented (Opaque) Finishes: Completely cover surfaces as necessary to provide a smooth, opaque surface of uniform finish, color, appearance, and coverage. Cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections will not be acceptable.
- I. Transparent (Clear) Finishes: Use multiple coats to produce a glass-smooth surface film of even luster. Provide a finish free of laps, runs, cloudiness, color irregularity, brush marks, orange peel, nail holes, or other surface imperfections.
1. Provide satin finish for final coats.
- J. Stipple Enamel Finish: Roll and redistribute paint to an even and fine texture. Leave no evidence of rolling, such as laps, irregularity in texture, skid marks, or other surface imperfections.
- K. Completed Work: Match approved samples for color, texture, and coverage. Remove, refinish, or repaint work not complying with requirements.

3.4 CLEANING

- A. Cleanup: At the end of each workday, remove empty cans, rags, rubbish, and other discarded paint materials from Project site.
 - 1. After completing painting, clean glass and paint-spattered surfaces. Remove spattered paint by washing and scraping without scratching or damaging adjacent finished surfaces.

3.5 PROTECTION

- A. Protect work of other trades, whether being painted or not, against damage from painting. Correct damage by cleaning, repairing or replacing, and repainting, as approved by Architect.
- B. Provide "Wet Paint" signs to protect newly painted finishes. After completing painting operations, remove temporary protective wrappings provided by others to protect their work.
 - 1. After work of other trades is complete, touch up and restore damaged or defaced painted surfaces. Comply with procedures specified in PDCA P1.

3.6 EXTERIOR PAINT SCHEDULE

- A. Ferrous Metal: Provide the following finish systems over exterior ferrous metal. Primer is not required on shop-primed items.
 - 1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a rust-inhibitive primer.
 - a. Primer: Exterior ferrous-metal primer.
 - b. Finish Coats: Exterior full-gloss alkyd enamel.

3.7 INTERIOR PAINT SCHEDULE

- A. Apparatus Bay Concrete Masonry Unit: Provide the following finish systems over interior concrete masonry:
 - 1. Apparatus Bay Walls: (High-Gloss Finish: One finish coat over an intermediate coat and a block filler.
 - a. Block Filler: Acrylic or epoxy block filler applied at spreading rate recommended by manufacturer as sufficient to fill pores.
 - 1) Moore: M88 Latex Block Filler.
 - 2) PPG: 16-90 Pitt-Glaze High Performance Acrylic Latex Block Filler.
 - 3) S-W: Heavy Duty Block Filler B42W46.
 - 4) Tnemec: Latex Masonry Block Filler.
 - b. Intermediate Coat: Acrylic enamel applied at spreading rate recommended by manufacturers to achieve a dry film thickness of 1.0 to 4.0 mils.
 - 1) Moore: M28 Acrylic Gloss Enamel.
 - 2) PPG: 90-3XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamel.
 - 3) S-W: DTM Acrylic Gloss Coating B66W100 Series.

- 4) Tnemec: Series 28 Tuf-Cryl Water Based Acrylic Emulsion.
 - c. Topcoat: High-gloss acrylic enamel applied at spreading rate recommended by manufacturers to achieve a dry film thickness of 1.0 to 4.0 mils.
 - 1) Moore: M28 Acrylic Gloss Enamel.
 - 2) PPG: 90-3XX Series Pitt-Tech One Pack Interior/Exterior High Performance Waterborne High Gloss DTM Industrial Enamel.
 - 3) S-W: DTM Acrylic Gloss Coating B66W100 Series.
 - 4) Tnemec: Series 28 Tuf-Cryl Water Based Acrylic Emulsion.
- B. Gypsum Board Walls: Provide the following finish systems over interior gypsum board surfaces:
 - 1. Low-Luster Acrylic-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior gypsum board primer.
 - b. Finish Coats: Interior low-luster acrylic enamel.
 - c. Retain paint system below for a low-luster (eggshell) acrylic-enamel finish over interior plaster surfaces subject to normal use and moderate environments.
- C. Ferrous Metal: Provide the following finish systems over ferrous metal:
 - 1. Full-Gloss Alkyd-Enamel Finish: Two finish coats over a primer.
 - a. Primer: Interior ferrous-metal primer.
 - b. Finish Coats: Interior full-gloss alkyd enamel.

3.8 SCHEDULE

- A. Exterior: Guard Rails on the roof of the Solids Control Center
- B. Interior: Electrical Room in the Solids Control Center, second floor.

END OF SECTION 099100

SECTION 099700 - SPECIAL COATINGS

PART 1 - GENERAL

1.1 SUMMARY

- A. Work covered by this Section includes the furnishing and application of paints, stains, primers, varnishes and other finish, decorative and protective coatings
- B. Shop priming and factory prefinishing are required on some, but not necessarily all, of the items described in other sections.
- C. Extent of work:
 - 1. All new process equipment and process piping.
 - 2. All building and room surfaces as indicated on the plans or as scheduled.
 - 3. All conduits, ducts, drains, etc of other trades unless such product is deemed having an acceptable factory pre-finish, under the following conditions:
 - a. When specifically called out as requiring special coating protection.

1.2 DEFINITIONS

- A. Special coating systems are defined as those types of materials and methods of application requiring more than normal skills and techniques for mixing, handling and application, as specified in the "Painting" section.
 - 1. The term "special coating systems" as used in this section includes applied materials used in prime, intermediate and finish coats.
 - 2. The word "paint", as applied in this and or other Sections shall apply to all special coatings required herein for the protection of materials from corrosive environment, weathering processes, or for aesthetic or other reasons.
 - 3. The term "exposed surfaces" is defined to include areas visible when permanent or built-in fixtures, convector covers, covers for finned tube radiation, grilles, and similar components are in place in areas to be coated. Extend special coatings in these areas as required to maintain the coating system integrity and provide desired protection.

1.3 SUBMITTALS

- A. Product Data: Submit manufacturer's technical information including basic materials analysis and application instructions for each coating material specified.
 - 1. List each material and cross-reference to the specific coating and finish system and application. Identify each material by the manufacturer's catalog number and general classification.
 - 2. In the event that the submittal requests a substitution then the following ASTM test results from an independent testing laboratory for the referenced products shall be included:

- a. ASTM B 117 Salt Fog
- b. ASTM D 3359 (Method A and B) Adhesion Test
- c. ASTM G8, Method A Cathodic Disbondment
- d. ASTM D 4541 (Elcometer)
- e. ASTM D 4060 Taber Abrasion
- f. ASTM D 522 (Conical Mandrel)
- g. ASTM D 3363 Pencil Hardness
- h. ASTM D 2794 Impact
- i. ASTM G 53 QUV Exposure
- j. ASTM D 2240 Durometer, Shore D
- k. ASTM D 870 Immersion (Potable Water)
- l. ASTM E 96 Moisture Vapor Transmission
- m. ASTM D 2370 Tensile Strength and Elongation
- n. ASTM D 638 Tear Strength

- B. Manufacturer's representative color and texture sample cards shall be submitted to the Engineer at least 30 days prior to paint application. Contractor shall coordinate work so as to allow sufficient time for paint to be delivered to the job site.

1.4 QUALITY ASSURANCE

- A. Single Source Responsibility: Provide primers and other undercoat material produced by the same manufacturer as the finish coats. Use only thinners recommended by the manufacturer, and only within recommended limits.
- B. Coordination of Work: Review other sections of these specifications in which other coatings are to be provided to ensure compatibility of the total coatings systems for various substrates.
 - 1. Upon request, furnish information on the characteristics of pre-primed materials, to ensure that provisions for specified finish coats can be appropriately applied.
 - 2. Notify the Engineer of any anticipated problems involved in using the coatings systems as specified.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the job site in the manufacturer's original, new, unopened packages and containers bearing manufacturer's name and label and the following information:
 - 1. Name or title of material.
 - 2. Federal Specification number, if applicable.
 - 3. Manufacturer's stock number and date of manufacture.
 - 4. Manufacturer's name.
 - 5. Contents by volume, for major pigment and vehicle constituents.
 - 6. Thinning instructions.
 - 7. Application instructions.
 - 8. Color name and number.

9. Handling instructions and precautions.

- B. Store materials not in actual use in tightly covered containers at a minimum ambient temperature of 45 deg. F (7 deg. C) in a well ventilated area. Maintain containers used in storage of coatings in a clean condition, free of foreign materials and residue.
 - 1. Protect from freezing where necessary. Keep storage area neat and orderly. Remove oily rags and waste daily. Take all necessary precautionary measures to ensure that workmen and work areas are adequately protected from fire hazards and health hazards resulting from handling, mixing and application of stains.
- C. No material shall be applied unless the containers are opened in the presence of the Owner's Representative.

1.6 PROJECT CONDITIONS

- A. Apply coatings only when the temperature of surfaces to be coated and surrounding air temperatures are above 45 deg. F (7 deg. C), unless otherwise permitted by manufacturer's printed instructions.
- B. Do not apply coatings in snow, rain, fog or mist, or when the relative humidity exceeds 85%, or to damp or wet surfaces unless otherwise permitted by manufacturer's printed instructions. Allow wet surfaces to dry thoroughly and attain the temperature and conditions specified before proceeding with or continuing with the coating operation.
 - 1. Work may continue during inclement weather only if areas and surfaces to be coated are enclosed and the temperature within the area can be maintained within limits specified by the manufacturer during application and drying periods.
- C. Report to responsible person such as safety personnel, General Trades Superintendent, etc., any condition which may pose a threat to the health and welfare of employees.
- D. Keep working area clean and safe.
- E. Obey all job site rules and regulations.
- F. Surfaces not to be painted; unless specifically stated otherwise:
 - 1. Face brick
 - 2. Pre-finished wall panels, partitions and ceiling tile
 - 3. Items with acceptable factory-applied final finish
 - 4. Concealed ducts, pipes and conduit.
 - 5. Glass, Aluminum, Copper, Bronze, Stainless Steel

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Tnemec Company, Inc., North Kansas City, Missouri
 - 2. Carboline Company, At. Louis, Missouri
 - 3. Sherwin Williams Company, Cleveland, Ohio
- B. Material Quality: Provide the best quality grade of the various types of coatings as regularly manufactured by acceptable coating manufacturers. Materials not displaying manufacturer's identification as a standard, best-grade product will not be acceptable.
- C. Proprietary names to designate colors or materials are not intended to imply that products of named manufacturers are required to the exclusion of equivalent products of other manufacturers.
- D. Request for substitution shall include manufacturer's literature for each product giving the name, product number, generic type, descriptive information, solids by volume, recommended dry film thickness and certified test reports showing results to equal the performance criteria of the products listed herein.

2.2 COATING SYSTEMS

A. Ferrous Metal:

1. Submerged, Non-Potable

Surface Preparation: SSPC-SP10 Near White Blast

First Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 3.0-5.0 mils
dry Carboline Carboguard 890 @ 3.0 - 5.0 DFT
Sherwin Williams Dura-Plate 235 at 3.0-5.0 mils DFT

Second Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 6.0-8.0 mils
dry Carboline Carboguard 890 @ 4.0 - 6.0 DFT
Sherwin Williams Dura-Plate 235 at 5.0-8.0 mils DFT

NOTE: If shop primed, field surface preparation for weld seams and abraded areas is SSPC-SP-10 and spot prime with Series 161 @ 3-5 mils dry or Carboline Carboguard 890 @ 3.0 - 5.0 DFT or Sherwin Williams Dura-Plate 235 @3.0-5.0 mils DFT.

2. Non-Submerged, Interior Exposure

Surface Preparation: SSPC-SP6 Commercial Blast

First Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 3.0-5.0 mils
dry Carboline Carboguard 60 @ 3.0 - 5.0 DFT
Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT

Second Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 4.0-6.0 mils dry
Carboline Carboguard 60 @ 4.0 - 6.0 DFT
Sherwin Williams Macropoxy 646 at 4.0-6.0 mils DFT

NOTE: If shop primed, field surface preparation for weld seams and abraded areas is SSPC-SP-10 and spot prime with Series N69 @ 3-5 mils dry or Carboline Carboguard 60 @ 3.0 - 5.0 DFT or Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT.

3. Galvanized Steel (including Bar Joist and Galvanized Steel)
 Surface Preparation: SSPC-SPI Solvent Clean on galvanized surfaces.
 SSPC-SP7 Brush-Off blast to lightly profile surface.
 First Coat: N69 Hi-Build Epoxoline II @ 2.0-4.0 mils dry
 Carboline Carboguard 888 @ 3.0 - 4.0 DFT
 Sherwin Williams Macropoxy 646 at 3.0-4.0 mils DFT

B. Non-Ferrous Metals:

1. Interior Exposure
 Surface Preparation: SSPC-SP1 Solvent Clean and Scarify per SSPC-SP 3
 First Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 2.0-3.0 mils dry
 Carboline Carboguard 60 @ 3.0 - 5.0 DFT
 Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT
 Second Coat: Tnemec Series N69 Hi-Build Epoxoline II @ 3.0-5.0 mils dry
 Carboline Carboguard 60 @ 3.0 - 5.0 DFT
 Sherwin Williams Macropoxy 646 at 3.0-5.0 mils DFT

2.3 COLOR CODING AND PROCESS SYSTEM IDENTIFICATION

- A. The following color coding is suggested for wastewater transport and treatment systems. Color coding for processing piping, equipment and appurtenances is a suggested system unless otherwise specified or requested by Owner. Final coding to be determined in the field:

1. Equipment - light gray with O.S.H.A. orange coupling guards and O.S.H.A. yellow belt guards.
2. Pipe Supports - hangers to be same color as piping applied, floor post to be same as adjacent wall color, and fabricated racks to be manufacturer's standard protective finish or paint same as adjacent wall color if not having a suitable protective finish.
3. Process piping-exposed interior or exterior shall match the existing facility color-coding system. Contractor shall confirm colors and identification requirements with the owner prior to painting. Unless otherwise directed by the Owner, use the following color-coding system:

System	Service	Pipe Material	Color	Tags
Digested Sludge	Feed to the Screw Press	DIP	Light Brown	"DIGESTED SLUDGE" with flow direction
Polymer	Feed to the Screw Press	PVC	Unpainted	"POLYMER" with flow direction
Filtrate	From Screw	PVC	Tan	"FILTRATE" with

	Press to PST			flow direction
Potable (City) water	-	Galvanized	OSHA Blue*	“POTABLE WATER” with flow direction
Non-Potable Water	-	Galvanized	Aqua*	“NON-POTABLE”
Plant Water	-	Galvanized	Blue	“PLANT WATER” with flow direction
Hoist and Trolleys	-	-	OSHA Yellow*	-

*These colors are recommended as standard by WEF.

- B. Miscellaneous, non-process related items such as electrical conduit, duct work, roof drains, etc. are to be properly prepped and finished to match adjacent wall or ceiling color.
1. In situations where two colors do not have sufficient contrast to easily differentiate between them, a six (6) inch band of contrasting color shall be on one of the pipes at approximately thirty (30) inch intervals.

2.4 SURFACE PREPARATION

A. General:

1. Dislodge dirt, rust, plaster nibs, mortar spatter and other dry material by scraping or brushing. Remove dust and loose material by brushing, sweeping, vacuuming or blowing with high-pressure air.
2. Remove oil, wax and grease by scraping off heavy deposits and cleaning with mineral spirits or a hot trisodium phosphate solution followed by a water rinse.
3. Verify that surfaces to be coated are dry, clean and free of dust, dirt, oil, wax grease or other contaminants.

B. Non-Ferrous Metal:

1. SSPC-SPI solvent cleaning to remove all contaminants.

C. Ferrous Metal:

1. Enclosed: Remove loose rust, mill scale and other foreign matter by hand (SSPC-SP2) or power tool (SSPC-SP3) cleaning and apply specified coating before rusting occurs.
2. Non-Submerged, Architecturally Exposed: Society of Protective Coatings, SSPC-SP6 Commercial Blast.
3. Submerged Steel: Society of Protective Coatings, SSPC-SP10 Near White Blast.

D. Galvanized Metal:

1. Remove contaminants and protective mill coating by SSPC-SP1 Solvent Cleaning or steam cleaning. All surfaces shall be prepared by light brush blasting to achieve a minimum 1.0 mil abrasive blast profile

PART 3 - EXECUTION

3.1 PRE-WORK INSPECTION

- A. Examine surfaces to be coated and report conditions that would adversely affect appearance or performance of coating systems and which cannot be put into an acceptable condition by preparatory work specified in Paragraph 3.2.
- B. Do not proceed with surface preparation and application until surface is acceptable or authorization to proceed is given by the Owner's representative.

3.2 SURFACE PREPARATION

- A. General:
 - 1. Dislodge dirt, rust, plaster nibs, mortar spatter and other dry material by scraping or brushing. Remove dust and loose material by brushing, sweeping, vacuuming or blowing with high-pressure air.
 - 2. Remove oil, wax and grease by scraping off heavy deposits and cleaning with mineral spirits or a hot trisodium phosphate solution followed by a water rinse.
 - 3. Verify that surfaces to be coated are dry, clean and free of dust, dirt, oil, wax grease or other contaminants.
- B. Non-Ferrous Metal:
 - 1. SSPC-SPI solvent cleaning to remove all contaminants.
- C. Ferrous Metal:
 - 1. Enclosed: Remove loose rust, mill scale and other foreign matter by hand (SSPC-SP2) or power tool (SSPC-SP3) cleaning and apply specified coating before rusting occurs.
 - 2. Non-Submerged, Architecturally Exposed: Society of Protective Coatings, SSPC-SP6 Commercial Blast.
 - 3. Submerged Steel: Society of Protective Coatings, SSPC-SP10 Near White Blast.
- D. Galvanized Metal:
 - 1. Remove contaminants and protective mill coating by SSPC-SP1 Solvent Cleaning or steam cleaning. All surfaces shall be prepared by light brush blasting to achieve a minimum 1.0 mil abrasive blast profile

3.3 APPLICATION

- A. General: Apply special coatings by brush, roller, spray, squeegee, or other applicators in accordance with the manufacturer's directions. Brushes best suited for the type of

material being applied. Use rollers of carpet, velvet back, or high-pile sheep's wool as recommended by the manufacturer for the material and texture required.

1. Coating colors, surfaces treatments and finishes are indicated in the "Schedules" of the contract documents.
 2. Provide finish coats that are compatible with the primers used.
 3. The number of coats and coating film thickness required is the same regardless of the application method. Do not apply succeeding coats until the previous coat has cured as recommended by the coating manufacturer. Sand between coating applications where sanding is required to produce an even smooth surface in accordance with the coating manufacturer's directions.
 4. Coat surfaces behind movable equipment and furniture the same as similar exposed surfaces.
 5. Coat the back sides of access panels, removable or hinged covers, and similar hinged items, to match exposed surfaces.
- B. Minimum Coating Thickness: Apply each material at not thinner than the manufacturer's recommended spreading rate. Provide a total dry film thickness of the entire coating system as recommended by the manufacturer.
- C. Prime Coats: Before the application of finish coats, apply a prime coat, as recommended by the coating manufacturer, to material that is required to be painted or finished, and which has not been prime coated by others.
1. Recoat primed and sealed substrates where there is evidence of suction spots or unsealed areas in the first coat, to assure a finish coat with no burn-through or other defects due to insufficient sealing.
- D. Brush Application: Brush-out and work brush coats into surfaces in an even film. Eliminate cloudiness, spotting, holidays, laps, brush marks, runs, sags, ropiness, or other surface imperfections. Neatly draw glass lines and color breaks.
1. Apply primers and first coats by brush unless the manufacturer's instructions permit use of mechanical applicators.
- E. Mechanical Applications: Use mechanical methods for coating applications permitted by the coating manufacturer's recommendations, governing ordinances, and trade union regulations.
1. Wherever spray application is used, apply each coat to provide the equivalent hiding of brush-applied coats. Do not double-back with spray equipment building-up film thickness of 2 coats in one pass, unless recommended by the coating manufacturer.
- F. Completed Work: Match approved samples for color, texture and coverage. Remove, refinish or recoat work not in compliance with specified requirements.
- G. Spray application will not be permitted for the Primary Clarifier Painting bid item.

3.4 INSPECTION

- A. Request acceptance of each coat before applying succeeding coats.
- B. The Contractor shall furnish the Engineer a suitable thickness detector of a type recommended by the paint manufacturer.
- C. Any field painting found to be defective shall be removed and the surfaces repainted as the Engineer may direct at no additional cost to the Owner.
- D. Before final approval of the work, all damaged surfaces of paint (field or factory applied) shall be cleaned and repainted or touched up as directed.

3.5 FIELD QUALITY CONTROL

- A. The Owner reserves the right to invoke the following material testing procedure at any time, and at any number of times during the period when coating operations are being conducted.
 - 1. The Owner will engage the services of an independent testing laboratory to sample the coating being used. Samples of material delivered to project site will be taken, identified and sealed, and certified in the presence of the Contractor.
 - 2. The testing laboratory will perform appropriate tests for any or all of the following characteristics as required by the Owner:
 - a. Quantitative materials analysis.
 - b. Absorption.
 - c. Accelerated weathering.

3.6 CLEANING

- A. Clean-Up: At the end of each workday during progress of work, remove rubbish, empty cans, rags and other discarded materials from the site.
 - 1. Upon completion of the work, clean window glass and other spattered surfaces. Remove spattered coatings by washing, scraping or other proper methods, using care not to scratch or otherwise damage adjacent finished surfaces.

3.7 PROTECTION

- A. Protect work of other trades, whether to be coated or not, against damage from coating operations. Correct damage by cleaning, repairing or replacing, and recoating as acceptable to the Engineer. Leave the work in an undamaged condition.
- B. Provide "Wet Paint" signs as required to protect newly-coated finishes. Remove temporary protective wrappings provided by others for protection of their work, after completion of coating operations.
 - 1. At completion of the work of other trades, touch-up and restore damaged or defaced coated surfaces.

END OF SECTION

SECTION 101423 - PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

A. Section Includes:

1. Panel signs.

1.2 ACTION SUBMITTALS

- A. Product Data: For each type of specified product.
- B. Product Schedule: For panel signs. Use same designations indicated on Drawings or specified.

1.3 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs.

1.4 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Separation or delamination of sheet materials and components.
 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Thermal Movements: For exterior signs, allow for thermal movements from ambient and surface temperature changes.
1. Temperature Change: 120 deg F, ambient; 180 deg F, material surfaces.

2.2 PANEL SIGNS

- A. Panel Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
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. Best Sign Systems, Inc.
 - b. Clarke Systems
 - c. Cosco
 - d. Seton Identification Products; a Brady Corporation company
2. Mounting: Manufacturer's standard method for substrates indicated.
3. Surface Finish and Applied Graphics:
 - a. Integral Sheet Color: Plastic sheet with color as indicated by manufacturer's designation.
4. Text and Typeface: Typeface as indicated by manufacturer's designation.
5. Flatness Tolerance: Sign is to remain flat or uniformly curved under installed conditions as indicated on Drawings and within a tolerance of plus or minus 1/16 inch measured diagonally from corner to corner.

2.3 PANEL-SIGN MATERIALS

- A. Vinyl Film: UV-resistant vinyl film of nominal thickness indicated, with pressure-sensitive, permanent adhesive on back; die cut to form characters or images as indicated on Drawings and suitable for exterior applications.

2.4 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.
 1. Verify adhesive complies with VOC emissions evaluation criteria.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, for compliance with requirements for installation tolerances and other conditions affecting performance of the Work.
- B. Verify that sign-support surfaces are within tolerances to accommodate signs without gaps or irregularities between backs of signs and support surfaces unless otherwise

indicated.

- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION OF PANEL SIGNS

- A. General: Install signs using mounting methods indicated and in accordance with manufacturer's written instructions.
 - 1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 - 2. Install signs so they do not protrude or obstruct in accordance with the accessibility standard.
 - 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Mounting Methods:
 - 1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

3.3 ADJUSTING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.

3.4 CLEANING

- A. On completion of installation, clean exposed surfaces of signs in accordance with manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423

SECTION 101423.16 - ROOM-IDENTIFICATION PANEL SIGNAGE

PART 1 - GENERAL

1.1 SUMMARY

- A. Section includes room-identification signs that are directly attached to the building.

1.2 UNIT PRICES

- A. Work of this Section is affected by unit prices specified in Section 012200 "Unit Prices."

1.3 DEFINITIONS

- A. Accessible: In accordance with the accessibility standard.

1.4 COORDINATION

- A. Furnish templates for placement of sign-anchorage devices embedded in permanent construction by other installers.
- B. Furnish templates for placement of electrical service embedded in permanent construction by other installers.

1.5 ACTION SUBMITTALS

- A. Product Data: For each type of product.
- B. Sustainable Design Submittals:
 - 1. Product Data: For adhesives, indicating VOC content.
 - 2. Laboratory Test Reports: For adhesives, indicating compliance with requirements for low-emitting materials.
- C. Shop Drawings: For room-identification signs.
 - 1. Include fabrication and installation details and attachments to other work.
 - 2. Show sign mounting heights, locations of supplementary supports to be provided by other installers, and accessories.
 - 3. Show message list, typestyles, graphic elements, including raised characters and Braille, and layout for each sign at least half size.

- D. Samples for Initial Selection: For each type of sign assembly, exposed component, and exposed finish.
 - 1. Include representative Samples of available typestyles and graphic symbols.
- E. Product Schedule: For room-identification signs. Use same designations indicated on Drawings or specified.

1.6 INFORMATIONAL SUBMITTALS

- A. Qualification Data: For Installer and manufacturer.
- B. Sample Warranty: For special warranty.

1.7 CLOSEOUT SUBMITTALS

- A. Maintenance Data: For signs to include in maintenance manuals.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.

1.9 WARRANTY

- A. Special Warranty: Manufacturer agrees to repair or replace components of signs that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Deterioration of finishes beyond normal weathering.
 - b. Deterioration of embedded graphic image.
 - c. Separation or delamination of sheet materials and components.
 - 2. Warranty Period: Five years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Accessibility Standard: Comply with applicable provisions in the ABA standards of the Federal agency having jurisdiction and ICC A117.1.

2.2 ROOM-IDENTIFICATION SIGNS

- A. Room-Identification Sign: Sign with smooth, uniform surfaces; with message and characters having uniform faces, sharp corners, and precisely formed lines and profiles; and as follows:
 - 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. ACE Sign Systems, Inc.
 - b. Allen Industries
 - c. Best Sign Systems, Inc.
 - d. Cosco
 - e. Seton Identification Products; a Brady Corporation company
 - 2. Laminated-Sheet Sign: Photopolymer face sheet with raised graphics laminated over subsurface graphics to acrylic backing sheet to produce composite sheet.
 - a. Composite-Sheet Thickness: 0.125 inch.
 - b. Surface-Applied Graphics: Applied vinyl film.
 - c. Color(s): As selected by A/E from manufacturer's full range.
 - 3. Sign-Panel Perimeter: Finish edges smooth.
 - a. Edge Condition: Square cut.
 - b. Corner Condition in Elevation: Rounded to radius indicated.
 - 4. Mounting: [Manufacturer's standard method for substrates indicated.
 - 5. Text and Typeface: Accessible raised characters and Braille typeface as indicated by manufacturer's designation. Finish raised characters to contrast with background color, and finish Braille to match background color.

2.3 SIGN MATERIALS

- A. Aluminum Sheet and Plate: ASTM B209, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- B. Aluminum Extrusions: ASTM B221, alloy and temper recommended by aluminum producer and finisher for type of use and finish indicated.
- C. Acrylic Sheet: ASTM D4802, category as standard with manufacturer for each sign, Type UVF (UV filtering).
- D. Vinyl Film: UV-resistant vinyl film with pressure-sensitive, permanent adhesive; die cut to form characters or images as indicated on Drawings.

- E. Paints and Coatings for Sheet Materials: Inks, dyes, and paints that are recommended by manufacturer for optimum adherence to surface and are UV and water resistant for colors and exposure indicated.

2.4 ACCESSORIES

- A. Adhesive: As recommended by sign manufacturer.
- B. Two-Face Tape: Manufacturer's standard high-bond, foam-core tape, 0.045 inch thick, with adhesive on both sides.

2.5 FABRICATION

- A. General: Provide manufacturer's standard sign assemblies according to requirements indicated.
 - 1. Preassemble signs and assemblies in the shop to greatest extent possible. Disassemble signs and assemblies only as necessary for shipping and handling limitations. Clearly mark units for reassembly and installation; apply markings in locations concealed from view after final assembly.
 - 2. Mill joints to a tight, hairline fit. Form assemblies and joints exposed to weather to resist water penetration and retention.
 - 3. Conceal connections if possible; otherwise, locate connections where they are inconspicuous.
 - 4. Provide rabbets, lugs, and tabs necessary to assemble components and to attach to existing work. Drill and tap for required fasteners. Use concealed fasteners where possible; use exposed fasteners that match sign finish.

2.6 GENERAL FINISH REQUIREMENTS

- A. Protect mechanical finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. Appearance of Finished Work: Noticeable variations in same piece are not acceptable. Variations in appearance of adjoining components are acceptable if they are within the range of approved Samples and are assembled or installed to minimize contrast.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. General: Install signs using mounting methods indicated and according to manufacturer's written instructions.

1. Install signs level, plumb, true to line, and at locations and heights indicated, with sign surfaces free of distortion and other defects in appearance.
 2. Install signs so they do not protrude or obstruct according to the accessibility standard.
 3. Before installation, verify that sign surfaces are clean and free of materials or debris that would impair installation.
- B. Accessibility: Install signs in locations on walls according to the accessibility standard.
- C. Mounting Methods:
1. Adhesive: Clean bond-breaking materials from substrate surface and remove loose debris. Apply linear beads or spots of adhesive symmetrically to back of sign and of suitable quantity to support weight of sign after cure without slippage. Keep adhesive away from edges to prevent adhesive extrusion as sign is applied and to prevent visibility of cured adhesive at sign edges. Place sign in position, and push to engage adhesive. Temporarily support sign in position until adhesive fully sets.

3.2 ADJUSTING AND CLEANING

- A. Remove and replace damaged or deformed signs and signs that do not comply with specified requirements. Replace signs with damaged or deteriorated finishes or components that cannot be successfully repaired by finish touchup or similar minor repair procedures.
- B. Remove temporary protective coverings and strippable films as signs are installed.
- C. On completion of installation, clean exposed surfaces of signs according to manufacturer's written instructions, and touch up minor nicks and abrasions in finish. Maintain signs in a clean condition during construction and protect from damage until acceptance by Owner.

END OF SECTION 101423.16

SECTION 104300 - EMERGENCY AID SPECIALTIES

PART 1 - GENERAL

1.1 SUMMARY

- A. Section Includes:
 - 1. Automated external defibrillators.
 - 2. Automated external defibrillator cabinets.
 - 3. SCBA and associated accessories.
- B. Related Requirements:
 - 1. Section 104413 "Fire Protection Cabinets" for fire extinguisher, fire hose, and fire valve cabinets.

1.2 DEFINITIONS

- A. AED: Automated external defibrillator.
- B. NIOSH: National Institute for Occupational Safety and Health; part of the U.S. Centers for Disease Control and Prevention.
- C. SCBA: Self-contained breathing apparatus.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of specified product.
 - 1. AEDs.
 - 2. AED Cabinets: Coordinate final AED schedule with number and type of AEDs to ensure proper fit and function.
 - a. Show door hardware, cabinet type, trim style, and panel style. Include roughing-in dimensions and details showing surface-mounting method and relationships of box and trim to surrounding construction.
 - 3. SCBA and Associated Accessories: In addition to requirements specified in Section 013300 "Submittal Procedures," include the following information:
 - a. Product Certificates: Include product certificates stating compliance with NIOSH and NFPA 1981 certification requirements.
 - b. Include manufacturer's sample warranty language.
- B. Field Quality Control Reports: For specified tests and inspections.

1.4 INFORMATIONAL SUBMITTALS

- A. Manufacturers' published instructions.

1.5 CLOSEOUT SUBMITTALS

- A. Warranty documentation.

1.6 WARRANTY FOR AUTOMATED EXTERNAL DEFIBRILLATORS

- A. Special Warranty: Manufacturer agrees to repair or replace AEDs that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: 8 years from date of Substantial Completion.

1.7 WARRANTY FOR SCBA AND ASSOCIATED ACCESSORIES

- A. Special Installer Extended Warranty: Installer warrants that assembled and installed SCBA and associated accessories perform in accordance with specified requirements and agrees to repair or replace components or products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.
 - 1. Extended-Warranty Period: Four years from date of Substantial Completion; full coverage for labor, materials, and equipment.
- B. Special Manufacturer Extended Warranty: Manufacturer warrants that SCBA and associated accessories perform in accordance with specified requirements and agrees to provide repair or replacement of components or products that fail to perform as specified within extended-warranty period. Warranty must convey to Owner upon acceptance of the Work.
 - 1. Extended-Warranty Period: Eight years from date of Substantial Completion; prorated coverage for materials only, freight prepaid.

PART 2 - PRODUCTS

2.1 AUTOMATED EXTERNAL DEFIBRILLATORS

- A. Automated External Defibrillators: Portable AED capable of automatically diagnosing life-threatening cardiac arrhythmias, suitable for use on adult or pediatric patients. Type, size, and capacity for each cabinet indicated.
 - 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Defibtech LLC; a Nihon Kohden company
 - b. Philips N.V.
 - c. Stryker Corporation
 - d. Zoll Medical Corporation
 - 2. Source Limitations: Obtain products from single manufacturer.
 - 3. Storage Case: Manufacturer's standard.
 - 4. Battery Capacity: Six hours.

5. Standby Life: Six years.
6. Optional Accessories: Additional adult pad set.

2.2 AUTOMATED EXTERNAL DEFIBRILLATOR CABINETS

- A. Automated External Defibrillator Cabinets: AED cabinet of suitable type, size and capacity for AED.
 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. JL Industries; Activar Construction Products Group, Inc.
 - b. Larsen's Manufacturing Company
 - c. Modern Metal Products
 - d. Potter Roemer LLC; a Division of Morris Group International
 2. Source Limitations: Obtain products from single manufacturer.
- B. Cabinet Construction: Flush doors with 5/8-inch doorstop attached by continuous hinge and equipped with zinc-plated pull and roller catch.
- C. Fire Rating: Nonrated.
- D. Surface-Mounted Cabinet: Rolled edge cabinet box fully exposed and mounted directly on wall with no trim.
- E. Door Hardware: Manufacturer's standard door-operating hardware of proper type for cabinet type, trim style, and door material and style indicated.
- F. Cabinet Material: Stainless steel sheet.
- G. Door Material: Stainless steel sheet.
- H. Door Style: Fully glazed acrylic sheet with frame.
- I. Finishes:
 1. Stainless Steel Sheet: Manufacturer's standard #4 satin.
- J. Alarm: Actuates when fire-protection cabinet door is opened and is powered by batteries.
 1. Manufacturer's standard audible alarm or manufacturer's optional, siren strobe.
 - a. Alarm contacts for existing alarm systems.
- K. Identification: Manufacturer's standard graphics and lettering complying with authorities having jurisdiction for letter style, size, spacing, and location.

2.3 SCBA AND ASSOCIATED ACCESSORIES

- A. Performance Criteria: Certified in accordance with NFPA 1981, by organization accredited in accordance with ISO/IEC 17065, after certification by NIOSH.

B. SCBA Assembly:

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. MSA Safety, Inc.
 - b. Scott; brand of 3M
 - c. Survivair; brand of Honeywell International Inc.
2. Source Limitations: Obtain products from single manufacturer.
3. Product Characteristics:
 - a. Description: Open-circuit, pressure-demand, compressed-air SCBA; includes completely assembled, portable, self-contained devices designed for application in hazardous breathing environments. Tested and certified by the NIOSH and the Mine Safety and Health Administration in accordance with 42 CFR 84, Subpart H.
 - b. Face Piece: Silicon, EPDM, or nitrile rubber; one-size-fits-all with double-sealing edge, stainless steel speaking diaphragm and lens retainer, five adjustable straps to hold face piece to head (two straps on each side and one on top), exhalation valve in mask, close-fitting nose piece to ensure no CO₂ buildup, and perspiration drain to avoid skin irritation and prevent lens fogging.
 - c. Backplate: Ergonomically designed of glass fiber, aluminum, or thermoset plastic.
 - d. Harness and Carrier Assembly: Large triangular back pad, with backplate and adjustable waist and shoulder straps. Modular design, detachable components, easy to clean and maintain. Shoulder straps are padded with flame-resistant material, reinforced with stainless steel cable, and attached with T-nuts, washers, and screws.
4. Accessories:
 - a. Air Cylinder, Regulator, and Pressure Gauges: 30 minutes, low-pressure 2216 psig, carbon-fiber composite, fiberglass composite, or all-aluminum cylinders fitted with quick-fill assembly for refilling and air transfer. Two-stage regulator, and gauge with end-of-service-time whistle signal.
 - b. Wall-Mounted Case: Watertight, high visibility orange or yellow, corrosion-resistant, tough, lockable plastic case.

PART 3 - EXECUTION

3.1 INSTALLATION OF AUTOMATED EXTERNAL DEFIBRILLATOR CABINETS

- A. Proceed with installation only after unsatisfactory conditions have been corrected.
- B. Install AED cabinets in locations and at mounting heights indicated.
- C. Fasten cabinets to structure, square and plumb.

3.2 INSTALLATION OF SCBA AND ASSOCIATED ACCESSORIES

- A. Comply with manufacturers' published instructions.
- B. Reference Standards for Installation: Unless more stringent installation requirements are specified in the Contract Documents or manufacturers' published instructions, comply with the following:
 - 1. SCBA and Associated Accessories: NFPA 1981.
 - 2. Consult Architect for resolution of conflicting requirements.
- C. Special Installation Techniques:
 - 1. SCBA and Associated Accessories:
 - a. Install warning signs, labels, and nameplates to identify SCBA locations and equipment.
- D. Interfaces with Other Work:
 - 1. Coordinate installation of new products with existing conditions.

3.3 FIELD QUALITY CONTROL OF SCBA AND ASSOCIATED ACCESSORIES

- A. Field tests and inspections must be witnessed by authorities having jurisdiction.
- B. Tests and Inspections:
 - 1. Perform manufacturers' recommended tests and inspections.
 - 2. SCBA and Associated Accessories: Perform tests and inspections required by NFPA 1981.
- C. Nonconforming Work:
 - 1. Units will be considered defective if they do not pass tests and inspections.
 - 2. Remove and replace defective units and retest.
- D. Field Quality Control Reports: Collect, assemble, and submit test and inspection reports.

3.4 CLOSEOUT ACTIVITIES FOR SCBA AND ASSOCIATED ACCESSORIES

- A. Training:
 - 1. Engage factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain SCBA and associated accessories. See requirements in Section 017900 "Demonstration and Training."
 - 2. SCBA Training: Provide instructional video that details operating procedures of equipment.

3.5 PROTECTION

- A. After installation, protect emergency aid specialties from construction activities. Remove and replace items that are contaminated, defaced, damaged, or otherwise caused to be unfit for use prior to acceptance by Owner.

END OF SECTION 104300

SECTION 104416 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification Sections, apply to work of this section.

1.2 SUMMARY

- A. Section includes portable, hand-carried fire extinguishers and mounting brackets for fire extinguishers.

1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product. Include rating and classification, material descriptions, dimensions of individual components and profiles, and finishes for fire extinguisher and mounting brackets.
- B. Product Schedule: For fire extinguishers. Coordinate final fire-extinguisher schedule with fire-protection cabinet schedule to ensure proper fit and function.

1.4 INFORMATIONAL SUBMITTALS

- A. Warranty: Sample of special warranty.

1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For fire extinguishers to include in maintenance manuals.

1.6 COORDINATION

- A. Coordinate type and capacity of fire extinguishers with fire-protection cabinets to ensure fit and function.

1.7 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace fire extinguishers that fail in materials or workmanship within specified warranty period.
 - 1. Failures include, but are not limited to, the following:
 - a. Failure of hydrostatic test according to NFPA 10 when testing interval required by NFPA 10 is within the warranty period.
 - b. Faulty operation of valves or release levers.

2. Warranty Period: Six years from date of Substantial Completion.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. NFPA Compliance: Fabricate and label fire extinguishers to comply with NFPA 10, "Portable Fire Extinguishers."
- B. Fire Extinguishers: Listed and labeled for type, rating, and classification by an independent testing agency acceptable to authorities having jurisdiction.

2.2 PORTABLE, HAND-CARRIED FIRE EXTINGUISHERS

- A. Fire Extinguishers: Type, size, and capacity for each mounting bracket indicated.
 1. Manufacturers: Subject to compliance with requirements, available manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - a. Amerex Corporation
 - b. Ansul
 - c. Babcock-Davis
 - d. Badger Fire Protection
 - e. Guardian Fire Equipment, Inc
 - f. J. L. Industries, Inc.
 - g. Kidde
 - h. Larsen's Manufacturing Company
 - i. Potter Roemer LLC
 - j. Pyro-Chem
 2. Source Limitations: Obtain fire extinguishers, fire-protection cabinets, and accessories, from single source from single manufacturer.
 3. Valves: Manufacturer's standard.
 4. Handles and Levers: Stainless steel.
 5. Instruction Labels: Include pictorial marking system complying with NFPA 10, Appendix B, and bar coding for documenting fire-extinguisher location, inspections, maintenance, and recharging.
- B. Multipurpose Dry-Chemical Type in Aluminum: UL-rated 4-A:60-B:C, 10-lb nominal capacity, with monoammonium phosphate-based dry chemical in enameled-aluminum container.

2.3 MOUNTING BRACKETS

- A. Mounting Brackets: Manufacturer's standard steel, designed to secure fire extinguisher to wall or structure, of sizes required for types and capacities of fire extinguishers indicated, with plated or black baked-enamel finish.

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. Amerex Corporation
 - b. Ansul
 - c. Babcock-Davis
 - d. Badger Fire Protection
 - e. Guardian Fire Equipment, Inc
 - f. J. L. Industries, Inc.
 - g. Kidde
 - h. Larsen's Manufacturing Company
 - i. Nystrom, Inc.
 - j. Pyro-Chem
 2. Source Limitations: Obtain mounting brackets and fire extinguishers from single source from single manufacturer.
- B. Identification: Lettering complying with authorities having jurisdiction for letter style, size, spacing, and location. Locate as indicated by A/E.
1. Identify bracket-mounted fire extinguishers with the words "FIRE EXTINGUISHER" in red letter decals applied to mounting surface.
 - a. Orientation: Vertical.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine fire extinguishers for proper charging and tagging.
 1. Remove and replace damaged, defective, or undercharged fire extinguishers.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. General: Install fire extinguishers and mounting brackets in locations indicated and in compliance with requirements of authorities having jurisdiction.
- B. Mounting Brackets: Fasten mounting brackets to surfaces, square and plumb, at locations indicated.
 1. Mounting Height: Top of fire extinguisher to be at 42 inches above finished floor.

END OF SECTION 104416

SECTION 230512 - BASIC HVAC MATERIALS AND METHODS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Piping materials and installation instructions common to most piping systems.
 - 2. Sleeves.
 - 3. Escutcheons.
 - 4. Equipment installation requirements common to equipment sections.
 - 5. Painting and finishing.
 - 6. Concrete bases.
 - 7. Supports and anchorages.
 - 8. HVAC demolition.

1.3 DEFINITIONS

- A. Finished Spaces: Spaces other than mechanical and electrical equipment rooms, furred spaces, pipe and duct shafts, unheated spaces immediately below roof, spaces above ceilings, unexcavated spaces, crawlspaces, and tunnels.
- B. Exposed, Interior Installations: Exposed to view indoors. Examples include finished occupied spaces and mechanical equipment rooms.
- C. Exposed, Exterior Installations: Exposed to view outdoors or subject to outdoor ambient temperatures and weather conditions. Examples include rooftop locations.
- D. Concealed, Interior Installations: Concealed from view and protected from physical contact by building occupants. Examples include above ceilings and in duct shafts.
- E. Concealed, Exterior Installations: Concealed from view and protected from weather conditions and physical contact by building occupants but subject to outdoor ambient temperatures. Examples include installations within unheated shelters.

1.4 QUALITY ASSURANCE

- A. Steel Support Welding: Qualify processes and operators according to AWS D1.1, "Structural Welding Code--Steel."

- B. Electrical Characteristics for Mechanical Equipment: Equipment of higher electrical characteristics may be furnished provided such proposed equipment is approved in writing and connecting electrical services, circuit breakers, and conduit sizes are appropriately modified. If minimum energy ratings or efficiencies are specified, equipment shall comply with requirements.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Deliver pipes and tubes with factory-applied end caps. Maintain end caps through shipping, storage, and handling to prevent pipe end damage and to prevent entrance of dirt, debris, and moisture.

1.6 COORDINATION

- A. Arrange for pipe spaces, chases, slots, and openings in building structure during progress of construction, to allow for mechanical installations.
- B. Coordinate installation of required supporting devices and set sleeves in poured-in-place concrete and other structural components as they are constructed.
- C. Coordinate requirements for access panels and doors for mechanical items requiring access that are concealed behind finished surfaces.

PART 2 - PRODUCTS

2.1 PIPE, TUBE, AND FITTINGS

- A. Refer to individual Division 23 piping Sections for pipe, tube, and fitting materials and joining methods.
- B. Pipe Threads: ASME B1.20.1 for factory-threaded pipe and pipe fittings.

2.2 JOINING MATERIALS

- A. Refer to individual Division 23 piping Sections for special joining materials not listed below.
- B. Pipe-Flange Gasket Materials: Suitable for chemical and thermal conditions of piping system contents.
 - 1. ASME B16.21, nonmetallic, flat, asbestos-free, 1/8-inch maximum thickness unless thickness or specific material is indicated.
 - a. Full-Face Type: For flat-face, Class 125, cast-iron and cast-bronze flanges.
 - b. Narrow-Face Type: For raised-face, Class 250, cast-iron and steel flanges.
 - 2. AWWA C110, rubber, flat face, 1/8 inch thick, unless otherwise indicated; and full-face or ring type, unless otherwise indicated.
- C. Flange Bolts and Nuts: ASME B18.2.1, carbon steel, unless otherwise indicated.

- D. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer, unless otherwise indicated.
- E. Solder Filler Metals: ASTM B 32, lead-free alloys. Include water-flushable flux according to ASTM B 813.
- F. Brazing Filler Metals: AWS A5.8, BCuP Series, copper-phosphorus alloys for general-duty brazing, unless otherwise indicated; and AWS A5.8, BAg1, silver alloy for refrigerant piping, unless otherwise indicated.

2.3 SLEEVES

- A. Galvanized-Steel Sheet: 0.0239-inch minimum thickness; round tube closed with welded longitudinal joint.
- B. Steel Pipe: ASTM A 53, Type E, Grade B, Schedule 40, galvanized, plain ends.
- C. Cast Iron: Cast or fabricated "wall pipe" equivalent to ductile-iron pressure pipe, with plain ends and integral waterstop, unless otherwise indicated.

2.4 ESCUTCHEONS

- A. Description: Manufactured wall and ceiling escutcheons and floor plates, with an ID to closely fit around pipe, tube, and insulation of insulated piping and an OD that completely covers opening.
- B. One-Piece, Deep-Pattern Type: Deep-drawn, box-shaped brass with polished chrome-plated finish.
- C. One-Piece, Cast-Brass Type: With set screw.
 - 1. Finish: Polished chrome-plated.
- D. One-Piece, Floor-Plate Type: Cast-iron floor plate.

PART 3 - EXECUTION

3.1 PIPING SYSTEMS - COMMON REQUIREMENTS

- A. Install piping according to the following requirements and Division 23 Sections specifying piping systems.
- B. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Indicated locations and arrangements were used to size pipe and calculate friction loss, expansion, pump sizing, and other design considerations. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- C. Install piping in concealed locations, unless otherwise indicated and except in equipment rooms and service areas.

- D. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- E. Install piping above accessible ceilings to allow sufficient space for ceiling panel removal.
- F. Install piping to permit valve servicing.
- G. Install piping at indicated slopes.
- H. Install piping free of sags and bends.
- I. Install fittings for changes in direction and branch connections.
- J. Install piping to allow application of insulation.
- K. Select system components with pressure rating equal to or greater than system operating pressure.
- L. Install escutcheons for penetrations of walls, ceilings, and floors according to the following:
 - 1. New Piping:
 - a. Piping with Fitting or Sleeve Protruding from Wall: One-piece, deep-pattern type.
 - b. Chrome-Plated Piping: One-piece, cast-brass type with polished chrome-plated finish.
 - c. Insulated Piping: One-piece, stamped-steel type with spring clips.
 - d. Bare Piping at Wall and Floor Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - e. Bare Piping at Ceiling Penetrations in Finished Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - f. Bare Piping in Unfinished Service Spaces: One-piece, cast-brass type with polished chrome-plated finish.
 - g. Bare Piping in Equipment Rooms: One-piece, cast-brass type.
 - h. Bare Piping at Floor Penetrations in Equipment Rooms: One-piece, floor-plate type.
- M. Install sleeves for pipes passing through concrete and masonry walls and concrete floor and roof slabs.
 - 1. Cut sleeves to length for mounting flush with both surfaces.
 - a. Exception: Extend sleeves installed in floors of mechanical equipment areas or other wet areas 2 inches above finished floor level. Extend cast-iron sleeve fittings below floor slab as required to secure clamping ring if ring is specified.
 - 2. Install sleeves in new walls and slabs as new walls and slabs are constructed.
 - 3. Install sleeves that are large enough to provide 1/4-inch annular clear space between sleeve and pipe or pipe insulation. Use the following sleeve materials:
 - a. Steel Pipe Sleeves: For pipes smaller than NPS 6.

- b. Stack Sleeve Fittings: For pipes penetrating floors with membrane waterproofing. Secure flashing between clamping flanges. Install section of cast-iron soil pipe to extend sleeve to 2 inches above finished floor level. Refer to Division 7 Sections for flashing materials and installation.
 - 1) Seal space outside of sleeve fittings with grout.
- 4. Except for underground wall penetrations, seal annular space between sleeve and pipe or pipe insulation, using joint sealants appropriate for size, depth, and location of joint. Refer to Division 7 Section "Joint Sealants" for materials and installation.
- N. Fire-Barrier Penetrations: Maintain indicated fire rating of walls, partitions, ceilings, and floors at pipe penetrations. Seal pipe penetrations with firestop materials. Refer to Division 7 Sections for materials and installation.
- O. Verify final equipment locations for roughing-in.
- P. Refer to equipment specifications in other Sections of these Specifications for roughing-in requirements.

3.2 PIPING JOINT CONSTRUCTION

- A. Join pipe and fittings according to the following requirements and Division 22 Sections specifying piping systems.
- B. Soldered Joints: Apply ASTM B 813, water-flushable flux, unless otherwise indicated, to tube end. Construct joints according to ASTM B 828 or CDA's "Copper Tube Handbook," using lead-free solder alloy complying with ASTM B 32.
- C. Brazed Joints: Construct joints according to AWS's "Brazing Handbook," "Pipe and Tube" Chapter, using copper-phosphorus brazing filler metal complying with AWS A5.8.
- D. Threaded Joints: Thread pipe with tapered pipe threads according to ASME B1.20.1. Join pipe fittings and valves as follows:
 - 1. Apply appropriate tape or thread compound to external pipe threads unless dry seal threading is specified.
- E. Flanged Joints: Select appropriate gasket material, size, type, and thickness for service application. Install gasket concentrically positioned. Use suitable lubricants on bolt threads.

3.3 PIPING CONNECTIONS

- A. Make connections according to the following, unless otherwise indicated:
 - 1. Install unions, in piping NPS 2 and smaller, adjacent to each valve and at final connection to each piece of equipment.

3.4 EQUIPMENT INSTALLATION - COMMON REQUIREMENTS

- A. Install equipment to allow maximum possible headroom unless specific mounting heights are not indicated.
- B. Install equipment level and plumb, parallel and perpendicular to other building systems and components in exposed interior spaces, unless otherwise indicated.
- C. Install mechanical equipment to facilitate service, maintenance, and repair or replacement of components. Connect equipment for ease of disconnecting, with minimum interference to other installations. Extend grease fittings to accessible locations.
- D. Install equipment to allow right of way for piping installed at required slope.

3.5 PAINTING

- A. Damage and Touchup: Repair marred and damaged factory-painted finishes with materials and procedures to match original factory finish.

3.6 CONCRETE BASES

- A. Concrete Bases: Anchor equipment to concrete base according to equipment manufacturer's written instructions and according to seismic codes at Project.
 - 1. Construct concrete bases of dimensions indicated, but not less than 4 inches larger in both directions than supported unit.
 - 2. Install dowel rods to connect concrete base to concrete floor. Unless otherwise indicated, install dowel rods on 18-inch centers around the full perimeter of the base.
 - 3. Install epoxy-coated anchor bolts for supported equipment that extend through concrete base, and anchor into structural concrete floor.
 - 4. Place and secure anchorage devices. Use supported equipment manufacturer's setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.
 - 5. Install anchor bolts to elevations required for proper attachment to supported equipment.
 - 6. Install anchor bolts according to anchor-bolt manufacturer's written instructions.
 - 7. Use concrete and reinforcement as specified in Division 3 Section "Cast-in-Place Concrete".

3.7 ERECTION OF METAL SUPPORTS AND ANCHORAGES

- A. Refer to Division 5 Section "Metal Fabrications" for structural steel.
- B. Cut, fit, and place miscellaneous metal supports accurately in location, alignment, and elevation to support and anchor mechanical materials and equipment.
- C. Field Welding: Comply with AWS D1.1.

3.8 HVAC DEMOLITION

- A. Refer to Sections "Cutting and Patching" and "Selective Demolition" for general demolition requirements and procedures.
- B. Disconnect, demolish, and remove piping systems, equipment, and components indicated to be removed.
 - 1. Piping to Be Removed: Remove portion of piping indicated to be removed and cap or plug remaining piping with same or compatible piping material.
 - 2. Piping to Be Abandoned in Place: Drain piping and cap or plug piping with same or compatible piping material.
 - 3. Ducts to Be Removed: Remove portion of ducts indicated to be removed and cap remaining ducts with same or compatible ductwork material.
 - 4. Ducts to Be Abandoned in Place: Cap ducts with same or compatible ductwork material.
 - 5. Equipment to Be Removed: Disconnect and cap services and remove equipment.
 - 6. Equipment to Be Removed and Reinstalled: Disconnect and cap services and remove, clean, and store equipment; when appropriate, reinstall, reconnect, and make equipment operational.
 - 7. Equipment to Be Removed and Salvaged: Disconnect and cap services and remove equipment and deliver to Owner.
- C. If pipe, insulation, or equipment to remain is damaged in appearance or is unserviceable, remove damaged or unserviceable portions and replace with new products of equal capacity and quality.

END OF SECTION 230512

SECTION 230553 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following mechanical identification materials and their installation:
 - 1. Equipment nameplates.
 - 2. Equipment markers.
 - 3. Pipe markers.

1.3 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Samples: For color, letter style, and graphic representation required for each identification material and device.

1.4 QUALITY ASSURANCE

- A. ASME Compliance: Comply with ASME A13.1, "Scheme for the Identification of Piping Systems," for letter size, length of color field, colors, and viewing angles of identification devices for piping.

1.5 COORDINATION

- A. Coordinate installation of identifying devices with completion of covering and painting of surfaces where devices are to be applied.
- B. Coordinate installation of identifying devices with location of access panels and doors.
- C. Install identifying devices before installing acoustical ceilings and similar concealment.

PART 2 - PRODUCTS

2.1 EQUIPMENT IDENTIFICATION DEVICES

- A. Equipment Nameplates: Metal, with data engraved or stamped, for permanent attachment on equipment.

1. Data:
 - a. Manufacturer, product name, model number, and serial number.
 - b. Capacity, operating and power characteristics, and essential data.
 - c. Labels of tested compliances.
 2. Location: Accessible and visible.
 3. Fasteners: As required to mount on equipment.
- B. Equipment Markers: Engraved, color-coded laminated plastic. Include contact-type, permanent adhesive.
1. Terminology: Match schedules as closely as possible.
 2. Data:
 - a. Name and plan number.
 - b. Equipment service.
 - c. Design capacity.
 - d. Other design parameters such as pressure drop, entering and leaving conditions, and speed.
 3. Size: 2-1/2 by 4 inches for control devices, dampers, and valves; 4-1/2 by 6 inches for equipment.

2.2 PIPING IDENTIFICATION DEVICES

- A. Manufactured Pipe Markers, General: Preprinted, color-coded, with lettering indicating service, and showing direction of flow.
1. Colors: Comply with ASME A13.1, unless otherwise indicated.
 2. Lettering: Use piping system terms indicated and abbreviate only as necessary for each application length.
 3. Pipes with OD, Including Insulation, Less Than 6 Inches: Full-band pipe markers extending 360 degrees around pipe at each location.
 4. Pipes with OD, Including Insulation, 6 Inches and Larger: Either full-band or strip-type pipe markers at least three times letter height and of length required for label.
 5. Arrows: Integral with piping system service lettering to accommodate both directions; or as separate unit on each pipe marker to indicate direction of flow.
- B. Self-Adhesive Pipe Markers: Plastic with pressure-sensitive, permanent-type, self-adhesive back.
- C. Plastic Tape: Continuously printed, vinyl tape at least 3 mils thick with pressure-sensitive, permanent-type, self-adhesive back.
1. Width for Markers on Pipes with OD, Including Insulation, Less Than 6 Inches: 3/4 inch minimum.
 2. Width for Markers on Pipes with OD, Including Insulation, 6 Inches or Larger: 1-1/2 inches minimum.

PART 3 - EXECUTION

3.1 APPLICATIONS, GENERAL

- A. Products specified are for applications referenced in other Division 23 Sections. If more than single-type material, device, or label is specified for listed applications, selection is Installer's option.

3.2 EQUIPMENT IDENTIFICATION

- A. Install and permanently fasten equipment nameplates on each major item of mechanical equipment that does not have nameplate or has nameplate that is damaged or located where not easily visible. Locate nameplates where accessible and visible. Include nameplates for the following general categories of equipment:
 - 1. Fuel-burning units, including furnaces, unit heaters, and water heaters.
 - 2. Compressors, condensers, and similar motor-driven units.
 - 3. Fans, blowers, primary balancing dampers, and mixing boxes.
 - 4. Packaged HVAC central-station and zone-type units.
- B. Install equipment markers with permanent adhesive on or near each major item of mechanical equipment. Data required for markers may be included on signs, and markers may be omitted if both are indicated.
 - 1. Letter Size: Minimum 1/4 inch for name of units if viewing distance is less than 24 inches, 1/2 inch for viewing distances up to 72 inches, and proportionately larger lettering for greater viewing distances. Include secondary lettering two-thirds to three-fourths the size of principal lettering.
 - 2. Data: Distinguish among multiple units, indicate operational requirements, indicate safety and emergency precautions, warn of hazards and improper operations, and identify units.
 - 3. Locate markers where accessible and visible. Include markers for the following general categories of equipment:
 - a. Fuel-burning units, including furnaces, unit heaters, and water heaters.
 - b. Compressors, condensers, and similar motor-driven units.
 - c. Fans, blowers, primary balancing dampers, and mixing boxes.
 - d. Packaged HVAC central-station and zone-type units.
- C. Install access panel markers with screws on equipment access panels.

3.3 PIPING IDENTIFICATION

- A. Install manufactured pipe markers indicating service on each piping system. Install with flow indication arrows showing direction of flow.
 - 1. Pipes with OD, Including Insulation, Less Than 6 Inches: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, 1-1/2 inches wide, lapped at least 1-1/2 inches at both ends of pipe marker, and covering full circumference of pipe.
 - 2. Pipes with OD, Including Insulation, 6 Inches and Larger: Self-adhesive pipe markers. Use color-coded, self-adhesive plastic tape, at least 1-1/2 inches wide, lapped at least 3 inches at both ends of pipe marker, and covering full circumference of pipe.

- B. Locate pipe markers and color bands where piping is exposed in finished spaces; machine rooms; accessible maintenance spaces such as shafts, tunnels, and plenums; and exterior nonconcealed locations as follows:
 - 1. Near each valve and control device.
 - 2. Near each branch connection, excluding short takeoffs for fixtures and terminal units. Where flow pattern is not obvious, mark each pipe at branch.
 - 3. Near penetrations through walls, floors, ceilings, and nonaccessible enclosures.
 - 4. At access doors, manholes, and similar access points that permit view of concealed piping.
 - 5. Near major equipment items and other points of origination and termination.
 - 6. Spaced at maximum intervals of 50 feet along each run. Reduce intervals to 25 feet in areas of congested piping and equipment.
 - 7. On piping above removable acoustical ceilings. Omit intermediately spaced markers.

3.4 ADJUSTING

- A. Relocate mechanical identification materials and devices that have become visually blocked by other work.

3.5 CLEANING

- A. Clean faces of mechanical identification devices.

END OF SECTION 230553

SECTION 230593 - TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes TAB to produce design objectives for the following:
 - 1. Air Systems:
 - a. Constant-volume air systems.
 - 2. HVAC equipment quantitative-performance settings.
 - 3. Verifying that automatic control devices are functioning properly.
 - 4. Reporting results of activities and procedures specified in this Section.

1.3 DEFINITIONS

- A. TAB: Testing, adjusting, and balancing.
- B. Testing, Adjusting, and Balancing (TAB) Firm: The entity responsible for performing and reporting TAB procedures.

1.4 SUBMITTALS

- A. Certified TAB Reports: Submit two copies of reports prepared, as specified in this Section, on approved forms certified by TAB firm.

1.5 QUALITY ASSURANCE

- A. TAB Firm Qualifications: Engage a TAB firm certified by either AABC or NEBB.

PART 2 - PRODUCTS (Not Applicable)

PART 3 - EXECUTION

3.1 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 approved submittal data of HVAC systems and equipment.

- C. Examine systems for functional deficiencies that cannot be corrected by adjusting and balancing.

3.2 GENERAL PROCEDURES FOR TESTING AND BALANCING

- A. Perform testing and balancing procedures on each system according to the procedures contained in AABC's "National Standards for Testing and Balancing Heating, Ventilating, and Air Conditioning Systems" or NEBB's "Procedural Standards for Testing, Adjusting, and Balancing of Environmental Systems", and this Section.
- B. Take and report testing and balancing measurements in inch-pound (IP) units.

3.3 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.

3.4 PROCEDURES FOR CONSTANT – VOLUME AIR SYSTEMS

- A. Adjust fans to deliver total indicated airflows within the maximum allowable fan speed listed by fan manufacturer.
- B. Adjust terminal outlets and inlets for each space to indicated airflows within specified tolerances of indicated values. Make adjustments using volume dampers rather than extractors and the dampers at air terminals.

3.5 PROCEDURES FOR MOTORS

- A. Motors, 1/2 HP and Larger: Test at final balanced conditions and record the following data:
 - 1. Manufacturer, model, and serial numbers.
 - 2. Motor horsepower rating.
 - 3. Motor rpm.
 - 4. Efficiency rating.
 - 5. Nameplate and measured voltage, amperage, each phase.
 - 6. Starter thermal-protection-element rating.

3.6 PROCEDURES FOR TEMPERATURE MEASUREMENTS

- A. During TAB, report the need for adjustment in temperature regulation within the automatic temperature-control system.
- B. Measure indoor dry-bulb temperatures every other hour for a period of two successive eight-hour days, in each separately controlled zone, to prove correctness of final temperature settings.
- C. Measure outside-air dry-bulb temperatures.

3.7 TEMPERATURE-CONTROL VERIFICATION

- A. Verify that controllers are calibrated and commissioned.
- B. Check transmitter and controller locations and note conditions that would adversely affect control functions.
- C. Record controller settings and note variances between set points and actual measurements.
- D. Check the operation of limiting controllers (i.e., high- and low-temperature controllers).
- E. Check the interaction of electrically operated switch transducers.
- F. Check the interaction of interlock and lockout systems.
- G. Record voltages of power supply and controller output. Determine whether the system operates on a grounded or nongrounded power supply.
- H. Note operation of electric actuators using spring return for proper fail-safe operations.

3.8 TOLERANCES

- A. Set HVAC system airflow and water flow rates within the following tolerances:
 - 1. Supply, Return, and Exhaust Fans and Equipment with Fans: Plus or minus 5 percent.
 - 2. Air Outlets and Inlets: Plus or minus 5 percent.

3.9 FINAL REPORT

- A. General: Typewritten, or computer printout in letter-quality font, on standard bond paper, in three-ring binder, tabulated and divided into sections by tested and balanced systems.
- B. Include a certification sheet in front of binder signed and sealed by the certified testing and balancing engineer.
- C. Electric-Coil Heat Apparatus Test Reports: In addition to manufacturer's factory startup equipment reports, include the following:
 - 1. Unit Data:
 - a. System identification.
 - b. Location.
 - c. Make and type.
 - d. Model number and unit size.
 - e. Manufacturer's serial number.
 - f. Capacity in KW and Btuh.
 - g. Number of stages or type of modulating control.

- h. Connected volts, phase, and hertz.
- i. Rated amperage.
- j. Airflow rate in cfm.
- k. Face area in sq. ft.
- l. Minimum face velocity in fpm.
- m. Motor horsepower and rpm.
- n. Motor volts, phase, and hertz.
- o. Motor full-load amperage and service factor.
- p. Sheave make, size in inches, and bore.
- q. Sheave dimensions, center-to-center, and amount of adjustments in inches.

2. Test Data (Indicated and Actual Values):

- a. Total airflow rate in cfm.
- b. Entering-air temperature in deg F.
- c. Leaving-air temperature in deg F.
- d. Air temperature differential in deg F.
- e. Air velocity in fpm.
- f. Entering-air static pressure in inches wg.
- g. Leaving-air static pressure in inches wg.
- h. Air static-pressure differential in inches wg.
- i. Operating set point in deg F.
- j. Motor voltage at each connection.
- k. Motor amperage for each phase.
- l. Heating output in KW and Btuh.

D. Fan Test Reports: For supply, return, and 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. Sheave dimensions, center-to-center, and amount of adjustments in inches.
- i. Number of belts, make, and size.

2. Motor Data:

- a. Make and frame type and size.
- b. Horsepower and rpm.
- c. Volts, phase, and hertz.
- d. Full-load amperage and service factor.

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.

E. Air-Terminal-Device Reports:

1. Unit Data:

- a. System and air-handling unit identification.
- b. Location and zone.
- c. Test apparatus used.
- d. Air-terminal-device make.
- e. Air-terminal-device size.
- f. Air-terminal-device effective area in sq. ft. (sq. m).

2. Test Data (Indicated and Actual Values):

- a. Airflow rate in cfm.
- b. Air velocity in fpm.
- c. Final airflow rate in cfm.
- d. Final velocity in fpm.
- e. Space temperature in deg F.

3.10 ADDITIONAL TESTS

- A. Within 90 days of completing TAB, perform additional testing and balancing 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 testing, inspecting, and adjusting during near-peak summer and winter conditions.

END OF SECTION 230593

SECTION 230719 - HVAC PIPING INSULATION

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes preformed, flexible pipe insulation; insulating cements; field-applied jackets; accessories and attachments; and sealing compounds.

1.3 SUBMITTALS

- A. Product Data: Identify thermal conductivity, thickness, and jackets (both factory and field applied, if any), for each type of product indicated.
- B. Installer Certificates: Signed by the Contractor certifying that installers comply with requirements.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Skilled mechanics who have successfully completed an apprenticeship program or another craft training program certified by the U.S. Department of Labor, Bureau of Apprenticeship and Training.
- B. Fire-Test-Response Characteristics: As determined by testing materials identical to those specified in this Section according to ASTM E 84, by a testing and inspecting agency acceptable to authorities having jurisdiction. Factory label insulation and jacket materials and sealer and cement material containers with appropriate markings of applicable testing and inspecting agency.
 - 1. Insulation Installed Indoors: Flame-spread rating of 25 or less, and smoke-developed rating of 50 or less.
 - 2. Insulation Installed Outdoors: Flame-spread rating of 75 or less, and smoke-developed rating of 150 or less.

1.5 COORDINATION

- A. Coordinate size and location of supports, hangers, and insulation shields specified in Division 23 Section "Hangers and Supports."
- B. Coordinate clearance requirements with piping Installer for insulation application.

1.6 SCHEDULING

- A. Schedule insulation application after testing piping systems. Insulation application may begin on segments of piping that have satisfactory test results.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Flexible Elastomeric Thermal Insulation:
 - a. Armstrong World Industries, Inc.
 - b. Rubatex Corp.

2.2 INSULATION MATERIALS

- A. Flexible elastomeric thermal insulation is not suitable for temperatures lower than minus 70 deg F (minus 57 deg C) and higher than 220 deg F (104 deg C).
- B. Flexible Elastomeric Thermal Insulation: Closed-cell, sponge- or expanded-rubber materials. Comply with ASTM C 534, Type I for tubular materials and Type II for sheet materials.
 - 1. Adhesive: As recommended by insulation material manufacturer.
 - 2. Ultraviolet-Protective Coating: As recommended by insulation manufacturer.

2.3 FIELD-APPLIED JACKETS

- A. General: ASTM C 921, Type 1, unless otherwise indicated.
- B. Standard PVC Fitting Covers: Factory-fabricated fitting covers manufactured from 20-mil- thick, high-impact, ultraviolet-resistant PVC.
 - 1. Shapes: 45- and 90-degree, short- and long-radius elbows, tees, valves, flanges, reducers, end caps, soil-pipe hubs, traps, mechanical joints, and P-trap and supply covers for lavatories for the disabled.
 - 2. Adhesive: As recommended by insulation material manufacturer.

2.4 VAPOR RETARDERS

- A. Mastics: Materials recommended by insulation material manufacturer that are compatible with insulation materials, jackets, and substrates.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates and conditions for compliance with requirements for installation and other conditions affecting performance of insulation application.
- B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 GENERAL APPLICATION REQUIREMENTS

- A. Apply insulation materials, accessories, and finishes according to the manufacturer's written instructions; with smooth, straight, and even surfaces; free of voids throughout the length of piping, including fittings, valves, and specialties.
- B. Refer to schedules at the end of this Section for materials, forms, jackets, and thicknesses required for each piping system.
- C. Use accessories compatible with insulation materials and suitable for the service. Use accessories that do not corrode, soften, or otherwise attack insulation or jacket in either wet or dry state.
- D. Apply insulation with longitudinal seams at top and bottom of horizontal pipe runs.
- E. Seal joints and seams with vapor-retarder mastic on insulation indicated to receive a vapor retarder.
- F. Apply insulation over fittings, valves, and specialties, with continuous thermal and vapor-retarder integrity, unless otherwise indicated. Refer to special instructions for applying insulation over fittings, valves, and specialties.
- G. Interior Wall and Partition Penetrations: Apply insulation continuously through walls and floors.
- H. Fire-Rated Wall and Partition Penetrations: Apply insulation continuously through penetrations of fire-rated walls and partitions.
 - 1. Firestopping and fire-resistive joint sealers are specified in Division 7 Section "Firestopping."
- I. Floor Penetrations: Apply insulation continuously through floor assembly.
 - 1. For insulation with vapor retarders, seal insulation with vapor-retarder mastic where floor supports penetrate vapor retarder.

3.3 FLEXIBLE ELASTOMERIC THERMAL INSULATION APPLICATION

- A. Apply insulation to straight pipes and tubes as follows:
 - 1. Follow manufacturer's written instructions for applying insulation.

2. Seal longitudinal seams and end joints with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

B. Apply insulation to fittings and elbows as follows:

1. Apply mitered sections of pipe insulation.
2. Secure insulation materials and seal seams with manufacturer's recommended adhesive. Cement to avoid openings in insulation that will allow passage of air to the pipe surface.

3.4 FINISHES

- A. Flexible elastomeric Insulation: After adhesive has fully cured, apply two coats of the insulation manufacturer's recommended protective coating.

3.5 PIPING SYSTEM APPLICATIONS

- A. Insulation materials and thicknesses are specified in schedules at the end of this Section.
- B. Items Not Insulated: Unless otherwise indicated, do not apply insulation to the following systems, materials, and equipment:
1. Flexible connectors.
 2. Vibration-control devices.
 3. Air chambers, unions, strainers, check valves, plug valves, and flow regulators.

3.6 INSULATION APPLICATION SCHEDULE, GENERAL

- A. Application schedules identify piping system and indicate pipe size ranges and material, thickness, and jacket requirements.

3.7 INSULATION APPLICATION SCHEDULE

- A. Service: Refrigerant Suction and Liquid Piping.
1. Operating Temperature: 35 to 50 deg F.
 2. Insulation Material: Flexible Elastomeric.
 3. Insulation Thickness: ½ inch.
 4. Jacket: None.
 5. Vapor Retarder Required: No.
 6. Finish: Painted.
- B. Service: Interior Condensate Drain Piping.
1. Operating Temperature: 35 to 75 deg F.
 2. Insulation Material: Flexible elastomeric.
 3. Insulation Thickness: ½ inches.
 4. Jacket: None
 5. Vapor Retarder Required: No.
 6. Finish: Painted.

SECTION 232113 - HYDRONIC PIPING

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 pipe and fitting materials and joining methods for the following:
 - 1. Plastic pipe and fittings.
 - 2. Joining materials.

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Hydronic piping components and installation shall be capable of withstanding the following minimum working pressure and temperature unless otherwise indicated:
 - 1. Condensate-Drain Piping: 150 deg F.

2.2 PLASTIC PIPE AND FITTINGS

- A. PVC Plastic Pipe: ASTM D1785, with wall thickness as indicated in "Piping Applications" Article.
 - 1. PVC Plastic Pipe Fittings: Socket-type pipe fittings, ASTM D2466 for Schedule 40 pipe; ASTM D2467 for Schedule 80 pipe.

2.3 JOINING MATERIALS

- A. Plastic, Pipe-Flange Gasket, Bolts, and Nuts: Type and material recommended by piping system manufacturer unless otherwise indicated.
- B. Solvent Cements for PVC Piping: ASTM D2564. Include primer according to ASTM F656.

PART 3 - EXECUTION

3.1 PIPING APPLICATIONS

- A. Condensate-Drain Piping: Schedule 40 PVC plastic pipe and fittings and solvent-welded joints.

3.2 PIPING INSTALLATIONS

- A. Drawing plans, schematics, and diagrams indicate general location and arrangement of piping systems. Install piping as indicated unless deviations to layout are approved on Coordination Drawings.
- B. Install piping in concealed locations unless otherwise indicated and except in equipment rooms and service areas.
- C. Install piping indicated to be exposed and piping in equipment rooms and service areas at right angles or parallel to building walls. Diagonal runs are prohibited unless specifically indicated otherwise.
- D. Install piping above ceilings to allow sufficient space for ceiling panel removal.
- E. Install piping to permit valve servicing.
- F. Install piping at indicated slopes.
- G. Install piping free of sags and bends.
- H. Install fittings for changes in direction and branch connections.
- I. Install piping to allow application of insulation.
- J. Select system components with pressure rating equal to or greater than system operating pressure.
- K. Install unions in piping, NPS 2 and smaller, adjacent to valves, at final connections of equipment, and elsewhere as indicated.
- L. Comply with requirements in Section 230553 "Identification for HVAC Piping and Equipment" for identifying piping.
- M. Install sleeves for piping penetrations of walls, ceilings, and floors. Comply with requirements for sleeves specified in Division 23 Sections.
- N. Install escutcheons for piping penetrations of walls, ceilings, and floors. Comply with requirements for escutcheons specified in Division 23 Sections.

3.3 HANGERS AND SUPPORTS

- A. Install the following pipe attachments:
 - 1. Adjustable steel clevis hangers for individual horizontal piping less than 20 feet long.
 - 2. On plastic pipe, install pads or cushions on bearing surfaces to prevent hanger from scratching pipe.
- B. Plastic Piping Hanger Spacing: Space hangers according to pipe manufacturer's written instructions for service conditions. Avoid point loading.

- C. Support vertical runs at roof, at each floor, and at 10-foot intervals between floors.

3.4 PIPE JOINT CONSTRUCTION

- A. Remove scale, slag, dirt, and debris from inside and outside of pipe and fittings before assembly.
- B. Plastic Piping Solvent-Cemented Joints: Clean and dry joining surfaces. Join pipe and fittings according to the following:
 - 1. Comply with ASTM F402 for safe-handling practice of cleaners, primers, and solvent cements.
 - 2. PVC Pressure Piping: Join ASTM D1785 schedule number, PVC pipe and PVC socket fittings according to ASTM D2672. Join other-than-schedule number PVC pipe and socket fittings according to ASTM D2855.
 - 3. PVC Nonpressure Piping: Join according to ASTM D2855.

END OF SECTION 232113

SECTION 233113 - METAL DUCTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes metal ducts for supply, return, outside, and exhaust air-distribution systems in pressure classes from minus 2- to plus 2-inch wg. Metal ducts include the following:
 - 1. Rectangular ducts and fittings.
- B. Related Sections include the following:
 - 1. Section 233300 "Duct Accessories" for dampers, sound-control devices, duct-mounting access doors and panels, turning vanes, and flexible ducts.
 - 2. Section 230593 "Testing, Adjusting, and Balancing for HVAC".

1.3 QUALITY ASSURANCE

- A. NFPA Compliance:
 - 1. NFPA 90A, "Installation of Air Conditioning and Ventilating Systems."
 - 2. NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 DUCT MATERIALS

- A. 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. Aluminum Sheets: ASTM B 209, alloy 3003, temper H14; with mill finish for concealed ducts and standard, 1-side bright finish for exposed ducts. Material thicknesses shall comply with SMACNA's "Industrial Duct Construction Standards".
- C. Reinforcement Shapes and Plates: Galvanized-steel where installed on galvanized sheet metal ducts. Stainless-steel where installed on stainless-steel ducts. Where used on aluminum ducts, isolate the different metals with neoprene, butyl rubber, or EPDM gasket materials.

2.3 SEALANT MATERIALS

- A. Joint and Seam Sealants, General: The term "sealant" is not limited to materials of adhesive or mastic nature but includes tapes and combinations of open-weave fabric strips and mastics.
- B. Water-Based Joint and Seam Sealant: Flexible, adhesive sealant, resistant to UV light when cured, UL 723 listed, and complying with NFPA requirements for Class 1 ducts.
- C. Flanged Joint Mastic: One-part, acid-curing, silicone, elastomeric joint sealant complying with ASTM C 920, Type S, Grade NS, Class 25, Use O.
- D. Flange Gaskets: Butyl rubber or EPDM polymer with polyisobutylene plasticizer.

2.4 HANGERS AND SUPPORTS

- A. Hanger Materials:
 - 1. General: All hangers, supports, rods, etc. to be corrosion resistant, hot dipped galvanized for interior, and Type 316 or 304 stainless steel for exterior, except as noted otherwise.
- B. Hanger Type: Threaded rod. Straps and wires are not permitted.
 - 1. Rod Sizes: Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for rod diameters.
- C. Duct Attachments: Sheet metal screws, blind rivets, or self-tapping metal screws; compatible with duct materials.

D. Trapeze and Riser Supports:

1. Supports for Aluminum Ducts: Aluminum support materials, or galvanized steel, or stainless steel, electrolytically separated from ducts.

2.5 RECTANGULAR DUCT FABRICATION

- A. Fabricate ducts, elbows, transitions, offsets, branch connections, and other construction according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" and complying with requirements for metal thickness, reinforcing types and intervals, tie-rod applications, and joint types and intervals.
 1. Lengths: Fabricate rectangular ducts in lengths appropriate to reinforcement and rigidity class required for pressure class.
 2. Deflection: Duct systems shall not exceed deflection limits according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible."
- B. Transverse Joints: Prefabricated slide-on joints and components constructed using manufacturer's guidelines for material thickness, reinforcement size and spacing, and joint reinforcement.
 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Nexus Inc.
 - c. Ward Industries, Inc.
- C. Formed-On Flanges: Construct according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," Figure 1-4, using corner, bolt, cleat, and gasket details.
 1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Lockformer.
 2. Duct Size: Maximum 30 inches wide and up to 2-inch wg pressure class.
 3. Longitudinal Seams: Pittsburgh lock sealed with noncuring polymer sealant.

PART 3 - EXECUTION

3.1 DUCT APPLICATIONS

- A. Duct Materials: All duct materials shall be aluminum.
- B. Static-Pressure Classes: Unless otherwise indicated, construct ducts according to the following:

1. Supply Ducts: 2-inch wg with seal Class A seams and joint construction.
2. Return Ducts (Negative Pressure): 2-inch wg with seal Class A seams and joint construction.
3. Exhaust Ducts (Negative Pressure): 2-inch wg with seal Class A seams and joint construction.
4. Exhaust Ducts (Positive Pressure): 2-inch wg with seal Class A seams and joint construction.

3.2 DUCT INSTALLATION

- A. Construct and install ducts according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible," unless otherwise indicated.
- B. Install ducts with fewest possible joints.
- C. Install fabricated fittings for changes in directions, size, and shape and for connections.
- D. Install couplings tight to duct wall surface with a minimum of projections into duct. Secure couplings with sheet metal screws. Install screws at intervals of 12 inches, with a minimum of 3 screws in each coupling.
- E. Install ducts with a clearance of 1 inch, plus allowance for insulation thickness.
- F. Seal all joints and seams. Apply sealant to male end connectors before insertion, and afterward to cover entire joint and sheet metal screws.
- G. Non-Fire-Rated Partition Penetrations: Where ducts pass through interior partitions and exterior walls and are exposed to view, conceal spaces between construction openings and ducts or duct insulation with sheet metal flanges of same metal thickness as ducts. Overlap openings on 4 sides by at least 1-1/2 inches.
- H. Protect duct interiors from the elements and foreign materials until building is enclosed. Follow SMACNA's "Duct Cleanliness for New Construction."

3.3 SEAM AND JOINT SEALING

- A. Seal duct seams and joints according to SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for duct pressure class indicated.

3.4 HANGING AND SUPPORTING

- A. Support horizontal ducts within 24 inches of each elbow and within 48 inches of each branch intersection.

3.5 CONNECTIONS

- A. Make connections to equipment with flexible connectors according to Division 23 Section "Duct Accessories."
- B. Comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for branch, outlet and inlet, and terminal unit connections.

END OF SECTION 233113

SECTION 233300 - DUCT ACCESSORIES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Volume dampers.
 - 2. Turning vanes.
 - 3. Flexible connectors.
 - 4. Duct accessory hardware.

1.3 SUBMITTALS

- A. Product Data: All items specified and utilized on Project.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 90A, "Installation of Air Conditioning and Ventilating Systems," and NFPA 90B, "Installation of Warm Air Heating and Air Conditioning Systems."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 VOLUME DAMPERS

- A. Manufacturers:
 - 1. Air Balance, Inc.
 - 2. American Warming and Ventilating.
 - 3. Flexmaster U.S.A., Inc.
 - 4. McGill AirFlow Corporation.
 - 5. METALAIRE, Inc.
 - 6. Nailor Industries Inc.

7. Penn Ventilation Company, Inc.
8. Ruskin Company.
9. Vent Products Company, Inc.

- B. General Description: Factory fabricated, with required hardware and accessories. Stiffen damper blades for stability. Include locking device to hold single-blade dampers in a fixed position without vibration. Close duct penetrations for damper components to seal duct consistent with pressure class.
- C. Standard Volume Dampers: Multiple- or single-blade, parallel- or opposed-blade design as indicated, standard leakage rating, with linkage outside airstream, and suitable for horizontal or vertical applications.
1. Aluminum Frames: Hat-shaped, 0.10-inch- thick, aluminum sheet channels; frames with flanges where indicated for attaching to walls; and flangeless frames where indicated for installing in ducts.
 2. Roll-Formed Aluminum Blades: 0.10-inch- thick aluminum sheet.
 3. Bearings: Molded synthetic.
 4. Tie Bars and Brackets: Aluminum.
- D. Damper Hardware: Zinc-plated, die-cast core with dial and handle made of 3/32-inch-thick zinc-plated steel, and a 3/4-inch hexagon locking nut. Include center hole to suit damper operating-rod size. Include elevated platform for insulated duct mounting.

2.3 TURNING VANES

- A. Fabricate to comply with SMACNA's "HVAC Duct Construction Standards--Metal and Flexible" for vanes and vane runners. Vane runners shall automatically align vanes.
- B. Manufactured Turning Vanes: Fabricate 1-1/2-inch- wide, single-vane, curved blades of galvanized sheet steel set 3/4 inch o.c.; support with bars perpendicular to blades set 2 inches o.c.; and set into vane runners suitable for duct mounting.
1. Manufacturers:
 - a. Ductmate Industries, Inc.
 - b. Duro Dyne Corp.
 - c. METALAIRE, Inc.
 - d. Ward Industries, Inc.

2.4 FLEXIBLE CONNECTORS

- A. Manufacturers:
1. Duro Dyne Corp.
 2. Ventfabrics, Inc.
 3. Ward Industries, Inc.
- B. General Description: Flame-retardant or noncombustible fabrics, coatings, and adhesives complying with UL 181, Class 1.

- C. Metal-Edged Connectors: Factory fabricated with a fabric strip 3-1/2 inches wide attached to two strips of 2-3/4-inch- wide, 0.028-inch- thick, galvanized sheet steel or 0.032-inch- thick aluminum sheets. Select metal compatible with ducts.
- D. 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.
- E. 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.

2.5 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 APPLICATION AND 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. Provide 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. Provide balancing dampers at points on supply, return, and exhaust systems where branches lead from larger ducts as required for air balancing. Install at a minimum of two duct widths from branch takeoff.
- D. Install flexible connectors immediately adjacent to equipment in ducts associated with fans and motorized equipment supported by vibration isolators and where ducts are installed perpendicular to building structural expansion joints.
- E. Adjust duct accessories for proper settings.

END OF SECTION 233300

SECTION 233423 - POWER VENTILATORS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes the following:
 - 1. Centrifugal roof and wall ventilators.

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan-performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Certified fan sound-power ratings.
 - 3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 4. Material thickness and finishes, including color charts.
 - 5. Dampers, including housings, linkages, and operators.
 - 6. Fan speed controllers.
- B. Wiring Diagrams: Power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For power ventilators to include in emergency, operation, and maintenance manuals.

1.5 QUALITY ASSURANCE

- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

- B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
- C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA standards.
- D. UL Standard: Power ventilators shall comply with UL 705.

1.6 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate installation of roof curbs, equipment supports, and penetrations.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set for each belt-driven unit.

PART 2 - PRODUCTS

2.1 CENTRIFUGAL ROOF VENTILATORS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Ammerman; General Resource Corp.
 - 2. Greenheck.
 - 3. JencoFan; Div. of Breidert Air Products.
 - 4. Loren Cook Company.
 - 5. Penn Ventilation.
- B. Description: Belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and accessories. Direct-driven fans shall be provided where indicated on the plans (See Equipment Schedules).
- C. Housing: Heavy-gage, removable, spun-aluminum, dome top and outlet baffle; venturi inlet cone.
- D. Fan Wheel: Aluminum hub and wheel with backward-inclined blades.
- E. Belt-Driven Drive Assembly: Resiliently mounted to housing, with the following features:

1. Fan Shaft: Turned, ground, and polished steel; keyed to wheel hub.
2. Shaft Bearings: Permanently lubricated, permanently sealed, self-aligning ball bearings.
3. Pulleys: Cast-iron, adjustable-pitch motor pulley.
4. Fan and motor isolated from exhaust airstream.

F. Accessories:

1. See "Mechanical Equipment Schedules" on the plans for all construction features, coatings, motor types, and other accessories.

G. Coatings, when specified, shall be applied to all fan items and accessories.

2.2 MOTORS

See "HVAC Equipment Schedule" on the Plans.

2.3 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, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install power ventilators level and plumb, in accordance with manufacturer's installation instructions.
- B. Install units with clearances for service and maintenance.
- C. Label units according to requirements specified in Division 23 Section "Mechanical Identification."

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. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Duct Accessories."
- B. Install ducts adjacent to power ventilators to allow service and maintenance.

- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Connect wiring according to Division 26 Section "Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 - 2. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 - 3. Adjust belt tension.
 - 4. Adjust damper linkages for proper damper operation.
 - 5. Verify lubrication for bearings and other moving parts.
 - 6. Verify that dampers in connected ductwork systems are in fully open position.
 - 7. Disable automatic temperature-control operators, energize motor and adjust fan to indicated rpm, and measure and record motor voltage and amperage.
 - 8. Shut unit down and reconnect automatic temperature-control operators.
 - 9. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Refer to Division 23 Section "Testing, Adjusting, and Balancing" for testing, adjusting, and balancing procedures.
- D. Replace fan and motor pulleys as required to achieve design airflow.
- E. Lubricate bearings.

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain power ventilators. Refer to Division 1 Sections.

END OF SECTION 233423

SECTION 233713 - DIFFUSERS, REGISTERS AND GRILLES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes ceiling- and wall-mounted diffusers, registers, and grilles.

1.3 SUBMITTALS

- A. Product Data: For each product indicated, include the following:
 - 1. Data Sheet: Indicate materials of construction, finish, and mounting details; and performance data including throw and drop, static-pressure drop, and noise ratings.
 - 2. Diffuser, Register, and Grille Schedule: Indicate Drawing designation, room location, quantity, model number, size, and accessories furnished.

1.4 QUALITY ASSURANCE

- A. Verification of Performance: Rate diffusers, registers, and grilles according to ASHRAE 70, "Method of Testing for Rating the Performance of Air Outlets and Inlets."

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 - 1. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified.

2.2 GRILLES AND REGISTERS

- A. Manufacturers
 - 1. Anemostat, a Mestek Company.
 - 2. Krueger.
 - 3. Price Industries.
 - 4. Titus.
 - 5. Tuttle and Bailey.

PART 3 – EXECUTION

3.1 SCHEDULES

- A. See “Air Grille Schedules” on the Plans for types utilized.

3.2 EXAMINATION

- A. Examine areas where diffusers, registers, and grilles are to be installed for compliance with requirements for installation tolerances and other conditions affecting performance of equipment. Correct unsatisfactory conditions.

3.3 INSTALLATION

- A. Install diffusers, registers, and grilles level and plumb.
- B. Ceiling-Mounted Outlets and Inlets: Drawings indicate general arrangement of ducts, fittings, and accessories. Air outlet and inlet locations have been indicated to achieve design requirements for air volume, noise criteria, airflow pattern, throw, and pressure drop. Make final locations where indicated, as much as practical. For units installed in lay-in ceiling panels, locate units in the center of panel. Where architectural features or other items conflict with installation, notify Architect for a determination of final location.
- C. Install diffusers, registers, and grilles with airtight connections to ducts.
- D. Use concealed anchorages where possible. Provide brass or lead washers fitted to screws where required to protect metal surfaces and to make a weathertight connection.
- B. Form closely fitted joints with exposed connections accurately located and secured.
- C. Provide perimeter reveals and openings of uniform width for sealants and joint fillers, as indicated.

3.4 ADJUSTING

- A. After installation, adjust diffusers, registers, and grilles to air patterns indicated.

3.5 CLEANING

- A. After installation, clean exposed surfaces to remove burrs, dirt, and smudges. Replace diffusers, registers, and grilles that have damaged finishes.
- B. Before final inspection, clean exposed surfaces with water and a mild soap or detergent not harmful to finishes. Thoroughly rinse surfaces and dry.

END OF SECTION 233713

SECTION 237423 - MAKE-UP AIR UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes make-up air units (MAU) for outdoor installation.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories.
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 1. Mounting Details: Detail fabrication including anchorages and attachments to structure and to supported equipment.
 - 2. Wiring Diagrams: Power, signal, and control wiring.
- C. Startup service reports.
- D. Operation and Maintenance Data: For direct-fired make-up air units to include in emergency, operation, and maintenance manuals.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of make-up air units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Entire unit shall be ETL Certified per UL 1995 and bear on ETL mark.

1.5 COORDINATION

- A. Coordinate size and location of all building penetrations and associated ducting, plumbing and electrical systems.
- B. Coordinate sequence of construction for roof curbs and associated roofing work.

1.6 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set for each unit.
 - 2. Fan Belts: One set for each belt-driven fan.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Engineered Air.
 - 2. Greenheck Fan Corporation.
 - 3. Engineer approved equal.

2.2 PACKAGED UNITS

- A. Factory-assembled, prewired, self-contained unit consisting of cabinet, outdoor air intake weather hood, supply fan, controls, filters, and electric heating section.

2.3 CABINET

- A. Cabinet: Double-wall 18 gauge galvanized-steel panels, formed to ensure rigidity and supported by galvanized-steel channels or structural channel supports with lifting lugs. All sections shall be insulated, and be provided with 24-gauge solid galvanized steel liner.
- B. Access Panels: Piano hinged for heating, filters, damper, access sections, control panels and fan motor assemblies.
- C. Internal Insulation: Fibrous-glass duct lining, comply with ASTM C 1071, Type II;
 - 1. Thickness: 1-inch.
 - 2. Insulation Adhesive: Comply with ASTM C 916, Type I.
 - 3. Mechanical Fasteners: Galvanized steel suitable for adhesive attachment, mechanical attachment, or welding attachment to casing without damaging liner when applied as recommended by manufacturer and without causing air leakage.
 - 4. Locations: Full interior coverage, entire unit.
- D. Finish: Heat-resistant, high performance polyester based powder resin, all sections and accessories.

- E. Discharge: See plans and HVAC Equipment Schedules.

2.4 SUPPLY-AIR FAN

- A. Fan Type: Centrifugal, rated according to AMCA 210; statically and dynamically balanced, galvanized steel; mounted on solid-steel shaft with heavy-duty, pillow-block bearings rated for L50 or 200,000 hours with external grease fittings.
- B. Motor: Premium efficiency, totally enclosed.
- C. Drive: V-belt drive with matching fan pulley and adjustable motor sheaves and belt assembly. Direct drive arrangement acceptable when specified (See HVAC Equipment Schedules on the Plans).
- D. Variable Frequency Drive: When specified (See HVAC Equipment Schedules on the Plans).
- E. Mounting: Fan wheel, motor, and drives shall be mounted in fan casing with neoprene isolators.

2.5 AIR FILTERS

- A. Comply with NFPA 90A.
- B. Disposable Panel Filters: 4-inch thick, factory-fabricated, pleated-panel-type MERV-14, disposable air filters with holding frames.
 - 1. Media: Interlaced non-woven and synthetic fibric media.
 - 2. Frame: Galvanized steel.

2.6 OUTDOOR-AIR INTAKE HOOD

- A. Type: Manufacturer's standard hood, with materials to match cabinet, designed to inhibit wind-driven rain and snow from entering unit.
- B. Aluminum Mesh: Manufacturer's mesh, to comply with ASHRAE 62.1.

2.7 ROOF CURBS

- A. Roof Curbs: Galvanized steel with corrosion-protection coating, watertight gaskets, and factory-installed wood nailer; with a height of 24-inches minimum, complying with NRCA standards. Roof curbs shall be 12-inches minimum height for units installed at grade and concrete foundations.
 - 1. Curb Insulation and Adhesive: Comply with NFPA 90A or NFPA 90B.
 - a. Materials: ASTM C 1071, Type I or Type II.
 - b. Thickness: 1-1/2 inches.

2.8 ELECTRIC-RESISTANCE HEATING COIL

- A. UL Compliance: Comply with requirements in UL 1995, "Heating and Cooling Equipment."
- B. Electric-Resistance Heating Elements:
 - 1. Coiled Resistance Wire: 80 percent nickel and 20 percent chromium.
 - 2. Tubular-Steel Sheath: Compacted magnesium oxide powder.
 - 3. Fins: Spiral-wound, copper-plated, steel fins continuously brazed to sheath.
 - 4. Heating Capacity: Low density 35 W per sq. in., factory wired for single-point wiring connection; with time delay for element staging and overcurrent- and overheat-protection devices.
 - 5. Modulating Heat Control: Silicone controlled rectifiers (SCRs).
 - 6. Safety Controls:
 - a. Blower-motor interlock, air-pressure switch.
 - b. Quiet mercury contactors.
 - c. Time delay between steps.
 - d. Integral, nonfused power disconnect switch.

2.9 CONTROLS

- A. Factory-wired, fuse-protected control transformer, connection for power supply and field-wired unit to remote touchscreen panel.
- B. Control Devices:
 - 1. Adjustable discharge air temperature controls unit mounted, with remote touchscreen panel.
- C. Fan Control: The fan is intended to operate continuously 24 hours/day, 365 days/year, to provide the required air changes per hour, per NFPA 820 and the Ten States Standards. The make-up air unit shall be interlocked to operate with the exhaust fan. The make-up supply fan shall contain air flow switches, starter current sensing relays, or other means to prove fan operation.

2.10 CAPACITIES, CHARACTERISTICS, AND ADDITIONAL ACCESSORIES

- A. See "HVAC Equipment Schedule" on the Plans.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances and other conditions affecting performance of the work.
- B. Examine roughing-in for piping, ducts, and electrical systems to verify actual locations of connections before equipment installation.
- C. Examine roof curbs and equipment supports for suitable conditions where units will be installed.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Comply with manufacturer's rigging and installation instructions for unloading units and moving to final locations.
- B. Where indicated on the plans, install makeup air units on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete", and as detailed on the plans.
- C. Curb Support: Install roof curb on roof structure according to "The NRCA Roofing Manual."
 - 1. Install and secure units on curbs and coordinate roof penetrations and flashing with roof construction.
 - 2. Coordinate size, installation, and structural capacity of roof curbs, equipment supports, and roof penetrations.
 - 3. Coordinate size, location, and installation of unit manufacturer's roof curbs and equipment supports with roof Installer.
- D. Install controls and equipment shipped by manufacturer for field installation with make-up air units.

3.3 CONNECTIONS

- A. Duct Connections: Duct installation requirements are specified in Division 23 Section "Metal Ducts." Drawings indicate the general arrangement of ducts. Connect supply and outside air ducts to make-up air units with flexible duct connectors. Flexible duct connectors are specified in Division 23 Section "Duct Accessories."
- B. Ground equipment according to Division 26 Section "Grounding and Bonding."
- C. Provide control wiring between unit panel and remote control touchscreen panel, according to Division 26 Section "Conductors and Cables."

- D. Provide interlocking wiring between unit panel and exhaust fan controls, according to Division 26 Section "Conductors and Cables."

3.4 STARTUP SERVICE

- A. Engage a factory-authorized service representative to perform startup service. Complete installation and startup checks according to manufacturer's written instructions and perform the following:
 - 1. Inspect for visible damage and integrity for all sections.
 - 2. Verify that controls are connected and operable.
 - 3. Verify that filters are installed.
 - 4. Verify bearing lubrication.
 - 5. Inspect fan-wheel rotation for movement in correct direction without vibration and binding.
 - 6. Adjust fan belts to proper alignment and tension.
 - 7. Start unit according to manufacturer's written instructions.
 - 8. Complete startup sheets and attach copy with Contractor's startup report.
 - 9. Inspect and record performance of interlocks and protective devices; verify sequences.
 - 10. Operate unit for run-in period recommended by manufacturer.
 - 11. Calibrate thermostats.
 - 12. Adjust and inspect high-temperature limits.
 - 13. Inspect dampers, if any, for proper stroke and interlock with return-air dampers.
 - 14. Inspect controls for correct sequencing of heating and normal and emergency shutdown.
 - 15. Measure and record airflow.
 - 16. Verify operation of remote panel, including all functions and failure modes. Inspect high-limit heat and all alarms.
 - 17. After startup and performance testing, change filters, verify bearing lubrication, and adjust belt tension.
- B. Remove and replace malfunctioning components that do not pass tests and inspections and retest as specified above.
- C. Prepare written report of the results of startup services.

3.5 ADJUSTING

- A. Adjust initial temperature set points. Set field-adjustable switches and circuit-breaker trip ranges as indicated.
- B. Working Adjustments: When requested within 12 months of date of Substantial Completion, provide on-site assistance in adjusting system to suit actual occupied conditions. Provide up to two visits to Project.

3.6 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain direct-fired make-up air units. Refer to Division 1 Sections.

END OF SECTION 237423

SECTION 238126 - SPLIT-SYSTEM AIR-CONDITIONING UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes split-system air-conditioning units consisting of separate evaporator-fan and compressor-condenser components. Units are designed for exposed or concealed mounting, and may be connected to ducts.

1.3 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated. Include performance data in terms of capacities, outlet velocities, static pressures, sound power characteristics, motor requirements, and electrical characteristics.
- B. Shop Drawings: Diagram power, signal, and control wiring.
- C. Field quality-control test reports.
- D. Operation and Maintenance Data: For split-system air-conditioning units to include in emergency, operation, and maintenance manuals.
- E. Warranty: Special warranty specified in this Section.

1.4 QUALITY ASSURANCE

- A. Product Options: Drawings indicate size, profiles, and dimensional requirements of split-system units and are based on the specific system indicated. Refer to Division 1 Section "Product Requirements."
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
- C. Energy-Efficiency Ratio: Equal to or greater than prescribed by ASHRAE 90.1, "Energy Efficient Design of New Buildings except Low-Rise Residential Buildings."

1.5 COORDINATION

- A. Coordinate size and location of concrete bases for units. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete."

1.6 WARRANTY

- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of split-system air-conditioning units that fail in materials or workmanship within specified warranty period.
 - 1. Warranty Period: Five years for compressor from date of Substantial Completion, one year on remaining components.

1.7 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Filters: One set of filters for each unit.
 - 2. Fan Belts: One set of belts for each unit.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Carrier Air Conditioning; Div. of Carrier Corporation.
 - 2. Mitsubishi Electronics America, Inc.; HVAC Division.
 - 3. Sanyo Fisher (U.S.A.) Corp.
 - 4. Trane Company (The); Unitary Products Group.
 - 5. York International Corp.

2.2 EVAPORATOR-FAN COMPONENTS

- A. General: Evaporator-fan unit shall be completely factory assembled including coil, condensate drain pan, fan, motor, filters, and controls in a casing.
- B. Cabinet, High-wall type: Polystyrene, with a baked enamel or polyester powder coating, with removable panels on front and ends, with drain connection.
- C. Cabinet, Ceiling mounted cassette type: steel cabinet, with enamel coated steel combination supply-air and return-air discharge grille.
- D. Insulation: Cabinet to be completely insulated with cleanable, foil-faced, fire-retardant, fiberglass insulation.

- E. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with thermal-expansion valve. See plans and equipment schedules for refrigerant circuit quantities (single, dual, etc.).
- F. Fan: Forward curve, centrifugal fan. Direct drive for nominal 4 tons and below. Belt drive, adjustable for nominal 5 tons and above.
- G. Fan Motors: Multitapped, multispeed for nominal 4 tons and below. Single speed for nominal 5 tons and above. All to have internal thermal protection and permanent lubrication.
- H. Filters: Permanent, cleanable, or 2-inch thick pleated throwaway type as indicated on the plans and equipment schedules.

2.3 AIR-COOLED, COMPRESSOR-CONDENSER COMPONENTS

- A. Casing: Galvanized steel, finished with baked enamel or polyester powder, with removable panels for access to controls, weep holes for water drainage, and mounting holes in base. Provide brass service valves, fittings, and gage ports on exterior of casing.
- B. Compressor(s): Hermetically sealed with crankcase heater and mounted on vibration isolation. Compressor motor shall have thermal- and current-sensitive overload devices, start capacitor, relay, and contactor.
 - 1. Compressor Type: Reciprocating or Scroll.
 - 2. Manual-reset high-pressure switch and automatic-reset low-pressure switch.
 - 3. Refrigerant Charge: R-454B.
 - 4. Compressor Quantities: See plans and equipment schedules for compressor quantities, as related to single or dual circuits.
- C. Refrigerant Coil: Copper tube, with mechanically bonded aluminum fins, complying with ARI 210/240, and with liquid subcooler.
- D. Fan: Aluminum-propeller type, directly connected to motor.
- E. Motor: Permanently lubricated, with integral thermal-overload protection.
- F. Low Ambient Operation: Permits operation down to -22 deg F.
- G. Mounting: Equipment supports for rooftop applications; concrete base for grade applications; manufacturer's wall mounting brackets for wall applications.

2.4 ACCESSORIES

- A. Thermostat: Low voltage with subbase to control compressor and evaporator fan.
 - 1. Compressor time delay.
 - 2. 24-hour time control of system stop and start.
 - 3. Liquid-crystal display indicating temperature, set-point temperature, time setting, operating mode, and fan speed.
 - 4. Fan-speed selection, including auto setting.

- B. Automatic-reset timer to prevent rapid cycling of compressor.
- C. Refrigerant Line Kits: Soft-annealed copper suction and liquid lines factory cleaned, dried, pressurized, and sealed; factory-insulated suction line with flared fittings at both ends.
- D. See equipment schedules on the plans for additional accessories unique for each piece of equipment.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install units level and plumb.
- B. Install evaporator-fan components using manufacturer's standard mounting devices securely fastened to building structure.
- C. Install wall-mounted, compressor-condenser components using manufacturer's wall-mounting assemblies.
- D. Install roof-mounted, compressor-condenser components on equipment supports. Anchor units to supports with removable, cadmium-plated fasteners.
- E. Install ground-mounting, compressor-condenser components on 6-inch-thick, reinforced concrete base; 4 inches larger on each side than unit. Concrete, reinforcement, and formwork are specified in Division 3 Section "Cast-in-Place Concrete." Coordinate anchor installation with concrete base.
- F. Install and connect precharged refrigerant tubing to component's quick-connect fittings. Install tubing to allow access to unit.

3.2 CONNECTIONS

- A. Piping installation requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of piping, fittings, and specialties.
- B. Install piping adjacent to unit to allow service and maintenance.
- C. Ground equipment according to Division 26 Section "Grounding and Bonding."
- D. Electrical Connections: Comply with requirements in Division 26 Sections for power wiring, switches, and motor controls.
- E. Provide control wiring, conduits in accordance with Division 26 Sections.

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
 - 1. Leak Test: After installation, charge system and test for leaks. Repair leaks and retest until no leaks exist.
 - 2. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 - 3. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 STARTUP SERVICE AND DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain units. Refer to Division 1 for Closeout Procedures.
- B. Operational Demonstration shall be per Division 1 Sections.
- C. Instruction of the Owner's Personnel shall be per Division 1 Sections.

END OF SECTION 238126

SECTION 260500 - GENERAL REQUIREMENTS FOR ELECTRICAL WORK

PART 1 - GENERAL

1.1 SECTION INCLUDES:

- A. General
- B. Intent of Drawings
- C. Interpretation of Drawings
- D. Quality Control
- E. Submittals
- F. Location Environmental Considerations
- G. Products
- H. Coordination
- I. Demolition
- J. Electrical Installation
- K. Relocate or Make Modifications to Any Existing Electrical, Instrumentation or Control Systems Wiring
- L. Quality Assurance
- M. Examination
- N. Preparation and Storage
- O. Installation
- P. Field Quality Control
- Q. Painting
- R. Cleaning
- S. Operation - Maintenance and Spare Parts Data

1.2 GENERAL

- A. The Electrical Contractor shall be responsible to check with the equipment manufactures of the physical size of the equipment that it will fit and that it can be moved into the indicated locations.

- B. Intent of Drawings – The Drawings are not intended to be used for construction purposes for the electrical work, but to supplement the Specifications as to the principal features of the electrical design. The intent of this section is that all equipment and electrical devices furnished and installed under this and other sections of the Specifications be properly interconnected to permit successful system operation regardless of whether all interconnections are specifically referenced in the Specifications and associated Drawings.
- C. Interpretation of Drawings
1. The locations of equipment to which electrical connections are to be made are approximate as shown on the drawings. It shall be the Electrical Contractor's responsibility to determine the exact conduit locations by reviewing shop drawings. The sizes of disconnect switches, motor starters, overload heaters, fuses or circuit breakers are approximate, and it shall be the Electrical Contractor's responsibility to obtain the correct sizes based on the actual installed equipment or items. The conduit and wire sizes shown on the drawings are the minimum sizes required and shall not be reduced.
- D. Quality Control
1. The Electrical Contractor shall maintain a level of quality of materials and installation means as to assure the completed electrical, instrumentation and control system will be completed in compliance with the Specifications.
- E. Submittals
1. Shop Drawings - Submit shop drawings under provision of Section 01061 for all electrical equipment and devices.
 2. Shop drawings shall include manufacturer's literature, specifications, schematic diagrams, field wiring interconnection diagrams and any other data necessary to indicate compliance with the Specifications
 3. Final "Record" Contract Drawings - Drawings and information required shall include but not be limited to the following:
 - a. Conduit runs shall be shown and identified at each end of run, include where conduit originates and the termination. Each conduit shall have a pull string attached and fastened at each end.
 - b. Power Distribution Schematics - Show actual installed switching details, cable size and type, conduit size, locations and runs, fuse size and type, circuit breaker frame size, trip setting and type.
 - c. Details and Diagrams
 4. Elementary Wiring Diagrams – Show actual motor control wiring with wire numbers, telephone system cable routing and station identification with cable numbers.
 5. One Line Diagrams - Show equipment names, fuse sizes and types, heater sizes, conduit and wire sizes, motor FLA and horsepower. Include wire and cable numbers or identification.
 6. Instrumentation and control Diagrams - Show actual installed, wired instrumentation loop diagrams, include actual installed device Tag Nos, Model Nos, Scaling.
 7. Lighting and Device Schedule
 - a. Show actual manufacturers and model numbers.

- b. Lighting panel layouts
- c. Actual circuit No. circuit description, breaker size and type.
- 8. Payment for the Division 16 work and materials shall not exceed 90% of the total bid price until all Operations and Maintenance data and record as built drawings have been completed and received by the Owner.

F. Location Environmental Considerations

- 1. Provide satisfactory operation and maintenance under the following conditions
- 2. Temperature:
 - a. Outside: - 20° to 110° F.
 - b. Inside: +40° to 120° F.
- 3. Relative Humidity: 100 percent
- 4. Process Temperature:
 - a. Liquid: 32° to 105° F
 - b. Air: - 32° to 200° F
- 5. Atmosphere:
 - a. As indicated on the drawings
 - b. Corrosive atmosphere Hydrogen Sulfide
 - c. Wet Locations
 - 1) As defined in NEC ART 100.
 - 2) Outside exposed areas, areas indoors near pumps, frequent washdown areas.
 - d. The interiors of conduits and raceways located in wet areas shall also classified as wet areas.
 - e. Damp Locations
 - 1) As defined in NEC ART 100.
 - 2) Areas under covered enclosures.
 - f. Wet and Corrosive areas
 - 1) Enclosures located in areas that are wet and corrosive shall be rated for NEMA 4X Stainless Steel or as noted on the drawings.
 - g. Hazardous Areas (Classified)
 - 1) Areas that are a hazardous area are indicated on the drawings. All new equipment and installation methods shall conform to the requirements in the NEC.

G. Products

- 1. Electrical materials and equipment shall be new and shall be labeled by the Underwriters Laboratories, Inc when ever standards have been established and the label service applies.
- 2. Wire and Terminal Labeling - Tag all wire, cable and conduit at each end or termination with suitable permanent tags, printed, stamped, or engraved with the wire, cable or conduit number. The figures on the tags shall be clear and legible.
- 3. Safety Signs - High voltage warning signs shall be provided and placed at all guarded locations as required by the N.E.C. The signs shall be permanent and conspicuous, and shall be plainly visible even when doors are open or panels removed from compartments.
- 4. Engraved Nameplates - Identify all electrical enclosures with engraved phenolic nameplates. Engrave and mount nameplates for all switchgear, disconnect switches, and individual motor starter enclosures indicating equipment served. Nameplates

shall be white with black letters. Minimum letter size shall be one-quarter inch.

H. Demolition

1. Electrical Contractor shall disconnect power from existing process equipment scheduled for removal by General Contractor. General Contractor to remove and dispose of actual equipment.
2. Electrical contractor shall perform the complete demolition and removal of electrical distribution equipment where indicated on the electrical contract drawings.

I. Electrical Installation

1. Electrical Contractor shall furnish and install, adjust, connect, and put into satisfactory operation all electrical equipment, control components and instrumentation items as indicated on the Drawings and specified herein.

J. Coordination

1. Electrical Contractor shall review all Specifications and Drawings for the electrical work included under these sections and coordinate this work. Investigate existing conditions in the field before submitting proposal. Become acquainted with the conditions under which the work of this section of the Specifications will be performed and accept all conditions as found.
2. Schedule and coordinate all relocations of, or modifications to electrical, instrumentation or control systems wiring, conduit equipment, or appurtenances to whatever extent is necessary and required in order to conform to structural and architectural conditions, duct work and piping interference's, etc., shall be included under this section of the Specifications.
3. Coordinate with other trades on the project so that all trades install their work to avoid interference with each other. Arrangements made among the trades which result in deviations from Drawings and Specifications are subject to the approval of the Owner.
4. The control panels and/or equipment are to be provided by the equipment supplier, General Contractor, and System Integrator. These items will require power and/or interconnections from the disconnect switch to the control panel and/or field mounted devices or junction boxes for power and control. Specific details to be determined by the shop drawings.

1.3 REFERENCES

- A. American National Standards Institute (ANSI).
- B. Factory Mutual Engineering Division (FM).
- C. Illumination Engineering Society (IES).
- D. Institute of Electrical & Electronics Engineers (IEEE).
- E. Insulated Cable Engineers Association (ICEA).

- F. Instrumentation, Systems and Automation Society (ISA)
- G. Joint Industrial Council (JIC).
- H. National Electrical Code (NEC).
- I. National Electrical Manufacturers Association (NEMA).
- J. International Electrical Testing Association (NETA).
- K. National Fire Protection Association (NFPA)
- L. Occupational Safety and Health Administration (OSHA)
- M. Ohio Building Code (OBC).
- N. Underwriters' Laboratories Incorporated (UL).
- O. ANSI/NEMA 1-2000 Standard Practices for Good Workmanship in Electrical Contracting.
- P. Quality Assurance
 - 1. Regulatory requirements
 - a. The Contractor shall obtain and pay for all fees for permits and inspections as required.
 - 2. Installation Standards
 - a. NEC – installation of electrical items shall be in accordance with the NEC.
 - b. Instrumentation and control – Installation of the instrumentation, control system shall be in accordance with standards of the ISA.

PART 2 - PRODUCTS (NOT USED)

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Inspect all devices at delivery for damage.
- B. Confirm all devices at delivery are as required according to design and shop drawings.
- C. Examine the site and structures for any obstructions which may interfere with the electrical installation as planned.

3.2 PREPARATION AND STORAGE

- A. Provide a dry heated storage area for all electrical and electronic equipment and devices.
- B. Electrical and electronic equipment devices shall be stored and shall be heated to prevent

condensation from forming. Electrical and electronic equipment found with condensation in the enclosure or condensation caused damage will not be accepted.

3.3 INSTALLATION

- A. The locations of equipment to which electrical connections are to be made are approximate as indicated on the Drawings.
- B. It shall be the Contractor's responsibility to check shop drawings relating to equipment requiring electrical connections and to determine the exact conduit locations.
- C. Electrical and electronic equipment installed but not energized shall continue to have a heat source to maintain the enclosure free of condensation. Electrical and electronic equipment found with condensation in the enclosure or condensation caused damage will not be accepted.
- D. Contractor shall perform all chasing, channeling, drilling and patching necessary. Repair any damage to the building or any equipment. Replace damaged equipment if, in the Engineer's judgment, the repair would not be satisfactory.
- E. No work shall be covered or hidden from view until it has been inspected and approved by the Engineer.
- F. Any workmanship or materials not meeting the requirements of the Specifications or Drawings shall be immediately replaced by the Contractor without cost to the Owner and to the satisfaction of the Owner.
- G. All wiring shall have permanent labels at all terminations and junctions of the wires and on all field wiring terminal strips.
- H. Safety signs shall be furnished and installed on or around all electrical equipment.
- I. Permanent marking labels shall be installed on exposed sides of each piece of electrical equipment, pull boxes, junction boxes and terminal boxes stating the maximum voltage level involved with the associated equipment.
- J. Concrete equipment pads for electrical equipment shall be furnished and placed by the Electrical Contractor.

3.4 PAINTING

- A. All wood panel mounting boards shall be painted.
- B. All electrical enclosures shall undergo a phosphatizing prepainting treatment. Final paint coats shall be a polyester powder coating with ANSI 61 light gray color for enclosures mounted inside and with ANSI 24 medium gray color for enclosures mounted outside.
- C. Remove any rust and touch up any scratches on all new electrical devices or enclosures with matching touch-up paint as supplied by the manufacturer.

3.5 FIELD QUALITY CONTROL

- A. Major components of the Electrical System shall be tested per NETA standards. NETA's Standard Specification for Testing, Parts 1 to 5, shall govern all testing.
- B. The following tests are per NETA Acceptance Testing Specifications, Part 7, Inspection and Test Procedures. Visual and Mechanical Inspections shall be performed for all equipment.
 - 1. Cables - Low Voltage shall have the following tests: Insulation resistance, continuity.
 - 2. Circuit Breakers - Low Voltage (Molded Case) that are rated at over 100 amps shall have the following tests: Contact resistance, time-current characteristic, instantaneous pickup current, insulation resistance.
 - 3. Grounding Systems shall have the following test: Fall of potential.
 - 4. Surge Arresters shall have the following tests: 60 hz sparkover, insulation power factor, ground continuity.
- C. After all testing has been completed to the satisfaction of the Owner, the entire Electrical (Power) System shall operate for a minimum test period of 30 days. Cumulative down time of all components furnished under Division 16 shall not exceed 1/2 hour as recorded by the Engineer during the test period. System documentation shall be delivered on the last day of test period. Test period shall not end until system documentation has been delivered. If the cumulative downtime limit is exceeded, the Engineer shall have the following options.
 - 1. Extend the test period as required until the cumulative downtime during the proceeding 30 days does not exceed 1/2 hour as recorded by the Engineer.
 - 2. Sub-systems which have no components contributing to the cumulative downtime will be approved as a partial acceptance.
- D. Sub-systems which have components that contributed to the cumulative downtime shall have their test period begin after all repairs and adjustments have been made.

3.6 OPERATION - MAINTENANCE AND SPARE PARTS DATA

- A. Submit specific data and information required under individual Division 16 Sections.
 - 1. Submit operation data as required.
 - 2. Submit maintenance data as required.
 - 3. Spare Parts Data - Submit as required. Include manufacturer's list of recommended spare parts.
 - 4. Parts and supplies judged to be necessary to keep equipment and control system operating successfully for first year of operation shall be furnished.
 - 5. Review individual sections for required lists of spare parts to be furnished.

3.7 CLEANING

- A. All areas are to be cleaned of construction debris and wire. Electrical equipment is to be cleaned of all construction dirt, dust, etc.

- B. All electrical and electronic equipment shall be kept clean and free of all dust, dirt, and debris at all times.
- C. All electrical and electronic boxes and enclosures shall have the covers of these boxes and enclosures closed and sealed except when actually working in these boxes and enclosures.

END OF SECTION 260500

SECTION 260519 – LOW VOLTAGE CONDUCTORS AND CABLES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Building wire and cable.
- B. Wiring connectors and connections.

1.2 RELATED SECTIONS

- A. Section 260553 - Electrical Identification.

1.3 REFERENCES

- A. Quality Control: Follow requirements for references and standards.
- B. NECA Standard of Installation (National Electrical Contractors Association).
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (International Electrical Testing Association).
- D. NFPA 70 - National Electrical Code.

1.4 SUBMITTALS FOR REVIEW

- A. Submittals: Follow procedures for submittals.
- B. Product Data: Provide for each cable assembly type.

1.5 SUBMITTALS AT PROJECT CLOSEOUT

- A. Contract Closeout Submittals – Follow as required.
- B. Project Record Documents: Record actual locations of components and circuits.

1.6 QUALIFICATIONS

- A. Manufacturer: Company specializing in manufacturing products specified in this Section with minimum three years documented experience.

1.7 REGULATORY REQUIREMENTS

- A. Conform to NFPA 70.

- B. Furnish products listed and classified by Underwriters Laboratories Inc., or testing firm acceptable to the authority having jurisdiction as suitable for the purpose specified and indicated.

1.8 PROJECT CONDITIONS

- A. Verify that field measurements are as indicated.
- B. Conductor sizes are based on copper only.
- C. Wire and cable routing indicated is approximate unless dimensioned.

1.9 COORDINATION

- A. Coordinate Work under provisions of Section 260500.
- B. Where wire and cable destination is indicated and routing is not shown, determine exact routing and lengths required.

PART 2 - PRODUCTS

2.1 BUILDING WIRE

- A. Manufacturers:
 - 1. Okonite Company.
 - 2. Alpha Wire Company.
 - 3. Southwire
 - 4. Substitutions: Follow as required for Material and Equipment.
- B. Description: Multi-stranded insulated copper wire, #12 AWG minimum for feeders and branch circuits and #14 AWG minimum for control circuits.
- C. Insulation Voltage Rating: 600 volts.
- D. Insulation: NFPA 70; Type XHHW or THWN insulation for service, feeders and branch circuits and control circuits.

2.2 WIRING CONNECTORS

- A. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape uninsulated conductors and connectors with electrical tape to 150 percent of insulation rating of conductor.
- B. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller. Buchanan crimp (Split cap and insulator) or Ideal crimp connector with wrap cap insulator.

- C. Use Adhesive-lined heat shrink tubing for watertight connections; T & B, 3M, or Raychem.

PART 3 - EXECUTION

3.1 EXAMINATION

- A. Verify that mechanical work likely to damage wire and cable has been completed.

3.2 PREPARATION

- A. Completely and thoroughly swab raceway before installing wire.

3.3 INSTALLATION

- A. Quality Control: Follow as required by manufacturer's instructions.
- B. Route wire and cable as required to meet Project Conditions.
- C. Install cable in accordance with the NECA "Standard of Installation."
- D. Use stranded conductors for control circuits.
- E. Use conductor not smaller than 12 AWG for power and lighting circuits.
- F. Use conductor not smaller than 14 AWG for control circuits.
- G. Use 10 AWG conductors for 20 ampere, 120 volt branch circuits longer than 75 feet (25 m).
- H. Pull all conductors into raceway at same time.
- I. Use suitable wire pulling lubricant for building wire 4 AWG and larger.
- J. Protect exposed cable from damage.
- K. Use suitable cable fittings and connectors.
- L. Neatly train and lace wiring inside boxes, equipment, and panelboards.
- M. Clean conductor surfaces before installing lugs and connectors.
- N. Make splices, taps, and terminations to carry full ampacity of conductors with no perceptible temperature rise.
- O. Use split bolt connectors for copper conductor splices and taps, 6 AWG and larger. Tape un-insulated conductors and connector with electrical tape to 150 percent of

insulation rating of conductor.

- P. Use solderless pressure connectors with insulating covers for copper conductor splices and taps, 8 AWG and smaller.
- Q. Use insulated spring wire connectors with plastic caps for copper conductor splices and taps, 10 AWG and smaller.
- R. Identify and color code wire and cable under provisions of Section 16075. Identify each conductor with its circuit number or other designation indicated.
- S. Replace conductors damaged during installation.
- T. No splices are allowed in conduits or raceways.

3.4 FIELD QUALITY CONTROL

- A. Starting of Systems: Follow requirements for field inspection, testing, and adjusting.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.3.1.

END OF SECTION 260519

SECTION 260520 – SHIELDED INSTRUMENTATION & VARIABLE FREQUENCY DRIVE CABLE

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Scope: Furnish all labor, materials, equipment and incidentals required to provide shielded cable as shown and specified.

1.2 SUBMITTALS

- A. Shop Drawings:
 - 1. Comply with Section 013323.
- B. Product data:
 - 1. Submit for review, copies of manufacturer's engineering data and technical information for shielded instrumentation cables proposed for use.

PART 2 - PRODUCTS

2.1 MATERIALS

- A. Instrumentation Cable
 - 1. Single Shielded Pair or Triad: 300 volt.
 - a. Tinned copper, 18 AWG or larger, stranded, polyethylene insulated conductors twisted with aluminum-polyester shield, stranded tinned 20 AWG copper drain wire and overall chrome vinyl jacket, 100 percent shield cover. Rated for 300 volts minimum.
 - b. Products and Manufacturers:
 - 1) Belden No. 8760, No. 8770, No. 9318, or No. 9365
 - 2) Alpha No. 2422, No. 2432.
 - 2. Multi-paired Shielded 300 volt:
 - a. Tinned copper, 18 AWG, stranded PVC insulated conductors, twisted in pairs with aluminum-polyester shield over each pair and its stranded drain wire (20 AWG), overall chrome vinyl jacket, 100 percent shield cover.
 - b. Products and Manufacturers:
 - 1) 3 pair - Belden No. 9369.
 - 2) 6 pair - Belden No. 9389.
 - 3) 9 pair - Belden No. 9390.
 - 4) 11 pair - Belden No. 9391.
 - 5) 15 pair - Belden No. 9392.
 - 6) Dekoron Poly-set.
 - 7) Okonite type SP-OS.

B. Variable Frequency Drive Shielded Cable

1. Four conductor shielded cable
 - a. Shielding to have an overall shield with an 85% tinned copper braided shield.
 - b. Cable to be Belden Variable Frequency Drive Cable 29502 through 29531 wire size as indicated or equal.

PART 3 - EXECUTION

3.1 PREPARATION

- A. Delivery, Storage and Protection: Comply with Section 016600.

3.2 INSTALLATION

- A. Install in conduit separated from power cables unless otherwise shown on the Drawings.
- B. Install instrumentation cable conduits as far as possible from power cable conduit.
- C. Ground shield at one end only, as recommended by instrument manufacturer, and as approved by the Owner.
- D. Terminate stranded conductors with pre-insulated crimp type ring tongue terminals properly sized to fit fastening device and to fit wire size.
- E. Identification: Identify all conductors at each terminal and splice location. Identification number labels shall be Thomas & Betts type WSL cable markers or equal with clear heat shrink tubing over the marker.
- F. Install CAT 5e and CAT 6 cabling in accordance with Commercial Building Telecommunications Pathways and Spaces ANSI/TIA/EIA 569-A and Commercial Building Telecommunications Cabling Standard ANSI/TIA/EIA 568-A.

3.3 TESTING

- A. Test each circuit in the presence of the Owner after permanent cables are in place to demonstrate that the circuit and connected equipment perform satisfactorily and that they are free from improper grounds and short circuits.
- B. Maintain a written record of circuits being tested, marking down circuit number and descriptive function and results of each step in the test procedures including repeated tests.
- C. Any cable or a portion of the cable which fails when tested shall be replaced with a new cable for the full length and retested.

END OF SECTION 260520

SECTION 260526 - GROUNDING AND BONDING

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Grounding electrodes and conductors.
- B. Equipment grounding conductors.
- C. Bonding.

1.2 REFERENCES

- A. ANSI/NFPA 70 - National Electrical Code.

1.3 PERFORMANCE REQUIREMENTS

- A. Grounding System Resistance: 5 ohms maximum.

1.4 SUBMITTALS

- A. Product Data: Provide for grounding connectors.
- B. Test Reports: Indicate overall resistance to ground (and resistance of each electrode).
- C. Manufacturer's Instructions: Include instructions for storage, handling, protection, examination, preparation and installation of exothermic connectors.

1.5 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of Sections 017839.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.1 MECHANICAL CONNECTORS

- A. Manufacturers:
 - 1. Burndy Corp.
 - 2. O-Z/Gedney.

- B. Material: Bronze.

2.2 EXOTHERMIC CONNECTIONS

- A. Manufacturers:
 - 1. Erico “Cadweld”.

2.3 WIRE

- A. Material: Stranded copper.
- B. Grounding Electrode Conductor: Size to meet NFPA 70 requirements.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install Products in accordance with manufacturer's instructions.
- B. Provide bonding to meet Regulatory Requirements.
- C. Equipment Grounding Conductor: Provide separate, insulated conductor within each feeder and branch circuit raceway. Terminate each end on suitable lug, bus, or bushing.

3.2 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Use suitable test instrument to measure resistance to ground of system. Perform testing in accordance with test instrument manufacturer's recommendations using the fall-of-potential method.

END OF SECTION 260526

SECTION 260529 - SUPPORTING DEVICES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Conduit and equipment supports.
- B. Anchors and fasteners.
- C. Concrete equipment supports

1.2 REFERENCES

- A. NECA - National Electrical Contractors Association.
- B. ANSI/NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Manufacturer's Instructions: Indicate application conditions and limitations of use stipulated by Product testing agency specified under Regulatory Requirements. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of Product.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for purpose specified and shown.

PART 2 - PRODUCTS

2.1 PRODUCT REQUIREMENTS

- A. Materials and Finishes: Provide adequate corrosion resistance.
- B. Provide materials, sizes, and types of anchors, fasteners and supports to carry the loads of equipment and conduit. Consider weight of wire in conduit when selecting products.
- C. Anchors and Fasteners:
 - 1. Concrete block walls: Use expansion anchors.
 - 2. Steel Structural Elements: Use welded fasteners.
 - 3. Concrete Surfaces: Use expansion anchors.

2.2 CHANNEL SYSTEMS

A. Manufacturer:

1. Unistrut, B-Line, Allied Power -Strut.
2. or Equal

B. Description:

1. Galvanized steel. - General locations
2. Aluminum- Wet, damp areas
3. Stainless steel - Wet, damp corrosive areas where compatible with chemicals
4. Fiberglass - Wet, damp, corrosive areas where compatible with chemicals

C. Size: 1 5/8" X 1 5/8"

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Provide anchors, fasteners, and supports in accordance with NECA "Standard of Installation."
- C. Do not fasten supports to pipes and conduit except as shown on Drawings.
- D. Obtain permission from Engineer before drilling or cutting structural members.
- E. Fabricate supports from structural steel, galvanized steel, aluminum or stainless steel channel. Rigidly weld members or use stainless steel hex head bolts and hardware to present neat appearance with adequate strength and rigidity. Use spring lock washers under all nuts.
- F. Install surface-mounted cabinets and panel boards with minimum of four anchors.
- G. In wet and damp locations use stainless steel or aluminum channel supports with stainless steel fasteners.
- H. In wet and damp locations use stainless steel or aluminum spacers to stand cabinets and panel boards one inch off wall.
- I. Spray coat cut end of galvanized steel channel or rigid steel conduit with spray cold galvanizing.
- J. Galvanized pipe used as equipment supports are to have the open ends capped with galvanized end caps.

- K. Provide concrete equipment pad, housekeeping pads, for all equipment that will be floor mounted. Pads to be formed, chamfer edges, and have a troweled finish. Concrete shall be smoothed around conduits. Equipment panels shall be anchored using concrete anchors. Equipment pads for outdoor mounted panels shall extend from the front of the equipment panel 3'-6" min. to allow for opening and standing.

END OF SECTION 260529

SECTION 260533 - CONDUIT

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. PVC coated rigid galvanized steel required for all new installations.
- B. Flexible metal conduit.
- C. Liquid-tight flexible metal conduit.
- D. Fittings and conduit bodies.
- E. Sealing Fittings
 - 1. Provide listed explosionproof sealing fittings
 - 2. Use Chico or equal damming and sealing compound

1.2 RELATED SECTIONS

- A. Section 260529 - Supporting Devices.
- B. Section 260553 - Electrical Identification.
- C. Sections 260534- Boxes.

1.3 REFERENCES

- A. NEC Article 500 and 501
- B. NEC 501.10(B) – Wiring Methods (Div 2)
- C. NEC 501.15 – Sealing
- D. NFPA 820 – Fire Protection in Wastewater Treatment and Collection Facilities
- E. ANSI C80.1 - Rigid Steel Conduit, Zinc Coated.
- F. ANSI/NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit and Cable Assemblies.
- G. ANSI/NFPA 70 - National Electrical Code.
- H. NECA "Standard of Installation."
- I. NEMA RN 1 - Polyvinyl Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.

- J. NEMA TC 3 - PVC Fittings for Use with Rigid PVC Conduit and Tubing.

1.4 SEALING REQUIREMENTS

- A. Provide seals per NEC 501.15 and NFPA 820 intent:
 - 1. At boundaries between classified and unclassified areas
 - 2. At entries into enclosures containing arcing devices
 - 3. At conduit entering buildings from classified spaces
- B. Install seals:
 - 1. Within 18 inches of enclosure where required [ARC FLASH...AF Report | PDF]
 - 2. With proper fiber dams and compound
 - 3. Seal installation is mandatory — no silicone or field improvisation permitted

1.5 SUBMITTALS

- A. Submit under provisions of Section 013323.
- B. Product Data: Provide for metallic conduit, flexible metal conduit, liquid-tight flexible metal conduit, nonmetallic conduit, flexible nonmetallic conduit, fittings, conduit bodies of each type planned to be used.

1.6 PROJECT RECORD DOCUMENTS

- A. Submit under provisions of project general requirements.
- B. Accurately record actual routing of all conduits exposed and concealed on record drawings.

1.7 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc as suitable for purpose specified and shown.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect, and handle Products to site under provisions of Section 016600.
- B. Accept conduit on site. Inspect for damage.
- C. Protect conduit from corrosion and entrance of debris by storing above grade. Provide appropriate covering.

- D. Protect PVC conduit from sunlight.

1.9 PROJECT CONDITIONS

- A. Verify routing and termination locations of conduit prior to rough-in.
- B. Conduit routing is shown on Drawings in approximate locations unless dimensioned. Route as required to complete wiring system.

PART 2 - PRODUCTS

2.1 CONDUIT REQUIREMENTS

- A. Minimum Size: 3/4 inch unless otherwise specified.
- B. Underground Installations:
 - 1. More than two feet from Foundation Wall: Use schedule 40 PVC conduit.
 - 2. Within two feet from Foundation Wall: Use plastic coated galv. rigid conduit.
 - 3. In or Under Slab on Grade: Use schedule 40 PVC conduit.
 - 4. When changing from underground to above ground, use PVC coated galv. rigid conduit to approximately two feet above finished grade.
 - 5. Conduits passing through poured concrete sidewalks, floating type slabs on grade shall be sleeved.
- C. Outdoor Locations, Above Grade: Use rigid galvanized steel conduit.
- D. In Slab Above Grade:
 - 1. Use schedule 40 PVC.
 - 2. Maximum Size Conduit in Slab: 3/4" for conduits crossing each other.
- E. Continuously Wet and Damp Locations: PVC coated rigid steel conduit.
- F. Corrosive Location: Use PVC coated rigid steel or schedule 40 PVC.
- G. Dry Locations:
 - 1. Concealed in framed wall or above suspended ceilings: Use steel electrical metallic tubing or schedule 40 PVC conduit.
 - 2. Exposed: Use rigid galvanized steel or as noted on drawings.
 - 3. Flexible metal conduit can be used for equipment connections. Max length of 3ft.
- H. Classified hazardous Class 1, Division 1 areas & Screen Rooms: PVC coated rigid steel conduit and explosion-proof flexible equipment connections.
- I. Equipment Connections:
 - 1. Use liquid-tight flexible metal conduit.

2. In corrosive or chemical rooms, use non-metallic flexible conduit and fittings.

J. Flexible Conduits shall be limited to three feet or less.

2.2 METAL CONDUIT

A. Rigid Steel Conduit: ANSI C80.1.

B. Fittings and Conduit Bodies: ANSI/NEMA FB 1 all steel fittings.

2.3 PVC COATED METAL CONDUIT

A. Manufacturers:

1. Robroy Industries "Plasti-Bond."
2. Thomas –Betts – “OCAL Blue”.

B. Description: NEMA RN 1; rigid steel conduit with external PVC coating, 40 mil thick.

C. Fittings and Conduit Bodies: ANSI/NEMA FB 1; steel fittings with external PVC coating to match conduit.

D. Expansion fittings to comply with UL 651; rated for environmental conditions where installed, and including flexible external bonding jumper.

2.4 FLEXIBLE METAL CONDUIT

A. Description: Interlocked aluminum construction.

B. Fittings: ANSI/NEMA FB 1.

2.5 LIQUIDTIGHT FLEXIBLE METAL CONDUIT

A. Manufacturers:

1. Sealtight VA Anaconda Metal Hose Div.
2. Liquidtight type L.A. Electric Flex Co.

B. Description: Interlocked aluminum construction with PVC jacket.

C. Fittings: ANSI/NEMA FB 1.

2.6 NONMETALLIC CONDUIT

A. Manufacturers:

1. Carlon Electrical Products Div.
2. LCP.
3. Quil.

- B. Description: NEMA TC 2; Schedule 40 PVC.
- C. Fittings and Conduit Bodies: NEMA TC 3.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install conduit in accordance with NECA "Standard of Installation."
- B. Install nonmetallic conduit in accordance with manufacturer's instructions.
- C. Arrange supports to prevent misalignment during wiring installation.
- D. Support conduit using coated steel or malleable iron straps, lay-in adjustable hangers, clevis hangers, and split hangers.
- E. Group related conduits; support using conduit rack. Construct rack using steel channel; provide space on each for 25 percent additional conduits.
- F. Fasten conduit supports to building structure and surfaces under provisions of Section 260529.
- G. Do not support conduit with wire or perforated pipe straps. Remove wire used for temporary supports
- H. Do not attach conduit to ceiling support wires.
- I. Arrange conduit to maintain headroom and present neat appearance.
- J. Route exposed conduit parallel and perpendicular to walls.
- K. Route conduit in and under slab from point-to-point.
- L. Do not cross conduits in slab unless ¾" conduits.
- M. Maintain adequate clearance between conduit and piping.
- N. Maintain 12-inch clearance between conduit and surfaces with temperatures exceeding 104 degrees F.
- O. Cut conduit square using saw or pipe cutter; de-burr cut ends.
- P. Bring conduit to shoulder of fittings; fasten securely.
- Q. Join nonmetallic conduit using cement as recommended by manufacturer. Wipe nonmetallic conduit dry and clean before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for 20 minutes, minimum.
- R. Use conduit hubs or sealing locknuts to fasten conduit to sheet metal boxes in damp and wet locations and to cast boxes.

- S. Install no more than equivalent of three 90-degree bends between boxes. Use conduit bodies to make sharp changes in direction, as around beams. Use factory elbows for bends in metal conduit larger than 2 inch size.
- T. Avoid moisture traps; provide junction box with drain fitting at low points in conduit system.
- U. Provide suitable fittings to accommodate expansion and deflection where conduit crosses, control and expansion joints.
- V. Conduits shall be sloped in such a manner that water may drain to the closest pull box if possible.
- W. Provide suitable pull string in each empty conduit except sleeves and nipples.
- X. Use suitable caps to protect installed conduit against entrance of dirt and moisture.
- Y. Ground and bond conduit under provisions of Section 260526.
- Z. Identify conduit under provisions of Section 260553.
- AA. Flexible conduit, non-metallic, liquid-tight and metallic, shall not be used in length longer than 6ft unless specifically approved. Flexible conduit is not to be used in place of neatly run rigid conduit.
- BB. Where called out on plans provide cable terminators / sealing bushings, CRC by O-Z/Gedney or approved equal. Verify specific cable outside diameters and follow manufacturer's installation requirements.
- CC. Coordinate with General Contractor for conduit floor and wall penetrations to avoid interference with equipment or reserved spaces.
- DD. Reuse existing conduit and raceways for new work where possible. Reused conduit shall be inspected, cleaned or replaced if necessary,

END OF SECTION 260533

SECTION 260534 - PULL, JUNCTION BOXES AND ENCLOSURES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Pull Boxes
- B. Junction Boxes
- C. Accessories

1.2 RELATED SECTIONS

- A. Section 260529 - Supporting Devices.

1.3 REFERENCES

- A. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum).
- B. NEMA ICS 4 - Terminal Blocks for Industrial Control Equipment and Systems.
- C. ANSI/NFPA 70 - National Electrical Code.

1.4 SUBMITTALS

- A. Submit under provisions of general project requirements and Section 260500.
- B. Product Data: Provide manufacturer's standard data for boxes and enclosures.
- C. Junction box locations and details
 - 1. Terminal block layout
 - 2. Grounding

1.5 REGULATORY REQUIREMENTS

- A. Conform to requirements of ANSI/NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Hoffman.
- B. Rittal.
- C. Or Equal

2.2 PULL BOXES

- A. Construction:
 - 1. Outdoors, Wet Damp areas, Corrosive areas. NEMA Type 4/4X, sunlight resistant fiberglass, polycarbonate or SS as specified on Drawings, enclosure with continuous hinge covers.
 - a. Covers: Continuous SS hinge, held closed by SS screws
 - 2. Indoors exposed NEMA 12, 13 or as specified on Drawings.
 - 3. Indoors flush wall mounted NEMA 1 w/ flush covers
 - 4. Indoors concealed NEMA 1 w/ screw cover
 - 5. Indoor wet and damp NEMA 4XSS
 - 6. Indoor corrosive areas NEMA 4XSS or compatible with chemical
 - 7. Hazardous locations NEMA 7

2.3 TERMINAL HINGED COVER ENCLOSURES

- A. Construction:
 - 1. Outdoor, Wet Damp areas, Corrosive areas. NEMA 4/4X, sunlight resistant fiberglass or polycarbonate or SS as specified on Drawings, Type 4/4X enclosure with continuous hinge cover.
 - a. Covers: Continuous SS hinge, held closed by flush latch operable by screwdriver.
 - 2. Indoors exposed NEMA 12, 13
 - 3. Indoors flush wall mounted NEMA 1 w/ flush covers
 - 4. Indoors concealed NEMA 1 w/ screw cover
 - 5. Indoor wet and damp NEMA 4XSS
 - 6. Indoor corrosive areas NEMA 4XSS or compatible with chemical
 - 7. Hazardous locations NEMA 7
- B. Provide white enamel interior metal panel for mounting terminal blocks and electrical components.

2.4 CABINETS

- A. Provide metal barriers to form separate compartments containing control wiring at less than 50 volts from power wiring.

- B. Provide accessory feet for free-standing equipment.

2.5 TERMINAL BLOCKS

A. Manufacturers:

1. Weidmuller SAK 6, SAK 2.5, ASK 1.
2. Allen-Bradley
3. Sq. D
4. Or equal

B. Terminal Blocks: ANSI/NEMA ICS 4.

C. Power Terminals: Unit construction type with closed back and tubular pressure screw connectors, rated 600 volts.

D. Signal and Control Terminals: Modular construction type, suitable for channel mounting, with tubular pressure screw connectors, rated 300 volts. Ground terminal shall be green.

E. Provide ground bus terminal block, with each connector bonded to enclosure.

F. Provide a typed legend of cables and terminal numbers with origin and destination.

G. Boxes where water may drain from the attached conduits shall have drains installed in the bottom or the lowest point of the box. Conduit penetration at such boxes shall be located along the sides or top of the box. Conduits shall not be installed in a manner that water can enter attached pull conduits.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install Products in accordance with manufacturer's instructions.

B. Install enclosures and boxes plumb. Anchor securely to wall and structural supports at each corner.

C. Do not attach boxes directly to masonry, concrete, or brick walls but provide a 1/4 inch spacer of PVC, nylon, or stainless steel.

D. Install enclosures and boxes using stainless steel fasteners.

E. Provide supports where required when no wall or other adequate support is available.

END OF SECTION 260534

SECTION 260553 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Nameplates and labels.
- B. Wire and cable markers.
- C. Conduit markers.

1.2 REFERENCES

- A. NFPA 70 - National Electrical Code.

1.3 SUBMITTALS

- A. Submit under provisions of Section 260500.
- B. Product Data: Provide catalog data for nameplates, labels, and markers.

1.4 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Furnish products listed and classified by Underwriters Laboratories, Inc.

PART 2 - PRODUCTS

2.1 NAMEPLATES AND LABELS

- A. Nameplates:
 - 1. Equipment Identification: Engraved three-layer laminated plastic, black letters on white background.
 - 2. Emergency Powered Equipment: Engraved three-layer laminated plastic, black letters on red background. As required by NEC
 - 3. Equipment supply voltage and phase: Engraved three-layer laminated plastic, black letters on yellow background. (ie 480/277V 3PH)
 - 3. Equipment power source identification: Engraved three-layer laminated plastic, black letters on yellow background. (ie SOURCE: MCC1 CB-1A)

B. Locations:

1. Each electrical distribution and control equipment enclosure.
2. Junction box.

C. Letter Size:

1. Use 1/8 inch letters for identifying individual equipment and loads.
2. Use 1/4 inch letters for identifying grouped equipment and loads.

D. Labels: Embossed adhesive tape, with 3/16 inch white letters on black background. Use only for identification of individual wall switches and receptacles, and control device stations.

2.2 WIRE MARKERS

A. Manufacturers:

1. T & B Shrink-Kon HVM wire markers.
2. Panduit - Pan Code HSDL.
3. Brady.

B. Description: Tubing type wire markers.

C. Locations: Each conductor at panelboard gutters, outlet and junction boxes, terminal strip and each load connection.

D. Legend:

1. Power and Lighting Circuits: Branch circuit or feeder number indicated on Drawings.
2. Control Circuits: Control wire number indicated on schematic and interconnection diagrams on drawings or on shop drawings.

PART 3 - EXECUTION

3.1 PREPARATION

A. Degrease and clean surfaces to receive nameplates and labels.

3.2 APPLICATION

A. Install nameplate parallel to equipment lines.

B. Secure nameplate to equipment front using stainless steel screws, rivets, or adhesive.

C. Identify underground conduits using foil backed underground warning tape. Install one tape per trench at 6 inches below finished grade.

END OF SECTION 260553

SECTION 262816 - ENCLOSED SWITCHES

PART 1 - GENERAL

1.1 SECTION INCLUDES

- A. Fusible switches.
- B. Safety Disconnect switches

1.2 RELATED SECTIONS

- A. Section 260553 – Electrical Identification

1.3 REFERENCES

- A. NECA - Standard of Installation (published by the National Electrical Contractors Association).
- B. NEMA FU1 - Low Voltage Cartridge Fuses.
- C. NEMA KS1 - Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (published by the International Electrical Testing Association).
- E. NFPA 70 - National Electrical Code.
- F. NEC Article 500 and 501
- G. NEC 501.10(B), 501.130, 501.15
- H. NFPA 820 (hazardous area classification for WWTPs)

1.4 SUBMITTALS FOR REVIEW

- A. Follow requirements for submittals, procedures for submittals, in general project requirements.
- B. Product Data: Provide switch ratings and enclosure dimensions.

1.5 SUBMITTALS FOR CLOSEOUT

- A. Record actual locations of enclosed switches in project record documents.

1.6 REGULATORY REQUIREMENTS

- A. Conform to requirements of NFPA 70.
- B. Products: Listed and classified by Underwriters Laboratories, Inc. as suitable for the purpose specified and indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Follow requirements for material and equipment in general project requirements: Product options and substitutions.
- B. Eaton
- C. Square D.
- D. Siemens Energy and Automation
- E. General Electric / ABB
- F. Substitutions: Engineer Approved Equal.

2.2 FUSIBLE SWITCH ASSEMBLIES

- A. Description: NEMA KS 1, Type HD enclosed load interrupter knife switch. Handle lockable in OFF position.
- B. Fuse clips: Designed to accommodate NEMA FU1, Class R fuses.
- C. Short Circuit rating: 200,000 amps

2.3 ENCLOSURES

- A. Fabrication: NEMA.
 - 1. Provide NEMA 7 and listed for Class 1 Div 2 installation.
 - 2. Interior Dry Locations: Type 1 or 12 as indicated on Drawings.
 - 3. Exterior Locations: Type 4X SS.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install in accordance with NECA "Standard of Installation."
- B. Install fuses in fusible disconnect switches.
- C. Apply adhesive tag on inside door of each fused switch indicating NEMA fuse class and size installed.

3.2 FIELD QUALITY CONTROL

- A. Follow requirements for Starting of Systems in general project requirements: Field inspection, testing.
- B. Inspect and test in accordance with NETA ATS, except Section 4.
- C. Perform inspections and tests listed in NETA ATS, Section 7.5.

END OF SECTION 262816

SECTION 330900 – PLC & HMI CONTROL SYSTEM

PART 1 - GENERAL

1.1 SUMMARY

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. This Section covers the general requirements for furnishing, installing, programming, adjusting, testing, documenting, and commissioning of complete and operational PLC and HMI based control systems. The control system includes (1) one PLC and HMI control system, communications, control devices, motor control, instrumentation, and equipment mounted HMI panel for complete control and monitoring of the screw press system. Control of all components of the dewatering system, including the ability to set times, operation, and operating speeds or capacities for the sludge dewatering press feed pump, discharge sludge cake conveyors, dewatering drums, mixers, polymer blending and feed system, and wash-down sprays. The control system shall be integrated into the Owner's SCADA system.
- C. This Section applies to the following control systems and panels:
 - 1. Screw Press Main Control Panel (PLC, VFD & HMI)
 - 2. Screw Press Equipment mounted Operator Panel (HMI)
- D. Related Section:
 - 1. Section 467331 – Dewatering Equipment
 - 2. Section 463333 – Polymer Systems
 - 3. Section 461211 – Shaftless Conveyor
 - 4. Section 432110 – Progressive Cavity Pumps
 - 5. Section 26 00 01 – Electrical Systems (Construction Contract)
 - 6. Section 33 09 01 – Instrumentation for Control Systems (Construction Contract)

1.2 REFERENCES

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only:
 - 1. 47 CFR 15 Radio Frequency Devices
 - 2. IEEE C62.41 Surge Voltages in Low-Voltage AC Power Circuits
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA 250 Enclosures for Electrical Equipment (1000 Volts Maximum)
 - 2. NEMA AB 1 Molded Case Circuit Breakers and Molded Case Switches

3. NEMA ICS 1 Industrial Controls and Systems
 4. NEMA ICS 2 Industrial Control Devices, Controllers and Assemblies
 5. NEMA ICS 4 Industrial Control and Systems: Terminal Blocks
 6. NEMA ICS 6 Enclosures for Industrial Control and Systems
 7. NEMA ST1 Standard for specialty transformers
- C. National Fire Protection Association (NFPA)
1. NFPA 70 National Electrical Code
 2. NFPA 780 Installation of Lightning Protection Systems
 3. NFPA 810 Radio and Television Equipment
- D. Underwriters Laboratories (UL)
1. UL 50 Enclosures for Electrical Equipment
 2. UL 83 Thermoplastic-Insulated Wires and Cables
 3. UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
 4. UL 444 Standards for Communication Cables
 5. UL 467 Grounding and Bonding Equipment
 6. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
 7. UL 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
 8. UL 508 The Standard for Industrial Control Equipment
 9. UL 508A Outline of Investigation for Industrial Control Panels
 10. UL 698 Industrial Control Equipment for Use in Hazardous (Classified) Locations
 11. UL 886 Outlet Boxes and Fittings for Use in Hazardous Locations
 12. UL 913 Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division I Hazardous Locations
 13. UL 1063 Machine Tool Wires and Cables
 14. UL 1092 Process Control Equipment
 15. UL 1203 Explosion Proof and Dust Ignition Proof Electrical Equipment for Use in Hazardous Locations
 16. UL 1449 Standard for Transient Voltage Surge Suppression
 17. UL 1604 Electrical Equipment for Use in Hazardous Locations, Class I and Class II, Division 2 and Class III, Divisions 1 and 2
 18. UL 1778 Uninterruptible Power Supply Equipment
 19. UL 2225 Standard for Metal-Clad Cables and Cable Sealing Fittings for Use in Hazardous Locations

20. UL 2279 Electrical Equipment for Use in Class I, Zone 0, 1, and 2 Hazardous Locations

1.3 DEFINITIONS OF TERMS

- A. UL 50 Enclosures for Electrical Equipment
- B. UL 83 Thermoplastic-Insulated Wires and Cables
- C. UL 94 Tests for Flammability of Plastic Materials for Parts in Devices and Appliances
- D. UL 444 Standards for Communication Cables
- E. UL 467 Grounding and Bonding Equipment
- F. UL 486A Wire Connectors and Soldering Lugs for Use with Copper Conductors
- G. UL 489 Molded-Case Circuit Breakers and Circuit-Breaker Enclosures
- H. UL 508 The Standard for Industrial Control Equipment
- I. UL 508A Outline of Investigation for Industrial Control Panels
- J. UL 698 Industrial Control Equipment for Use in Hazardous (Classified) Locations
- K. UL 886 Outlet Boxes and Fittings for Use in Hazardous Locations
- L. UL 913 Intrinsically Safe Apparatus and Associated Apparatus for Use in Class I, II, and III, Division I Hazardous Locations
- M. UL 1063 Machine Tool Wires and Cables
- N. UL 1092 Process Control Equipment
- O. UL 1203 Explosion Proof and Dust Ignition Proof Electrical Equipment for Use in Hazardous Locations
- P. UL 1449 Standard for Transient Voltage Surge Suppression
- Q. UL 1604 Electrical Equipment for Use in Hazardous Locations, Class I and Class II, Division 2 and Class III, Divisions 1 and 2
- R. UL 1778 Uninterruptible Power Supply Equipment
- S. UL 2225 Standard for Metal-Clad Cables and Cable Sealing Fittings for Use in Hazardous Locations
- T. UL 2279 Electrical Equipment for Use in Class I, Zone 0, 1, and 2 Hazardous Locations

1.4 SPECIAL REQUIREMENTS

- A. All Scope of Work shall be provided under the supervision of a single Contractor
- B. The Contractor shall be specialized in the design, assembly, programming, testing, installation, and service of PLC control systems for at least the last (8) eight years. Contractor shall provide supporting documentation with their bid demonstrating this requirement.
- C. The Contractor shall employ technical and professional staff with documented experience in the design, assembly, programming, testing, installation, operation, troubleshooting, and service of PLC control systems. Contractor shall provide supporting documentation on their staff with their bid demonstrating this requirement.
- D. The Contractor shall be experienced with the programming and commissioning of the respective PLC, HMI, and Motor Control systems. Contractor shall provide supporting documentation with their bid demonstrating this requirement.
- E. The Contractor shall become familiar with all details of the work and verify any required dimensions and distances. Contractor shall understand and document, as needed, any existing power panels, field wiring, instrumentation, and field devices. If any conflicts occur necessitating departures from the drawings, details of and reasons for departures shall be submitted and approved prior to implementing any change.

1.5 STANDARD PRODUCTS

- A. Material and equipment shall be the standard product of a manufacturer regularly engaged in the manufacture of the product and shall essentially duplicate items that have been in satisfactory use for at least (5) years prior to bid opening.

1.6 MATERIALS AND EQUIPMENT

- A. The label or listing of the Underwriters Laboratories, Inc., shall be accepted as evidence that the materials or equipment conform to the applicable standards of that agency. In lieu of this label or listing, a statement from a nationally recognized, adequately equipped testing agency indicating that the items have been tested in accordance with required procedures and that the materials and equipment comply with all contract requirements will be accepted. However, materials and equipment installed in hazardous locations must bear the UL label unless the data submitted from another testing agency is specifically approved in writing by the Owner. Materials and equipment shall be approved based on the manufacturer's published data. For other than equipment and materials specified to conform to UL publications, a manufacturer's statement indicating complete compliance with the applicable Federal Specification, or standard of the American Society for Testing and Materials, National Electrical Manufacturers Association, or another commercial standard, is acceptable.

1.7 RESPONSIBILITIES

- A. The Contractor shall be fully and completely responsible for all work performed and all materials installed under the contract. All contracts between the Contractor and subcontractor(s) shall conform to and meet all requirements specified in the contract documents.
- B. The Contractor shall be responsible for, but not limited to:
 - 1. Contractor shall design respective Control Panel drawings in AutoCAD, including back panel layout, front door layout, Bill of Materials, power distribution and grounding, motor control, PLC input and output card drawings, network/system architecture.
 - 2. Contractor shall furnish, assemble, test, and install the control system in accordance with approved Submittals, respective design drawings, specifications, and testing requirements.
 - 3. Contractor shall create and test all custom PLC, HMI, and communications user programs for the control system.
 - 4. Contractor shall provide Submittals as outlined.
 - 5. Contractor shall coordinate and execute the FAT at their facility.
 - 6. Contractor shall ensure that network communication is online and fully functioning with the existing Owner's network and Owner's SCADA as part of system commissioning.
 - 7. Contractor shall coordinate and execute the SAT onsite.
 - 8. Contractor shall redline control system design drawings with any changes made during construction, FAT, SAT, and operational testing for updating and delivery of final as-built drawings.
 - 9. Contractor shall provide Spare Parts as outlined.
 - 10. Contractor to provide all electrical permits and inspections as required by the State, County, and City.
 - 11. Contractor shall provide (1) one day of onsite system training for the Owner. Training shall be on regular business days from 8 am to 3:00 pm.

1.8 SUBMITTALS

- A. Shop Drawings
 - 1. Contractor shall submit manufacturers' data sheets for Owner review and consideration, and any material, part, or equipment substitutions/modifications requests prior to making a change.
 - 2. Contractor shall submit for Owner review and consideration any material, part, or equipment substitutions/modifications requests prior to making a change.

B. Submittals

1. Contractor shall prepare a complete shop drawing submittal of all (specified or substituted) components, devices, instruments, and equipment, including fully detailed shop drawings, catalog cuts, wiring connections, and such other documentation as may be required to fully describe the equipment and to demonstrate its conformity to these plans and specifications. Catalog information shall be submitted for all components and equipment required for the project.
2. All submittals shall be complete, organized, and indexed. Partial submittals will not be accepted. Submit an electronic copy in PDF.
3. Owner review and approval are required on all shop drawings.

C. HMI Screen Submittals

1. The Contractor shall provide a PDF of all HMI screens utilized in the respective control panel. HMI screen submittal is required for review and approval prior to FAT execution. The screen shall represent the Contractor's final checked version and represent all the screens for the respective control panel.

D. Control Panel Drawing Submittals

1. Following approval of the shop drawing submittals, the Contractor shall provide a complete set of each respective Control Panel set of drawings. Submit an electronic copy in PDF.

E. Data Map to Owner's SCADA Submittal

1. The Contractor shall provide a list in Excel, including tag name, description, register, and units. Indicate if it's a Read or Written value/bit. Submit an electronic copy in PDF.

F. FAT Test Plan

1. Contractor shall submit an electronic copy in pdf of the FAT plan, descriptions and test execution spreadsheets that will be executed.

G. SAT Test Plan

1. Contractor shall submit an electronic copy in PDF of the SAT plan, description, and test execution spreadsheets that will be executed.

1.9 OPERATION AND MAINTENANCE MANUALS

A. Provide Operation and Maintenance (O&M) data for the completed control system. Provide (2) two copies of the O&M manual in a three-ring binder and in PDF electronic format. The O&M manual shall include:

1. All system equipment, components, and device product cutsheets with actual part number and options highlighted.
2. By Control System Panel - control panel functions and indicator descriptions.
3. By Control System Panel - operations and procedures.

4. By Control System Panel - HMI color screen printouts of all screens with a function description of menus, operator control, and input/output data.
5. Troubleshooting section for control procedures
6. Steps to restarting the PLC system from a cold start, such as utility power failure, UPS failure/battery drain.

1.10 SPARE PARTS

- A. Spare parts shall be furnished as specified below. Provide a Spare Parts line item cost. All spare parts shall be the same make, model, # and options as the respective approved part in the submittals. Spare parts shall be furnished new in OEM packaging.
 1. PLC CPU (Qty. 1 of each type used) with program preloaded on a flash card
 2. PLC Output Card (Qty. 1 of each type used)
 3. PLC Input Card (Qty. 1 of each type used)
 4. PLC Analog Input Card (Qty. 1 of each type used)
 5. PLC Analog Output Card (Qty. 1 of each type used)
 6. PLC Network or COMM Card (Qty. 1 of each type used)
 7. Control Panel UPS (Qty. 1 of each type used)
 8. 24 VDC Power Supply (Qty. 1 of each type used)
 9. VFD (Qty. 1 of each type/ size used)
 10. HMI (Qty. 1 of each type used)
 11. Ethernet Switch (Qty. 1 of each type used)
 12. Electronic components with long lead time / special order (Qty. 1 of each type used)
 13. Extra Fuses (Qty. 10 of each type)
 14. Field mounted devices that may experience higher wear or severe duty (Qty. 1 of each type used).

PART 2 - PRODUCTS

2.1 GENERAL

- A. Material shall be new, free from defects, and of the quality specified. All equipment and materials utilized in the system shall be the products of manufacturers with a minimum of (8) eight years of experience in the manufacture of similar equipment. Similar items in the system shall be the products of the same manufacturer. All equipment shall be of industrial grade and shall be specifically intended for control, monitoring and operation of motor-driven pumps and equipment. All equipment shall be of modular design to facilitate interchangeability of parts and to assure ease of servicing.

2.2 MAJOR EQUIPMENT LIST

- A. Provide all equipment and devices shown on the drawings and specified herein, including but not limited to, the following major Control System equipment:
 - 1. PLC & HMI Control Panels
 - 2. All required screw press process system instrumentation and analytical equipment

2.3 PLC CONTROL PANELS

- A. Similar items in the system shall be products from the same Manufacturer.
- B. Material shall be new, free from defects, and of the quality specified. All equipment shall be of industrial grade and of standard construction, shall be capable of long, reliable, trouble-free service, and shall be specifically intended for control and monitoring industrial equipment.
 - 1. Control Panel Identification Nameplates
 - a. Nameplates shall be furnished for all door-mounted devices. Nameplates shall be duralith or micarta with black letters on a white background. Letters shall be 3/16" high with seven (7) letters per inch, except where indicated otherwise. Engraving shall be done with a blunt tool to provide clear, wide lines. Refer to the design drawings for the control panel front door nameplate schedule.
 - b. All components mounted on the interior removable panel shall have identification adjacent to each device, using the same material as the paragraph above, except black letters on a yellow background. The nameplate shall identify the device and schematic device number. The nameplates shall be located to provide an unobstructed view of the nameplate after wiring is complete. All identification nameplates shall have chamfered edges and fastened with stainless steel round head sheet metal screws.
 - 2. Control Panel Enclosures
 - a. The enclosures shall be a UL-listed enclosure constructed to NEMA 4X stainless steel specifications. All doors shall have a locking hasp or a key lock handle. Provide two keys per lock. The enclosure back panel shall include a 20% additional capacity for future components. A removable white painted steel inner panel shall be provided for the mounting of equipment devices. A print holder shall be provided inside the door. Removable lifting means shall be provided to facilitate handling of all panels weighing over 200 pounds or exceeding 10 cubic feet in volume.
 - b. VCP: The enclosure shall be floor-standing. Provide the enclosure manufacturer's stand kit of the same material where the enclosure does not come with integral feet.
 - c. VCP: Contractor shall determine enclosure height, width, and depth based on back-panel and front door-mounted devices.
 - d. VCP: Contractor shall verify available wall space for the width and height. The enclosure shall not impede or require the removal or modifications of existing systems, structures, equipment, and utilities.

- e. VCP: Contractor shall verify available floor/panel pad space for the width and depth. The enclosure footprint shall not impede or require the removal or modifications of existing systems, structures, equipment, and utilities.
 - f. VLCP: The enclosure shall be mounted to the contractor's equipment and not require wall or floor space.
 - g. Saginaw or Approved Equivalent
3. Control Wiring
- a. Wire shall be color-coded as follows:
 - 1) AC Line & Load: Black
 - 2) AC Control: Red
 - 3) Neutral: White
 - 4) DC + Power: Blue
 - 5) DC Control: Blue
 - 6) DC - Common: White/blue stripe
 - 7) Mechanical Ground: Green or Green/Yellow Stripe
 - 8) Control Wiring Powered from Other Sources: Yellow
 - b. Conductor size shall be #14 or larger (as required). All control, interface, and power wire terminating in the respective control panel shall be stranded wire type MTW or SIS, heavy wall, except where otherwise indicated. DC control wiring shall be stranded #16 AWG or larger except where otherwise indicated.
 - c. All instrumentation and analog shielded cables shall be stranded #18 AWG with a 100% coverage shield and drain wire, 150 volt insulation except where otherwise indicated. Terminate and ground shield and drain wire as indicated on drawings. All wiring shall be copper conductors.
4. Terminal Blocks
- a. Terminal blocks shall be sized to accept wires terminating there on with a minimum of 250Vac rating at 15 amps. Terminal blocks shall be suitable for high-rise DIN rail mounting. The blocks shall have tin-plated copper alloy terminals and a marking surface for circuit identification.
 - b. Three-level terminal level blocks shall be used for analog I/O shield terminations.
 - c. Two-level common connection terminal blocks shall be used for DC circuit distribution.
 - d. Terminal block color shall be as outlined on the design drawings. All terminal blocks shall be from the same manufacturer.
5. Wiring Duct and Cover
- a. The wiring duct and cover shall be constructed of white rigid vinyl (PVC). The wiring duct shall have angled and interlocking lips to permit the duct cover to interlock with the duct. The wiring duct size shall be as indicated on the drawings. Wiring duct and covers shall be from the same manufacturer.
6. High Rise DIN Rail
- a. High-rise mounting rail shall be used for all terminal block mounting. The rail shall be constructed of aluminum with a height of 2 to 3 inches. The rail shall be designed for use with DIN rail terminal blocks.
7. Standard Rail

- a. Standard DIN rail shall be used to mount all DIN mountable devices except terminal blocks. The standard DIN rail shall be constructed of rigid aluminum or zinc-plated steel. The rail shall be designed for use with all rail-mounted panel components.
- 8. Control Panel Enclosure Fan(s) & Vents
 - a. The fans and vents shall have an outer removable stainless-steel cover with a replaceable type filter element. The contractor shall determine fan size (CFM) based on the calculated total heat load of the respective panel components and the highest ambient temperature of the panel location. Provide one spare filter element per unit.
 - b. Fan package shall be from the Enclosure Manufacturer
- 9. Control Panel Thermostats
 - a. The control panel thermostat shall be a self-contained unit designed for use in control panel enclosures and DIN rail mounting. It shall have a minimum of one normally open contact rated for 120Vac at 1A inductive load. It shall have a minimum set-point adjustment from 40 degrees F to 90 degrees F. The thermostat shall have screw-type connections.
- 10. Safety Relay for E-Stop or ESD Circuit
 - a. The control relay coil voltages shall be 24Vdc. Dual safety input. Automatic and Manual reset options. Minimum of 3 output contacts rated at AC-15: 1.5 A @ 250 Vac, DC-13: 2 A @ 24Vdc. Cross-fault detection, Safety Category 4 and SIL 3. DIN rail mount.
 - b. Allen Bradley Guardmaster or Approved Equivalent
- 11. Control Relays
 - a. The control relay coil voltages shall be 24Vdc. The relays shall be socket-type terminals with a mating socket base. The socket base shall be suitable for DIN rail mounting and have pressure plate screw terminal connections. The relays shall have a minimum of two Form C contacts, rated for a minimum of 8 amps each at 120 VAC. The contacts shall be gold. The relay shall have an ON/OFF indicator. The overall dimensional data will not require adjusting the design drawing layout. All control relays shall be from the same manufacturer.
 - b. Allen Bradley or Approved Equivalent
- 12. Control Panel Receptacle
 - a. The control panel receptacle shall be a 120VAC 15 AMP receptacle mounted inside the control panel enclosure and designed for panel mounting.
- 13. 120 Vac Single-Pole Circuit Breakers
 - a. The single-pole breakers shall be a thermal magnetic type rated for 10KA short-circuit interrupt current at 120 Vac. The unit shall be rated for a minimum of 230VAC operating voltage and have a minimum electromechanical life of at least 20,000 cycles. The circuit breaker shall have finger and hand-touch-safe screw-type connections and be designed for DIN rail mounting. Single-pole circuit breakers shall be from the same manufacturer.
- 14. 24 Vdc Single Pole Circuit Breakers

- a. The single pole breakers shall be a thermal magnetic type rated for 10KA short circuit interrupt current at 250 Vdc. The unit shall be rated for 125 Vdc and have a minimum electromechanical life of at least 20,000 cycles. The circuit breaker shall have finger and hand touch safe screw type connections and designed for DIN rail mounting. Single pole circuit breakers shall be from the same manufacturer.
15. Network Switches
- a. The Ethernet switch shall have the required RJ45 ports plus 4 spare ports supporting a transmission speed of 10/100 Mbps and 2 fiber ports (ST) type. Front-facing diagnostic/status LEDs. The unit is designed for direct DIN rail mounting. The overall dimensional data, including cooling space as required by the manufacturer, will not require adjusting the design drawing layout. Rated for installation with adjacent components on the DIN rail without derating. MTBF greater than 80 years/700,000 hours at 25 Deg C operating. Minimum operating temperature range -10 Deg C to 60 Deg C.
 - b. Allen Bradley Stratix or Approved Equivalent
16. 24 Vdc Power Supplies
- a. The 24 Vdc power supplies shall be 120 Vac powered and provide 24 Vdc and be sized in amps to power devices with a minimum of 25% spare current capacity output. The 24 Vdc output shall be adjustable from 24 to 28 Vdc. Maximum DC ripple of 50 mV peak to peak. Designed for direct DIN Rail mount. Rated at full current output up to an enclosure temperature of 40 Deg C. Designed to be installed with no air gap between adjacent DIN rail-mounted devices. Power supply shall have a dry contact output for the power supply OK status. MTBF greater than 80 years/700,000 hours at 25 Deg C operating. Minimum operating temperature range -10 Deg C to 60 Deg C.
 - b. Sola or Approved Equivalent
17. Uninterruptible Power Supply
- a. The uninterruptible power supply shall be rated for 120VAC with a 750VA capacity. The unit shall be a self-contained unit with a 3-foot, NEMA 5-15P male plug and a minimum of 2 battery/surge receptacles. The unit shall have an input voltage window from 80VAC to 150VAC for utility operation. The unit shall compensate for utility under-voltage (90VAC to 105VAC) by boosting the output. The unit shall compensate for utility over-voltage (125VAC to 140VAC) by decreasing the output. When running on battery, the unit shall provide 115VAC output with a maximum +/- 8% allowable deviation at 60Hz with a maximum +/- 0.1 Hz deviation. The transfer time shall be a maximum of 6 ms. The unit shall have an online circuit breaker and an internal battery with internal current limiting. The batteries shall be hot-swappable, sealed, maintenance-free lead-acid type. The maximum recharge time shall be 5 hours from a completely discharged state. The unit shall have indicator lights for "online", "on battery", "UPS overloaded", and "replace battery". There shall be an audible alarm for "on battery", "low battery", and "overload". The unit shall have full-time EMI and RFI filtering and surge protection. The UPS shall be located at the bottom of the control panel enclosure and sized such that it doesn't obstruct or interfere with the view or adjustment of back panel and front door-mounted devices.

- b. APC or Approved Equivalent
18. Control Panel Pilot Lights
- a. Pilot lights shall be 24Vdc rated with high-intensity LED cluster lamps. The units shall have the same NEMA rating as the control panel enclosure. The pilot light shall have a minimum diameter of 30mm, NEMA style. The LED cluster and lens shall be of the same color. The LED cluster and lens shall be field removable for future replacement. Where front door-mounted pilot lights are provided, the color of the pilot light shall follow this methodology:
 - 1) Control Power On – Green
 - 2) Emergency Stop – Red Mushroom Head, Maintained Operator
 - 3) Equipment or Device General Fault/Alarm Light – Red
 - 4) Equipment or Device Running – Green
 - 5) Open/Running – Green
 - 6) Close/Stopped – Red
 - 7) Alarms – Red
 - b. Pilot Lights shall be from the same manufacturer and model type as other front door-mounted devices on all control panels.
 - c. Allen Bradley or Approved Equivalent
19. Control Panel Pushbuttons
- a. The pushbuttons shall have a minimum of two normally open and two normally closed contacts rated for 7 amps at 120VAC. The contacts shall be field removable for future replacement. The unit shall be rated for a minimum of 1 million cycles. The pushbutton shall be a flush operator. The pushbuttons shall be rated for NEMA 4/4X and a minimum of 30 mm in diameter. Where front door-mounted pushbuttons are provided, the color of the pushbutton shall follow this methodology:
 - 1) Control Power On – Green
 - 2) Emergency Stop – Red Mushroom Head, Maintained Operator
 - 3) General Fault/Alarm Reset – Black
 - 4) Motor Start – Green
 - 5) Motor Stop – Red
 - 6) Equipment or Device Start – Green
 - 7) Equipment or Device Stop – Red
 - b. Pushbuttons shall be from the same manufacturer and model type as other front door-mounted devices on all control panels.
 - c. Allen Bradley or Approved Equivalent
20. Control Panel Two/Three Position Selector Switches
- a. Position selector switches shall have a minimum of two normally open and two normally closed contacts rated for 7 amps at 120VAC. The contacts shall be field removable for future replacement. The unit shall be rated for a minimum of 1 million cycles. The unit shall be a two-position maintained operator with the key lock in both positions. The units shall have the same NEMA rating as the control panel enclosure. They shall have a minimum diameter of 30mm, NEMA style. Provide a “no-spin” locking ring washer. Three-position selector switches are required for all motors, pumps, and motor-operated devices to facilitate HAND OFF AUTO mode control.

- b. Selector switches shall be from the same manufacturer and model type as other front door-mounted devices on all control panels.
 - c. Allen Bradley or Approved Equivalent
- 21. Motor Starters
 - a. Motor starters shall be NEMA rated starters. The overload and starter shall be intended to be used together by the manufacturer. The starter shall have an auxiliary N.O. contact for the PLC to monitor the running status of the starter. The motor starter coil shall be 24Vdc unless otherwise specified. The starter contacts shall be rated for a minimum of 1 million cycles at intended current usage for the AC-3 category. IEC type motor starters shall be sized with a 30% additional current load capacity.
 - b. Allen Bradley or Approved Equivalent
- 22. Motor Overloads
 - a. The overload and starter shall be intended to be used together by the manufacturer. The overload shall electrically interlock the starter with an N.C. contact. The overload shall have an auxiliary N.O. contact for the PLC to monitor the overload status of the motor overload and an additional contact to interlock the starter from being energized. The overload shall have an adjustable trip range to allow field setting of the trip.
 - b. Allen Bradley or Approved Equivalent
- 23. AC Motor Current Sensing Relay
 - a. The CT sensing relay shall be a panel-mounted enclosed device with a CT loop to monitor one phase of the motor. The sensing relay shall be self-powered and not require adjustment or calibration. The relay shall be sized according to the respective motor current it will be monitoring. The switch shall close when it detects the required motor current, indicating a run condition. This switch is required for all motors controlled by motor starters. Each respective switch shall be monitored by the PLC digital input.
 - b. RK Electronics or Approved Equivalent
- 24. Variable Frequency Drives (VFD)
 - a. Allen Bradley, ABB, or Approved Equivalent
 - b. VFD Sizing: The FLA output rating of the VFD shall meet or exceed the actual motor nameplate of the connected load, except for the following specific sizes:
 - 1) 0.5 to 1.0 HP motors – 1 HP rated VFD
 - 2) 1.5 to 2.0 HP motors – 2 HP rated VFD
 - 3) 3.0 HP to 5.0 HP - 5 HP rated VFD
 - c. VFD Enclosure and Mounting: NEMA 1 rated housing where installed inside a NEMA 12, 13, 3R, 4, or 4X-rated panel enclosure. The VFD shall be designed to be mounted inside a control panel enclosure with a maximum of 2 inches of space required on the top and the bottom for ventilation without output current de-rating. The VFD shall be rated for zero clearance mounting on both sides.
 - d. VFD Communications: Integral Ethernet/IP and RS485 ports. All of the VFD internal commands and status words shall be accessible without additional interfaces or communication protocols to the PLC CPU.

- e. VFD Onboard Inputs and Outputs: The VFD shall have built-in or plug-in modular type cards that provide PLC accessible digital and analog inputs and outputs. Minimum of six (6) programmable 24VDC digital inputs, four (4) 24VDC or relay programmable digital outputs. Minimum of (2) analog inputs scalable for 0-10VDC and 4-20mA with a minimum of 10-bit resolution. Minimum of (1) analog outputs scalable for 0-10VDC and 4-20mA with a minimum of 10-bit resolution.
- f. VFD Control:
 - 1) The VFD has the option of being controlled from PLC software commands over Ethernet or hardwired commands wired into the VFD IO. Control is defined as speed, selectable acceleration times, selectable deceleration times, start, and stop.
 - 2) A minimum of four (4) accel and decel modes can be programmed in a range of 0 to 600 seconds in 0.1 increments. Stop modes shall include selection of Ramp, Coast, DC-Brake, and Ramp to Stop.
- g. VFD Keypad Interface:
 - 1) All VFDs shall have the same manufacturer keypad interface regardless of horsepower rating. The keypad shall be removable from the VFD with a cable for remote mounting on the front door of the panel enclosure. The keypad interface shall have the same NEMA rating as the panel enclosure. The keypad will have a display and provide a means for an operator to allow program parameter settings and run the VFD in a manual mode (HAND) without the need for PLC control.
 - 2) The keypad shall provide a means to view historical fault codes and times. All applicable operating values shall be capable of being displayed in engineering (user) units. The display shall be in complete English words (alpha-numeric codes are not acceptable):
 - a) Output Frequency
 - b) Motor Speed (RPM, %, or Engineering units)
 - c) Motor Current
 - d) Drive Temperature
 - e) DC Bus Voltage
 - f) Output Voltage
- h. VFD Electrical: The line in voltage tolerance shall be a minimum of -15% and +10%. Power blip ride through shall be at least 100ms. The line in frequency tolerance shall be a minimum of a range of 50Hz to 63Hz. Maximum short circuit rating of 60,000 amps symmetrical. shall operate on a line voltage overload rating of the drive shall be 150% of its normal rated duty current for 60 seconds.
- i. VFD Electrical Protection: The overload rating of the drive shall be 150% of its normal rated duty current for 60 seconds and 200% for 3 seconds. The VFD shall have a built-in ground fault trip that detects phase to ground. The VFD shall have a built-in phase-to-phase (short circuit) fault trip.
- j. VFD Environmental: Continuous operating temperature from 0 Deg F to 120 Deg F without output current de-rating. Continuous operating at altitudes of 0 to 3300 feet above sea level and up to 95% humidity, non-condensing, without output current de-rating.

25. VFD Line & Load Reactors

- a. The VFD line reactor shall be sized according to the HP rating of the respective connected VFD. They shall be rated for line voltage with finger-safe line and lug terminals. They shall be rated for 3% impedance. They shall be an open type and recommended for mounting and use inside an enclosure.
 - b. The requirement for VFD load reactors shall be as specified in the VFD manufacturer's installation requirements based on the length and type of motor cable for the respective motor installation.
- 26. Main Disconnect
 - a. The VFD panel main disconnect shall be a flange-mount type suitable for direct mounting on the enclosure manufacturer's flange mount knockout. The disconnect handle shall be a flexible cable type with all required mounting and cable operator hardware. The disconnect shall be a non-fusible type, complete with the manufacturer's rated line and lug kits. The operator handle shall be all metal with an equal or better NEMA rating than the panel enclosure. Current and voltage rating of the disconnect shall be as required based on the total motor and control panel load.
 - b. Square D or Approved Equivalent
- 27. Main Circuit Breaker
 - a. The motor branch circuit breaker shall be rated for the line voltage of the motors and recommended for mounting and use inside an enclosure. The circuit breaker trip rating shall be sized for a minimum of 150% of the respective total connected motor and panel current. The circuit breaker shall have a standard magnetic trip and a minimum short circuit rating of 50kA.
- 28. Power Distribution Block
 - a. Distribution blocks shall be rated for line voltage and recommended for mounting and use inside an enclosure. The block shall be sized for a minimum of 150% of the respective total connected motor and panel current. They shall have a finger safe cover over the line, load lugs, and block.
- 29. Intrinsically Safe Barriers
 - a. Intrinsically safe interfaces shall be used on all field mounted components located in a hazardous location. The intrinsically safe devices shall be selected by the contractor based on the field devices conductor quantity, primary side voltage, and current requirements.

2.4 PLC SYSTEM

A. PLC Hardware

- 1. All PLC hardware shall be Allen Bradley CompactLogix or an approved equivalent.
- 2. PLC CPU: Allen Bradley 5380 5069-L320ER Processor.
- 3. PLC I/O: Provide CompactLogix Digital Input & Output, Analog Input & Output cards as required for the respective number and type of terminations. Include a minimum of 25% spare on each type of card.
- 4. Provide all required cables and pre-loaded development software and licenses for a complete and operational system.

5. Contractor shall program, test, and commission the HMI in accordance with these specifications.

B. HMI Screens:

1. HMI screens shall be Allen Bradley FactoryView Plus with a 15" color screen or approved equivalent. HMI shall have Ethernet and USB connectivity, NEMA 4X rated, front door mount, 512MB or approved equivalent.
2. Provide all required cables and pre-loaded development software and licenses for a complete and operational system.
3. Contractor shall program, test, and commission the HMI in accordance with these specifications.

C. Programming of PLC and HMI

1. The Contractor shall develop and execute all programming, functional testing and commissioning for the entire control system according to the descriptions in this specification and design drawing features and place the complete system into operation.
2. Adjustments or additional required sequence interlocks, alarming, or minor graphic features added during testing and commissioning shall be included in the bid price.
3. The Contractor shall provide all field technicians to execute the startup and functional checkouts and performance testing of the complete control system.
4. PLC and HMI developed program files shall become the property of the Owner and shall be provided on a USB drive with full access rights.

D. PLC & HMI Programming Software

1. The PLC and HMI programming development software are provided solely by the Contractor for developing the software applications for the project.

PART 3 - EXECUTION

3.1 GENERAL

- A. Install materials and equipment in a workman-like manner, utilizing craftsmen skilled in the respective trade. Provide work that has a neat and finished appearance.
- B. Conduit penetrations are not permitted through the top of any enclosures or equipment.

3.2 GENERAL

A. Grounding

1. The control panel enclosure, back panel, and front door shall be grounded to the incoming ground bus using #14 green stranded wire. All internal and field ground wiring shall be grounded to the ground terminals. The ground terminals shall be grounded to the incoming ground bus using #14 green stranded wire.

B. VCP Enclosure Mounting

1. The enclosure shall be floor-standing and securely mounted to both the floor and wall/ structure. Floor fasteners and anchors shall be stainless steel.
2. All wall fastening shall utilize galvanized or zinc-coated steel Unistrut, stainless steel fasteners, and stainless steel anchors.

C. VLCP Enclosure Mounting

1. The enclosure shall be mounted on the contractor's equipment.
2. Enclosure fastening shall utilize galvanized or zinc-coated steel Unistrut, stainless steel fasteners, and stainless steel anchors.

D. Enclosure Cutouts

1. All cutouts on enclosures and doors shall be made with a hydraulic die-type knockout tool. Knockout size for mounting components shall be in accordance with the component manufacturer's installation specifications. Knockouts for pushbuttons, pilot lights, and selector switches shall be 2.75-inch centers.
2. Top penetrations of the enclosures are not permitted.
3. All cutouts shall be free from burrs, rough edges, and damage. Incorrect cutouts compromising the NEMA rating of the enclosure or impairing proper solid mounting of the respective component will require the Contractor to replace the door or enclosure.

E. Wiring Identification

1. All control wires shall be identified at both ends with numbers shown on the design drawings using heat-shrinkable identification sleeves, computer-generated black lettering on white sleeve. Handwritten wire numbering will not be accepted.

F. Nameplate Identification

1. All devices and equipment mounted on the removable back-panel shall have identification adjacent to each device. All nameplates shall be located to provide an unobstructed view of the nameplate after wiring is complete. Do not mount nameplates on wireway covers.

G. Internal Panel Wire Routing

1. A.C. and D.C. wiring shall be kept separate as much as possible. All A.C. and D.C. control wires shall be terminated in terminal blocks. All shielded wire conductors shall be furnished before terminating with a slip-on crimp-style pin terminal with an insulated grip. If a method of distributing strain on wire bent frequently, such as those connected to devices on doors, is not employed, extra flexible hinge wire shall be used.

H. Terminal Blocks

1. Terminal Block Installation: Terminal blocks shall be sized to accept wires terminating thereon. All terminal blocks shall be identified with the wire number terminating thereon. All terminal blocks shall be of a color outlined in the products

section. Terminal blocks shall be mounted on a high-rise mounting rail to permit easy installation and removal of wiring. Terminal blocks shall be provided with 15% spare terminals. Terminal blocks shall be furnished in the cabinet for all external connections. The side of terminals indicated for field connections shall be free of internal wire terminations. Provide end anchors at the end of a terminal section. Provide terminal block jumper bars/strips where common circuits are required on two or more terminal blocks.

2. Terminal Block Layout: Install and layout terminal blocks in common groups. Common groups are 120Vac, Neutral, Ground, 24Vdc, Inputs, Outputs. Input and Output groups shall be installed in addressing order.

I. PLC Input/Outputs and Wiring

1. All PLC digital inputs shall be 24Vdc unless otherwise specified
2. Relay output cards shall be used to control AC voltage devices, systems with a different source of power, and where electrical isolation is required.
3. 24Vdc outputs cards shall be used for 24Vdc devices not exceeding 75 % of the power ratings of the output channel.
4. All PLC digital/analog inputs and outputs shall be terminated. This includes all unused inputs and outputs. All input and output devices connected to the PLC shall be terminated on the appropriate colored terminal blocks. Input and output devices shall not be terminated directly on the PLC hardware terminals. Wiring to spare inputs and outputs shall bear the I/O number as the wire number. Direct wiring of panel components and field devices on the PLC cards is not permitted.

J. Circuit Isolation and Protection

1. Separate single-pole circuit breakers are required to isolate and protect each of the following:
 - a. PLC power supply
 - b. HMI
 - c. 24Vdc Power Supply
 - d. Instrument Field Power
 - e. Panel Receptacle
 - f. Panel Heater (determine if needed)
 - g. Air Conditioner (determine if needed)
 - h. Enclosure Fans
 - i. PLC Output Group
 - j. PLC Input Group
 - k. UPS Load Side Power
 - l. Communication/Network/Interface Equipment

K. Power Circuit Isolation and Protection

1. Separate circuit isolation and protection are required for each of the following:
 - a. Control Panel Main – Fused or CB Disconnect with either a Lockable Front Door Mounted Rotary Operator or Lockable Flange Mounted Operator
 - b. Motor Starters – Circuit Breakers with Adjustable Trip
 - c. Variable Frequency Drives – Fuses as Specified by VFD Manufacturer

- d. Control Transformer Primary - CB or Fuses (where required)

3.3 CONTROL PANEL PLC PROGRAMMING

- A. The Contractor shall create each respective Control Panel PLC program to include, but not be limited to, the following:
 - 1. Logic, data, and descriptions not relevant or used (old code) shall be removed prior to FAT and/or SAT.
 - 2. Device and equipment start/stop, sequence, interlocks, setpoints
 - 3. Process control
 - 4. Auto and Manual control
 - 5. Alarm, Events, Trends
 - 6. Alarm, Event, Trend interface with Contractor's HMIs and to Owner's SCADA
 - 7. Setpoint and Control interface with Contractor's HMIs and from Owner's SCADA
 - 8. Network communications interface with Owner's SCADA
 - 9. The program shall be written in a fault-tolerant manner to prevent frequent operator intervention.
 - 10. The program structure shall be divided into subroutines for each logical process and equipment group. Communication routines and data shall be in respective separate subroutines.
 - 11. All analog data values shall be scaled in the program. The scaled value shall represent the real final value. Scaling in the HMI and SCADA is not permitted.
 - 12. Programs shall be written in ladder format. Programs shall be fully documented with rung and address comments. Comments at the start of new logic routines. Provide I/O listings, address, data usage, and configuration printouts. All data table words shall have descriptions.

3.4 CONTROL PANEL HMI PROGRAMMING

- A. The Contractor shall create each respective control panel HMI program as outlined herein. Screen graphics, details, and layout shall take advantage of the screen size and resolution. Screens and functions shall be intuitive, text size easy to read, and easy intuitive navigation. The main overall pump and well screen graphic shall be the default home screen. Dark screen saver shall be used for periods of inactivity greater than 30 minutes.
- B. The Contractor shall accurately depict equipment and devices for the respective system. Box or circle outlines representing equipment and devices or P&ID symbols will not be accepted. The contractor shall provide moving and/or color animation for all moving or rotating pieces of equipment, devices, and fluid flow, including but not limited to: motors, pumps, fluids with flow status in pipes.
- C. HMI Animation Color

1. Screen animation color shall be as follows, unless otherwise indicated:
2. Fault, Overload, or Alarm – Flashing Red
3. Equipment or Device Running – Solid Green
4. Equipment or Device Stopped – Solid Red
5. Start Button – Solid Green
6. Stop Button – Solid Red
7. Valve Open - Solid Green
8. Valve Closed – Solid Red

D. HMI Common Screen Features

1. Time and date
2. Screen name
3. Login/out button
4. Display the user name currently logged in
5. Screen Menu Navigation “Tree”

E. HMI Alarming

1. Provide an alarm summary screen that displays the alarms in order as they occurred and the acknowledged or unacknowledged status. The alarm descriptions shall be concise so that the operator can understand the exact nature of the alarm condition. The time and date the alarm occurred shall be displayed for each alarm. Provide alarm acknowledgment and alarm clearing features. Acknowledged points that are not in alarm shall automatically clear from the Alarm Summary.
2. Alarm status color is as follows:
 - a. Red and flashing – unacknowledged and in alarm
 - b. Red and not flashing – acknowledged and in alarm
 - c. Blue – unacknowledged, was in alarm but cleared

3.5 HMI SCREEN SECURITY

- A. HMI screens shall be set up with a minimum Admin access for full access and control, Operator Level for setpoint changes, and View user access for view-only access and acknowledging alarms. Coordinate with the Owner on all levels of access required.
- B. Coordinate with Owner on users' names, passwords, and respective access levels.

3.6 HMI - FAT TESTING

- A. The Contractor shall assemble and integrate the factory test setup as specified to prove the performance of the system satisfies all requirements, including system communication requirements, in accordance with the approved test procedures. The FAT shall take place during regular daytime working hours on weekdays. Model numbers and software revisions shall be identical to those that will be delivered to the site. The

contractor shall execute the FAT test with the Owner/Engineer as witness. The FAT setup shall include the following:

1. Completed and operational control panels with hardware and software as specified.
2. PLC's communicating with HMI as specified.
3. HMIs and PLC's fully programmed as specified.
4. Field devices and instruments shall be simulated utilizing wired toggle switches for digital inputs and 4-20mA sources for analog inputs to demonstrate field functions, program interlocks, sequences, and HMI alarms.
5. All control panel front door devices and equipment are wired and operational
6. Motor starters and VFDs are operational

B. The Contractor shall submit the FAT test execution plans for review. The FAT shall not be scheduled until the Owner/Engineer has approved the FAT test execution plans. Features and functions outlined below shall be outlined for execution in the FAT test document. At the conclusion of the FAT execution, the Contractor shall make all revisions to the control system as noted in the FAT comments field. A scanned copy of the executed FAT test documents shall be provided to Owner/Engineer at the conclusion of the test. The FAT test document shall include the following:

1. PLC Hardware used.
2. PLC/HMI Software used.
3. Description/List of Test and Simulation Equipment
4. The FAT test execution plans shall be created in Excel in the sample format shown below, including the Test Name, Step, Procedure, Result, with respective entries for Pass, Fail, Initials, and Comments.

PUMP X START/STOP AUTO/MANUAL						
Test #		Test Steps	Pass	Fail	Witness Initials	Comments
1	Procedure	Change Pump X Mode to Manual Mode				
	Procedure	Press Pump X Start Button on HMI				
	Result	Verify Pump is Running				
	Result	Verify Pump indicates Running on the HMI				
	Result	Verify HMI Animations				
2	Procedure	Change Pump X Mode to Auto Mode				
	Procedure	Simulate or Create a Required Start Condition				
	Result	Verify Pump is Running				
	Result	Verify Pump indicates Running on the HMI				
	Result	Verify HMI Animations				

5. The FAT test execution document shall also include a list of all PLC I/O addresses with respective columns for "I/O Description", "Initials", "PASS", and "FAIL".

C. All special testing materials and equipment required to demonstrate compliance with the specification shall be provided by the Contractor. Where it is not practical to test with

real process variables, provide suitable means of simulation. These simulation techniques shall be subject to the approval of the Owner/Engineer prior.

3.7 SAT EXECUTION

A. General

1. The Contractor shall deliver SAT test execution plans for the test prior to execution for review and approval of the Owner/Engineer. The SAT shall not be scheduled until the Owner/Engineer has approved the SAT test execution plans. Features and functions outlined below shall be outlined for execution in the SAT test document.
2. The SAT test execution plans shall be created in Excel in the sample format shown below, including the Test Name, Step, Procedure, Result, with respective entries for Pass, Fail, Initials, and Comments.

PUMP X START/STOP AUTO/MANUAL						
Test #		Test Steps	Pass	Fail	Witness Initials	Comments
1	Procedure	Change Pump X Mode to Manual Mode				
	Procedure	Press Pump X Start Button on HMI				
	Result	Verify Pump is Running				
	Result	Verify Pump indicates Running on the HMI				
	Result	Verify HMI Animations				
2	Procedure	Change Pump X Mode to Auto Mode				
	Procedure	Simulate or Create a Required Start Condition				
	Result	Verify Pump is Running				
	Result	Verify Pump indicates Running on the HMI				
	Result	Verify HMI Animations				

3. All control system functions, alarms, sequences, inputs/outputs, and operation possibilities shall be demonstrated. Where a function, sequence, or operation cannot naturally occur at the time of testing, it shall be simulated.
4. Control set-points and modes of operation shall be modified through the HMI screen and other operator devices such as pushbuttons, selector switches, and VFD controllers. Password protection shall be verified for all set-point entries and mode changes. The minimum and maximum set-point windows shall be tested for all analog levels.

B. Test Failure Assessment

1. If the SAT test was stopped due to failures, the Contractor shall identify the failures, determine the causes of failures, repair failures, and deliver a written report to the Owner. The report shall explain in detail the nature of each failure, corrective action taken, results of tests performed, and shall recommend the point at which the testing should be resumed. After delivering the written report, the Contractor shall convene a test review meeting at the job site to present the results and recommendations to the Owner. As a part of this test review meeting, the contractor shall demonstrate that the failure has been corrected. Based on the contractor's report and the test review meeting, Owner will determine the restart point and may require the test to

be fully or partially rerun. The Contractor shall not commence any required re-testing until after receipt of written notification by Owner.

2. The contractor will not be held responsible for failures resulting from the following:
An outage of the main power supply in excess of the capability of any backup power source, provided that the automatic initiation of all backup sources was accomplished. Failure of existing equipment and existing instrumentation, provided that the failure was not due to contractor-furnished equipment, installation, or software.

END OF SECTION 330900

SECTION 400507 - PROCESS PIPE HANGERS AND SUPPORTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawing and general provisions of the Contract, including the General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes hangers and supports for process piping systems and equipment.
- B. Related Sections: The following Sections contain requirements that relate to this Section:
 - 1. Division 5 Section "Metal Fabrications" for materials for attaching hangers and supports to building structure.

1.3 DEFINITIONS

- A. MSS: Manufacturers Standardization Society for the Valve and Fittings Industry.
- B. Terminology: As defined in MSS SP-90, "Guidelines on Terminology for Pipe Hangers and Supports."

1.4 PERFORMANCE REQUIREMENTS

- A. Design channel support systems for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.
- B. Design heavy-duty steel trapeze for piping to support multiple pipes capable of supporting combined weight of supported systems, system contents, and test water.

1.5 SUBMITTALS

- A. General: Submit the following according to the Conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: For each type of pipe hanger, channel support system component, and thermal-hanger shield insert indicated.
- C. Shop Drawings shall be signed and sealed by a qualified professional engineer for multiple piping supports and trapeze hangers. Include design calculations and indicate size and characteristics of components and fabrication details. Shop drawings for each type of hanger and support, indicating dimensions, weights, required clearances, and methods of component assembly.
- D. Submit pipe hanger and support schedule showing manufacturer's Figure No., size, location, and features for each required pipe hanger and support.

1.6 QUALITY ASSURANCE

- A. Welding: Qualify processes and operators according to ASME Boiler and Pressure Vessel Code: Section IX, "Welding and Brazing Qualifications."
- B. Engineering Responsibility: Design and preparation of Shop Drawings and calculations for each multiple pipe support and trapeze by a qualified professional engineer.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the manufacturers specified:
 - 1. Pipe Hangers:
 - a. AAA Technology and Specialties Co., Inc.
 - b. B-Line Systems, Inc.
 - c. Carpenter & Patterson, Inc.
 - d. Empire Tool & Manufacturing Co., Inc.
 - e. Globe Pipe Hanger Products, Inc.
 - f. Grinnell Corp.
 - g. GS Metals Corp.
 - h. Michigan Hanger Co., Inc.
 - i. National Pipe Hanger Corp.
 - j. PHD Manufacturing, Inc.
 - k. PHS Industries, Inc.
 - l. Piping Technology & Products, Inc.
 - 2. Channel Support Systems:
 - a. B-Line Systems, Inc.
 - b. Grinnell Corp.; Power-Strut Unit.
 - c. GS Metals Corp.
 - d. Michigan Hanger Co., Inc.; O-Strut Div.
 - e. National Pipe Hanger Corp.
 - f. Thomas & Betts Corp.
 - g. Unistrut Corp.
 - h. Wesanco, Inc.
 - 3. Thermal-Hanger Shield Inserts:
 - a. Carpenter & Patterson, Inc.
 - b. Michigan Hanger Co., Inc.
 - c. PHS Industries, Inc.
 - d. Pipe Shields, Inc.
 - e. Rilco Manufacturing Co., Inc.
 - f. Value Engineered Products, Inc.
 - 4. Powder-Actuated Fastener Systems:
 - a. Gunnebo Fastening Corp.
 - b. Hilti, Inc.
 - c. ITW Ramset/Red Head.

- d. Masterset Fastening Systems, Inc.

2.2 MANUFACTURED UNITS

- A. Pipe Hangers, Supports, and Components: MSS SP-58, factory-fabricated components. Refer to "Hanger and Support Applications" Article in Part 3 for where to use specific hanger and support types.
 - 1. General:
 - a. Interior hangers, rods, supports, etc. to be corrosion resistant, hot dipped galvanized steel.
 - b. Exterior hangers, rods, supports, etc. to be corrosion resistant, Type 304 or 316 stainless steel.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
 - 3. All attachments to precast hollow-core concrete slabs shall comply with slab manufacturer's installation instructions.
- B. Channel Support Systems: MFMA-2, factory-fabricated components for field assembly.
 - 1. Coatings: Manufacturer's standard finish unless bare metal surfaces are indicated.
 - 2. Nonmetallic Coatings: On attachments for electrolytic protection where attachments are in direct contact with copper tubing.
- C. Thermal-Hanger Shield Inserts: 100-psi minimum compressive-strength insulation, encased in sheet metal shield.
 - 1. Material for Cold Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 - 2. Material for Cold Piping: ASTM C 552, Type I cellular glass with vapor barrier.
 - 3. Material for Cold Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate with vapor barrier.
 - 4. Material for Hot Piping: ASTM C 552, Type I cellular glass or water-repellent-treated, ASTM C 533, Type I calcium silicate.
 - 5. Material for Hot Piping: ASTM C 552, Type I cellular glass.
 - 6. Material for Hot Piping: Water-repellent-treated, ASTM C 533, Type I calcium silicate.
 - 7. For Trapeze or Clamped System: Insert and shield cover entire circumference of pipe.
 - 8. For Clevis or Band Hanger: Insert and shield cover lower 180 degrees of pipe.
 - 9. Insert Length: Extend 2 inches beyond sheet metal shield for piping operating below ambient air temperature.

2.3 MISCELLANEOUS MATERIALS

- A. Powder-Actuated Drive-Pin Fasteners: Powder-actuated-type, drive-pin attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- B. Mechanical-Anchor Fasteners: Insert-type attachments with pull-out and shear capacities appropriate for supported loads and building materials where used.
- C. Structural Steel: ASTM A 36/A 36M, steel plates, shapes, and bars, black and galvanized.
- D. Grout: ASTM C1107, Grade B, factory-mixed and -packaged, non-shrink and nonmetallic, dry, hydraulic-cement grout.
 - 1. Characteristics: Post hardening and volume adjusting; recommended for both interior and exterior applications.
 - 2. Properties: Non-staining, noncorrosive, and nongaseous.
 - 3. Design Mix: 5000-psi, 28-day compressive strength.

PART 3 - EXECUTION

3.1 HANGER AND SUPPORT APPLICATION

- A. General: Interior hangers, rods, supports, etc. to be corrosion resistant, hot dipped galvanized steel. Exterior hangers, rods, supports, etc. to be corrosion resistant, Type 304 or 316 stainless steel.
- B. All attachments to precast hollow-core concrete slabs shall comply with slab manufacturer's installation instructions.
- C. Specific hanger requirements are specified in Sections specifying equipment and systems.
- D. Comply with MSS SP-69 for pipe hanger selections and applications that are not specified in piping specification Sections.
- E. Horizontal-Piping Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Adjustable Steel Clevis Hangers (MSS Type 1): For suspension of non-insulated or insulated stationary pipes, NPS 1/2 to NPS 30.
 - 2. Yoke-Type Pipe Clamps (MSS Type 2): For suspension of 120 to 450-deg F pipes, NPS 4 to NPS 16, requiring up to 4 inches of insulation.
 - 3. Carbon- or Alloy-Steel, Double-Bolt Pipe Clamps (MSS Type 3): For suspension of pipes, NPS 3/4 to NPS 24, requiring clamp flexibility and up to 4 inches of insulation.
 - 4. Steel Pipe Clamps (MSS Type 4): For suspension of cold and hot pipes, NPS 1/2 to NPS 24, if little or no insulation is required.

5. Pipe Hangers (MSS Type 5): For suspension of pipes, NPS 1/2 to NPS 4, to allow off-center closure for hanger installation before pipe erection.
6. Adjustable Swivel Split- or Solid-Ring Hangers (MSS Type 6): For suspension of non-insulated stationary pipes, NPS 3/4 to NPS 8.
7. Adjustable Steel Band Hangers (MSS Type 7): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
8. Adjustable Band Hangers (MSS Type 9): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 8.
9. Adjustable Swivel-Ring Band Hangers (MSS Type 10): For suspension of non-insulated stationary pipes, NPS 1/2 to NPS 2.
10. Split Pipe-Ring with or without Turnbuckle-Adjustment Hangers (MSS Type 11): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 8.
11. Extension Hinged or Two-Bolt Split Pipe Clamps (MSS Type 12): For suspension of non-insulated stationary pipes, NPS 3/8 to NPS 3.
12. U-Bolts (MSS Type 24): For support of heavy pipe, NPS 1/2 to NPS 30.
13. Clips (MSS Type 26): For support of insulated pipes not subject to expansion or contraction.
14. Pipe Saddle Supports (MSS Type 36): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange.
15. Pipe Stanchion Saddles (MSS Type 37): For support of pipes, NPS 4 to NPS 36, with steel pipe base stanchion support and cast-iron floor flange and with U-bolt to retain pipe.
16. Adjustable Pipe Saddle Supports (MSS Type 38): For stanchion-type support for pipes, NPS 2-1/2 to NPS 36, if vertical adjustment is required, with steel pipe base stanchion support and cast-iron floor flange.
17. Single Pipe Rolls (MSS Type 41): For suspension of pipes, NPS 1 to NPS 30, from two rods if longitudinal movement caused by expansion and contraction might occur.
18. Adjustable Roller Hangers (MSS Type 43): For suspension of pipes, NPS 2-1/2 to NPS 20, from single rod if horizontal movement caused by expansion and contraction might occur.
19. Complete Pipe Rolls (MSS Type 44): For support of pipes, NPS 2 to NPS 42, if longitudinal movement caused by expansion and contraction might occur but vertical adjustment is not necessary.
20. Pipe Roll and Plate Units (MSS Type 45): For support of pipes, NPS 2 to NPS 24, if small horizontal movement caused by expansion and contraction might occur and vertical adjustment is not necessary.
21. Adjustable Pipe Roll and Base Units (MSS Type 46): For support of pipes, NPS 2 to NPS 30, if vertical and lateral adjustment during installation might be required in addition to expansion and contraction.

- F. Vertical-Piping Clamps: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Extension Pipe or Riser Clamps (MSS Type 8): For support of pipe risers, NPS 3/4 to NPS 20.
 2. Carbon- or Alloy-Steel Riser Clamps (MSS Type 42): For support of pipe risers, NPS 3/4 to NPS 20, if longer ends are required for riser clamps.
- G. Hanger-Rod Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel Turnbuckles (MSS Type 13): For adjustment up to 6 inches for heavy loads.
 2. Steel Clevises (MSS Type 14): For 120 to 450-deg F piping installations.
 3. Swivel Turnbuckles (MSS Type 15): For use with MSS Type 11, split pipe rings.
 4. Malleable-Iron Sockets (MSS Type 16): For attaching hanger rods to various types of building attachments.
 5. Steel Weldless Eye Nuts (MSS Type 17): For 120 to 450-deg F piping installations.
- H. Building Attachments: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
1. Steel or Malleable Concrete Inserts (MSS Type 18): For upper attachment to suspend pipe hangers from concrete ceiling.
 2. Top-Beam C-Clamps (MSS Type 19): For use under roof installations with bar-joist construction to attach to top flange of structural shape.
 3. Side-Beam or Channel Clamps (MSS Type 20): For attaching to bottom flange of beams, channels, or angles.
 4. Center-Beam Clamps (MSS Type 21): For attaching to center of bottom flange of beams.
 5. Welded Beam Attachments (MSS Type 22): For attaching to bottom of beams if loads are considerable and rod sizes are large.
 6. C-Clamps (MSS Type 23): For structural shapes.
 7. Top-Beam Clamps (MSS Type 25): For top of beams if hanger rod is required tangent to flange edge.
 8. Side-Beam Clamps (MSS Type 27): For bottom of steel I-beams.
 9. Steel-Beam Clamps with Eye Nuts (MSS Type 28): For attaching to bottom of steel I-beams for heavy loads.
 10. Linked-Steel Clamps with Eye Nuts (MSS Type 29): For attaching to bottom of steel I-beams for heavy loads, with link extensions.
 11. Malleable Beam Clamps with Extension Pieces (MSS Type 30): For attaching to structural steel.
 12. Welded-Steel Brackets: For support of pipes from below or for suspending from above by using clip and rod. Use one of the following for indicated loads:
 - a. Light (MSS Type 31): 750 lb.

- b. Medium (MSS Type 32): 1500 lb.
 - c. Heavy (MSS Type 33): 3000 lb.
- 13. Side-Beam Brackets (MSS Type 34): For sides of steel or wooden beams.
- 14. Plate Lugs (MSS Type 57): For attaching to steel beams if flexibility at beam is required.
- 15. Horizontal Travelers (MSS Type 58): For supporting piping systems subject to linear horizontal movement where head room is limited.
- I. Saddles and Shields: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Steel Pipe-Covering Protection Saddles (MSS Type 39): To fill interior voids with insulation that matches adjoining insulation.
 - 2. Protection Shields (MSS Type 40): Of length recommended by manufacturer to prevent crushing insulation.
 - 3. Thermal-Hanger Shield Inserts: For supporting insulated pipe, 360-degree insert of high-density, 100-psi minimum compressive-strength, water-repellent-treated calcium silicate or cellular-glass pipe insulation, same thickness as adjoining insulation with vapor barrier and encased in 360-degree sheet metal shield.
- J. Spring Hangers and Supports: Unless otherwise indicated and except as specified in piping system Specification Sections, install the following types:
 - 1. Restraint-Control Devices (MSS Type 47): Where indicated to control piping movement.
 - 2. Spring Cushions (MSS Type 48): For light loads if vertical movement does not exceed 1-1/4 inches.
 - 3. Spring-Cushion Roll Hangers (MSS Type 49): For equipping Type 41 roll hanger with springs.
 - 4. Spring Sway Braces (MSS Type 50): To retard sway, shock, vibration, or thermal expansion in piping systems.
 - 5. Variable-Spring Hangers (MSS Type 51): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from hanger.
 - 6. Variable-Spring Base Supports (MSS Type 52): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from base support.
 - 7. Variable-Spring Trapeze Hangers (MSS Type 53): Preset to indicated load and limit variability factor to 25 percent to absorb expansion and contraction of piping system from trapeze support.
 - 8. Constant Supports: For critical piping stress and if necessary to avoid transfer of stress from one support to another support, critical terminal, or connected equipment. Include auxiliary stops for erection, hydrostatic test, and load-adjustment capability. These supports include the following types:
 - a. Horizontal (MSS Type 54): Mounted horizontally.

- b. Vertical (MSS Type 55): Mounted vertically.
- c. Trapeze (MSS Type 56): Two vertical-type supports and one trapeze member.

3.2 HANGER AND SUPPORT INSTALLATION

- A. Pipe Hanger and Support Installation: Comply with MSS SP-69 and MSS SP-89. Install hangers, supports, clamps, and attachments as required to properly support piping from building structure.
- B. Channel Support System Installation: Arrange for grouping of parallel runs of piping and support together on field-assembled channel systems.
 - 1. Field assemble and install according to manufacturer's written instructions.
- C. Heavy-Duty Steel Trapeze Installation: Arrange for grouping of parallel runs of horizontal piping and support together on field-fabricated, heavy-duty trapezes.
 - 1. Pipes of Various Sizes: Support together and space trapezes for smallest pipe size or install intermediate supports for smaller diameter pipes as specified above for individual pipe hangers.
 - 2. Field fabricate from ASTM A 36/A 36M, steel shapes selected for loads being supported. Weld steel according to AWS D-1.1.
- D. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.
- E. Install powder-actuated drive-pin fasteners in concrete after concrete is placed and completely cured. Use operators that are licensed by powder-actuated tool manufacturer. Install fasteners according to powder-actuated tool manufacturer's operating manual.
- F. Install mechanical-anchor fasteners in concrete after concrete is placed and completely cured. Install fasteners according to manufacturer's written instructions.
- G. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories.
- H. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- I. All piping shall be adequately supported and braced by means of adequate hangers, concrete piers, pipe supports, brackets, or as otherwise shown on the plan or recommended by the pipe and equipment manufacturer requirements. No pipe support shall fall on a pipe joint. Contactor shall provide unions and flexible couplers (not shown on plans) to provide adequate removal of valves and equipment.

- J. Load Distribution: Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. Pipe Slopes: Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.
- L. Insulated Piping: Comply with the following:
 - 1. Attach clamps and spacers to piping.
 - a. Piping Operating above Ambient Air Temperature: Clamp may project through insulation.
 - b. Piping Operating below Ambient Air Temperature: Use thermal-hanger shield insert with clamp sized to match OD of insert.
 - c. Do not exceed pipe stress limits according to ASME B31.9.
 - 2. Install MSS SP-58, Type 39 protection saddles, if insulation without vapor barrier is indicated. Fill interior voids with insulation that matches adjoining insulation.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 3. Install MSS SP-58, Type 40 protective shields on cold piping with vapor barrier. Shields shall span arc of 180 degrees.
 - a. Option: Thermal-hanger shield inserts may be used. Include steel weight-distribution plate for pipe NPS 4 and larger if pipe is installed on rollers.
 - 4. Shield Dimensions for Pipe: Not less than the following:
 - a. NPS 1/4 to NPS 3-1/2: 12 inches long and 0.048 inch thick.
 - b. NPS 4: 12 inches long and 0.06 inch thick.
 - c. NPS 5 and NPS 6: 18 inches long and 0.06 inch thick.
 - d. NPS 8 to NPS 14: 24 inches long and 0.075 inch thick.
 - 5. Insert Material: Length at least as long as protective shield.
 - 6. Thermal-Hanger Shields: Install with insulation same thickness as piping insulation.

3.3 EQUIPMENT SUPPORTS

- A. Fabricate structural steel stands to suspend equipment from structure above or support equipment above floor.
- B. Grouting: Place grout under supports for equipment and make a smooth bearing surface.

3.4 METAL FABRICATION

- A. Cut, drill, and fit miscellaneous metal fabrications for pipe and equipment supports.
- B. Fit exposed connections together to form hairline joints. Field-weld connections that cannot be shop-welded because of shipping size limitations.

- C. Field Welding: Comply with AWS D1.1 procedures for manual shielded metal-arc welding, appearance and quality of welds, methods used in correcting welding work, and the following:
 - 1. Use materials and methods that minimize distortion and develop strength and corrosion resistance of base metals.
 - 2. Obtain fusion without undercut or overlap.
 - 3. Remove welding flux immediately.
 - 4. Finish welds at exposed connections so that no roughness shows after finishing, and so that contours of welded surfaces match adjacent contours.

3.5 ADJUSTING

- A. Hanger Adjustment: Adjust hangers to distribute loads equally on attachments and to achieve indicated slope of pipe.

3.6 PAINTING

- A. Touching Up: Clean field welds and abraded areas of shop paint. Paint exposed areas immediately after erecting hangers and supports. Use same materials as used for shop painting. Comply with SSPC-PA 1 requirements for touching up field-painted surfaces.
 - 1. Apply paint by brush or spray to provide a minimum dry film thickness of 2.0 mils.
- B. Galvanized Surfaces: Clean welds, bolted connections, and abraded areas and apply galvanizing-repair paint to comply with ASTM A 780.

END OF SECTION 400507

SECTION 400523 - PROCESS VALVES

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. The extent of each type of valve and size required is indicated on drawings and/or schedule.
- B. All valves used for a particular service are to be of the same manufacturer, make, and style for each valve type.
- C. Each valve unit shall be of the proper size and type to suit the intended service with appropriate body style, operator, joint accessories, coatings, guides, supports, pertinent accessories to be complete, in place, tested, and ready for service in conformance with project conditions.

1.3 SUBMITTALS

- A. General: Submit the following in accordance with the conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Provide manufacturer's illustrated catalog data depicting general construction, materials list, coatings, and necessary appurtenances in sufficient detail to verify product compliance.
- C. Shop Drawings: Provide manufacturer's drawings showing principal dimensions, operator detail, and arrangements, project schedule tag reference, or location of intended usage as required to suit project conditions.

1.4 QUALITY ASSURANCE

- A. Supply valves and appurtenances that are standard products in regular production by a manufacturer whose products have proven reliable in similar service for at least five (5) years.
- B. All valves used for a particular service are to be of the same manufacturer, make, and style for each valve type.
- C. Each valve shall be subjected to operation and hydrostatic tests at the manufacturer's plant as specified within applicable AWWA Standards.
- D. All coated surfaces shall receive manufacturer's production and holiday testing as specified in applicable AWWA Standards.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. Preparation for Transport: Prepare valves for shipping as follows:
 - 1. Ensure valves are dry and internally protected against rust and corrosion.
 - 2. Protect valve ends against damage and entry of dirt, etc., by use of appropriate end protectors.
 - 3. Set valves in the best position for handling. Set gate valves closed to prevent rattling; set ball and plug valves open to minimize exposure of functional surfaces; set butterfly valves closed or slightly open; and block swing check valves in either closed or open position.
- B. Storage: Use the following precautions during storage:
 - 1. Do not remove valve end protectors unless necessary for inspection; then reinstall for storage.
 - 2. Protect valves from weather. Store valves indoors. Maintain valve temperature higher than the ambient dew point temperature. If outdoor storage is necessary, support valves off the ground or pavement in watertight enclosures.
- C. Handling: Use a sling to handle the valve whose size requires handling by crane or lift. Rig valves to avoid damage to exposed or internal valve parts. Do not use handwheels and stems as lifting or rigging points.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Cast information in raised letters on valve body. Name and Working Pressure: Valve bodies shall be of either gray or ductile cast iron and shall have the name, monogram, or initials of the manufacturer cast thereon.
- B. Valves shall have non-rising stems, open by turning left or counter-clockwise, and be provided with either a 2-inch square nut for buried valves or a handwheel for exposed valves unless otherwise noted. The direction of opening shall be indicated by an arrow cast on the body and/or the actuator.
- C. All body bolts and nuts shall be bronze or stainless steel for buried, submerged, or nonprotected applications and cadmium plated for exposed or interior applications that will receive protective finish coatings.

2.2 CHECK VALVES - WATER

- A. Swing Check: Valves shall be quiet closing and constructed for a minimum of 150 pounds working pressure. They shall be an iron body, stainless steel body seats, with outside lever and adjustable weights, and have hinge pins of stainless steel.
- B. Valves shall be as manufactured by: Valves shall be a product of: Clow, GA, APCO, or an approved equal.

- C. Air Cushioned Swing Check: Valves shall be GA Industries Model 250-D cushioned swing check valves with outside lever and weight; APCO; or an approved equivalent. Cushioned check valves shall be installed in the locations noted.
- D. Valves shall be in full compliance with the latest revision of AWWA Specification C508.

2.3 GATE OR TAPPING VALVES

- A. The valves, described in this section, shall be resilient-seated gate valves manufactured to meet or exceed AWWA C509. Valves shall be of compression-type seal design, providing bubble-tight shut-off with bi-directional seating ability for pressures up to 200 psi.
- B. The valve shall have a smooth, unobstructed waterway free from any sedimentation pockets. Valve shall provide a 100% port of nominal pipe size when fully open. The tapping valve port shall be sized to permit a full pipe port tap.
- C. Body style shall be mechanical joint type for buried service, flange joint type for exposed service, and, when required, to include special end connections for tapping requirements or otherwise if indicated on the Contract Drawings.
- D. Stuffing boxes shall be O-ring seal type with two (2) rings located in the stem above the thrust collar.
- E. Thrust bearings shall be of the low-friction torque reduction type, located both above and below the stem collar.
- F. Valves shall be as manufactured by American Flow Control, Clow, M & H, Mueller, U.S. Pipe, or an approved equal.

2.4 PLUG VALVES

- A. Valves shall be the non-lubricated, eccentric type with resilient, soft-faced Buna-N rubber plugs providing bi-directional dead-tight shut-off to the full valve rating. Valve pressure ratings shall be 175 psi through 12 inches and 150 psi for valves over 12 inches.
- B. Bodies of valves shall be furnished with a welded overlay seat of not less than 90% pure nickel. Seat area shall be completely covered with a raised surface weld to ensure that the plug face contacts only nickel. Screwed-in seats shall not be acceptable.
- C. Plugs shall be of ASTM A126 Class B cast iron or elastomer-coated ductile iron ASTM A536 Grade 65-45-12. The plug shall have a cylindrical seating surface eccentrically offset from the center of the plug shaft. The interference between the plug face and body seat shall be externally adjustable in the field with the valve in line under pressure. Round-shaped ports are not acceptable.
- D. Valve bearings shall be sleeve type, oil impregnated, permanently lubricated, stainless steel. Nonmetallic bearings shall not be acceptable.
- E. Shaft seals may be of the multiple V-ring type and shall be externally adjustable and replaceable without removing the valve or actuator while under pressure.

- F. Plug Valves 4-inch and above shall be equipped with a gear and handwheel.
- G. Valves shall be as manufactured by DeZurik, or an approved equivalent.

2.5 OPERATORS

- A. All valves 6 inches and larger, and all buried, submerged, or chain-operated valves shall be gear-operated. Gears for valve operation shall be sized for the working pressure and installed in such a manner that the stuffing box will be accessible for packing.
- B. Manual Operation
 - 1. Valves shall be equipped with nut, handwheel, crank, chain, gears, floor stand, and other appurtenances as required for manual operation as specified or scheduled.
 - 2. Operation shall be designed so that the effort required to operate the handwheel, lever, or chain shall not exceed 25 lbs. applied at the extremity of the wheel or lever.
 - 3. Handwheels on valves 4 in. and larger shall not be less than 12 in. in diameter.
 - 4. Chainwheels shall be provided when the installed centerline of the valve is over 5 ft.-6 in. above the floor. Chains shall be cadmium plated and loop 3 ft.-6 in. from the floor. Orient the chainwheel and provide intermediate pulley mounting, if necessary, to permit unobstructed chain operation.
 - 5. Wrench nuts shall be cast iron or bronze, 1-15/16 in. at top, 2 in. square at base, and 1-3/4 in. high with a flanged base.
 - a. Provide one (1) tee wrench for each valve type used and of each significant length differential required. All wrenches supplied shall be a length so that the bar handle extends approximately 3 feet above finished grade, in addition to the required bury depth length(s).
- C. Electric valve operations
 - 1. The operator shall be the helical and worm gear type driven by an electric motor. All power gearing shall be grease lubricated. The actuator shall be in conformance with AWWA C540. The valve manufacturer shall furnish the value of the maximum operating torque required to operate the valve as defined in the Appendix to AWWA C540. The operator manufacturer shall furnish evidence that the operator is designed to equal or exceed the torque requirements.
 - 2. Unless otherwise noted, the operator shall be geared to operate the valve from the fully open position to the fully closed position or vice-versa in approximately 60 seconds. It shall be possible to change this cycle time by substituting suitable gear trains. The operator shall be equipped with a declutchable handwheel for manual operation. The operator shall be designed to hold the valve in any intermediate position between fully open and fully closed without creeping or fluttering.
 - 3. Suitable reduction gearing shall be provided off the main shaft of the gearing, turning approximately 270 degrees while the valve performs full travel. The reduction gearing shall be equipped with the following position-indicating devices for each operator:
 - a. A mechanical position indicator dial;

- b. The output signal shall be 4-20 ma; a standard potentiometer, 1000 ohms with linearity of +/- 3% for indication in the remote controller.
- 4. Each operator shall be equipped with adjustable torque switches for overload protection in both opening and closing directions, with a torque switch bypass for unseating.
- 5. Each operator shall be equipped with four adjustable train gear limit switches. Each limit switch shall include a switch and counter gear. The setting accuracy shall be less than 1/10 turn of the operator output shaft. Two (2) gear limit switches are for remote indication of end positions.
- 6. Each motor shall be 480 volts, 60 Hz, three-phase, induction type as recommended by the operator manufacturer.
- 7. Three (3) thermostats in series placed in the winding shall provide the motor with thermal protection. They shall interrupt the control circuit as soon as the temperature goes beyond the permissible winding temperature.
- 8. Each operator shall be equipped with a reversing magnetic starter. The starter shall be capable of receiving contact closures from remote sources to actuate the operator in either direction. Control voltage shall be 120 volts supplied by a transformer included in the control enclosure. Each operator shall include a local OPEN-STOP-CLOSE control, push button station, and a pad lockable LOCAL-OFF-REMOTE selector switch.
- 9. All electrical components shall be integral with the operator, housed in a watertight NEMA 4X enclosure, and completely wired.
- 10. A circuit-breaker disconnect shall be provided with the operator.
- 11. Easily identifiable terminal blocks shall be provided for all external power, control, and signal connections.
- 12. Operators, located outdoors, shall include thermostats and space heaters in the motor and control compartments.
- 13. The operator shall be as manufactured by Rotork, Limitorque, EIM, Auma, or an approved equal.

2.6 PROTECTIVE COATINGS

- A. All iron parts of valve assemblies shall be painted before leaving the shop.
- B. All exterior and internal waterway ferrous surfaces of each valve, except finished or bearing surfaces, shall be shop-painted with a liquid or powder epoxy coating of approximately 10 mils dry film thickness conforming to AWWA C-550.

2.7 EXTENSION STEMS AND STEM GUIDES

- A. When required by drawings, schedule, or project details, provide an extension stem made of cold-rolled steel material and the same size as the stem of the valve it operates. If the extension is more than 8 ft. long, intermediate stem guides shall be installed and supported from the wall by suitable brackets at a maximum spacing of 8 ft.

- B. Brackets and stem guides shall be made of cast iron and fully adjustable. The guide block shall be bronze bushed where it contacts the extension stem. Stem guides shall be as manufactured by the Eddy Valve Co., Rodney Hunt, or equal. Secure stem guides to walls with stainless steel bolts. In the event of offset of misalignment, provide off-set extension road with universal end fittings at the valve actuator and stem drop connection.
- C. Extension stem shall have a connecting socket for a 2-inch square nut and a pin socket to lock on the valve operating nut.

2.8 VALVE BOXES

- A. Valve boxes shall be cast iron, 5-1/4" shaft, three-piece screw type, adjustable boxes. The top section has a drop lid of which to be marked for service, which is used to cast thereon. Cover and boxes shall be a round pattern.
- B. Provide a proper base size and shape to straddle the valve bonnet without touching or being supported by the valve mechanism. Use No. 6 base size for 6-inch and 8-inch gate valves or typical butterfly valve operators, No. 160 oval base size for 12-inch and larger gate valves or other size necessary to suit a particular valve manufacturer's requirement.
- C. Extension sections shall be provided where the depth of trench is such that they are needed to bring the top of the box to finished grade. The valve box shall be installed so that it is perfectly vertical and centered on the valve operating nut.

2.9 FLOOR BOXES AND STANDS

- A. Each valve operator projecting through a floor shall be equipped with a floor box or floor stand and extension stem.
- B. Floor boxes for access to operating nuts of valves, slide gates shall be cast iron covers and bodies with bronze or brass bushings. Casting length to equal the thickness of the concrete slab. Floor boxes shall be manufactured by Clow, Trumbull Industries, or an approved equal.
- C. Floor stands shall be made of cast iron and shall extend to a level where the handwheel or other operator is easily operated. Stands shall be fitted with bronze bushings to maintain proper stem alignment, brass or stainless-steel nameplates shall be provided to identify the related valve manufacturer, valve type, and size, or in the case of a stand being of valve manufacturer, a cast-in name would suffice. Provide plastic stem covers with an open-close scale for all rising stem applications. Stands shall be anchored to the concrete slab with stainless steel bolts.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Valves shall be carefully handled and placed so as not to permit any damage to the interior coatings, disc, or seat. Internal type lifting devices shall not be permitted. Do not use handwheels or stems for lifting of rigging points.

- B. All valves shall be carefully installed in their respective positions, free from distortion and stress. Connecting joints shall conform to applicable requirements of the specifications.
- C. Stem guides shall be accurately aligned.
- D. If the valve box is tipped or otherwise not centered on the valve operating nut or not installed at the proper elevation, the Contractor shall, at his own expense, make whatever correction is required to remedy the defect promptly, upon notice to do so by the Engineer.

3.2 TESTING

- A. All valves shall be tested in place by the Contractor as far as practicable under conditions for the pipelines in which they are placed, and defects revealed in valves or connections under test shall be corrected at the expense of the Contractor to the satisfaction of the Engineer.

3.3 OPERATION AND MAINTENANCE MANUALS

- A. Prior to or with the delivery of equipment, the manufacturer shall provide copies of an operation and maintenance manual, including storage, installation, start-up, operating and maintaining instructions, and a complete parts and recommended spare parts list. The O & M Manuals shall be in compliance with the General Requirements of these specifications.

END OF SECTION 400523

SECTION 402336 - PIPES AND PIPE FITTINGS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Divisions 1– 46 Specification sections, apply to work of this section.

1.2 DESCRIPTION OF WORK

- A. CONTRACTOR shall provide all labor, materials, equipment, and incidentals as shown, specified, and required to furnish all process pipes and fittings.
- B. Exposed and buried process piping:
 - 1. Extent of piping is shown on the Drawings and Piping Schedule, specifying pipe service, diameter, material, lining, coating, pressure rating, joint type, and testing required.
- C. Coordination:
 - 1. Review installation procedures under this and other Sections and coordinate the installation of items to be installed with or before ductile iron pipe Work.
- D. Interior and exterior process piping.
- E. Piping associated with the following processes: chemical feed piping.
- F. All PVC and CPVC pipe and fittings shall be manufactured in the U.S.A.

1.3 QUALITY ASSURANCE

- A. General: All materials shall be free from defects impairing strength and durability and be of the best quality for the purposes specified or shown on the Drawings. It shall have structural properties sufficient to sustain or withstand strain and stresses to which it is normally subjected and be true to detail.
- B. Manufacturer's Qualifications:
 - 1. Firms regularly engaged in the manufacture of pipes and pipe fittings of types and sizes required, whose products have been in satisfactory use in similar service for not less than 5 years.
 - 2. Provide piping and appurtenances that are the standard product in regular production by Manufacturers whose products have proven reliable in similar service for at least two years.
 - 3. Provide piping and appurtenances of the same type from a single manufacturer.

4. All castings used for coupling housings, fittings, and valve bodies shall be date stamped for quality assurance and traceability.
 5. Ductile iron pipe manufacturer shall be responsible for all products and all factory-applied linings and coatings, whether installed at pipe manufacturer's facility or at manufacturer's Supplier's facility.
 6. All grooved joint couplings, fittings, valves, and specialties shall be the products of a single manufacturer. Grooving tools shall be of the same manufacturer as the grooved components.
- C. Regulatory Requirements:
1. Pipe and fittings, including linings and coatings, that will convey potable water or water that will be treated to become potable, shall be certified by an accredited organization in accordance with NSF/ANSI 61 as being suitable for contact with potable water, and shall comply with the requirements of authorities having jurisdiction at the Site.
- D. Testing:
1. Manufacturer's certified test results, as defined for the type of pipe, shall be stamped approved by the Contractor and forwarded to the Engineer as a Reference Submittal. No pipe shall be installed that does not meet the requirements of these Specifications.
- E. All pipes, joints, and fittings shall be pressure tested as required by this Specification for the type of pipe. The Contractor shall notify the Engineer or Owner, in writing, at least 48 hours before performing the tests.
- F. Codes and Standards
1. Welding: Quality welding procedures, welders, and operators in accordance with ASME B31.1, or ASME B31.9, as applicable, for shop and project site welding of piping work.
 - a. Certify welding of piping work using Standard Procedure Specifications by, and welders tested under the supervision of, the National Certified Pipe Welding Bureau (NCPWB).
 2. Brazing: Certify brazing procedures, brazers, and operators in accordance with ASME Boiler and Pressure Vessel Code, Section IX, for shop and job-site brazing of piping work.
 3. NSF Labels: Where plastic piping is indicated to transport potable water, provide pipe and fittings bearing an approval label by the National Sanitation Foundation (NSF).
- G. The Contractor shall be responsible for making all field measurements before installation of his work. Any deviations in measurements between the field conditions and the Drawings shall be immediately reported to the Engineer.

1.4 SUBMITTALS

- A. Provide technical submittals in accordance with Division 01 Section “Submittal Procedures”, demonstrating piping and accessories conform completely to the requirements of this Section.
- B. Product Data:
 - 1. Submit manufacturer's technical product data, installation instructions, and dimensioned drawings for each type of pipe and pipe fitting.
 - 2. Submit piping schedule showing Manufacturer, pipe diameter, pipe or tube weight, wall thicknesses, fitting type, joint type, and accessories for each piping system.
 - 3. Support and anchor details with the manufacturer's maximum recommended loads.
 - 4. Design calculations indicating support spacing requirements for all pipe sizes.
 - 5. Grooved joint products shall be shown on drawings, and product submittals shall be specifically identified with the applicable Victaulic style or series number.
- C. Shop Drawings
 - 1. Detailed drawings and data for pipe, fittings, gaskets, appurtenances, linings (for DIP), and coatings (for DIP).
 - 2. Complete piping layout indicating type of pipe, diameter, and location. Show dimensions from adjacent structure, equipment, and other piping.
 - 3. Location of all pipe joints, sleeves, valves, and couplings.
 - 4. Location of all pipe supports and anchors.
 - 5. Details of pipe anchors, supports, couplings, and joints.
 - 6. Grooved joint couplings and fittings may be shown on drawings and product submittals and shall be specifically identified by the manufacturer’s style or series designation.
- D. Informational Submittals: Submit the following:
- E. Testing: Copies of all field test reports.
- F. Contractor shall verify chemical compatibility of piping, solvents, gaskets, seals, O-rings, etc., for each chemical feed system. Provide chemical compatibility charts and the manufacturer’s written verification of compatibility for each chemical feed system.
- G. Welding Certifications: Submit reports as required for piping work.
- H. Brazing Certifications: Submit reports as required for piping work.
- I. Maintenance Data: Submit maintenance data and parts lists for each type of mechanical fitting. Include this data, product data, and certifications in the maintenance manual, in accordance with the requirements of Division 1.

1.5 DELIVERY, STORAGE, AND HANDLING:

- A. Handling, delivery, and storage shall be in accordance with the manufacturer's recommendations.
 - 1. In no case shall the pipe or appurtenance be dumped, dropped, or thrown.
 - 2. Interiors of piping shall be completely free of dirt and foreign matter.
- B. Protect flanges and fittings from moisture and dirt by inside storage and enclosure, or by packing with durable, waterproof wrapping.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Piping Materials: Provide pipe and tube of type, joint type, grade, size, and weight (wall thickness or Class) indicated for each service. Where type, grade, or class is not indicated, provide proper selection as determined by the Installer for installation requirements, and comply with governing regulations and industry standards.
- B. All standard and special ductile iron castings shall conform to the latest applicable AWWA and/or ANSI specifications for pressure fittings with end conditions as specified herein. AWWA C110 (ANSI A21.10) shall be applicable for all ductile iron fittings.
- C. Pipe/Tube Fittings: Provide factory-fabricated fittings of type, materials, grade, class, and pressure rating indicated for each service and pipe size. Provide sizes and types matching pipe, tube, valve, or equipment connection in each case. Where not otherwise indicated, comply with governing regulations and industry standards for selections, and with the pipe manufacturer's recommendations where applicable.
- D. The outside of all piping, valves, and fittings shall bear the Manufacturer's standard marking for type, pressure, etc.
- E. All pipe and fittings shall be equal to or better than the grade specified.
- F. Whenever Specifications call for close bending or coiling, use Grade B pipe.
- G. All piping materials shall be new and free from defects and shall be subject to standard mill test before being shipped. No salvaged or used pipe shall be used.
- H. Fittings shall have the Manufacturer's name or trademark legibly raised or cut into each piece, and shall bear the Manufacturer's standard marking for type, pressure, etc.
- I. All pipes shall be cut off even and reamed full bore. Threads shall be cut smoothly, true, and to full standard size. Piping shall be installed clean of chips, burrs or oil.
- J. Victaulic grooved fittings, couplings, and valves may be utilized in lieu of welded, threaded, or flanged joints as shown on the Drawings. Gasket selection and intended use shall be verified as suitable for the intended service as published in the manufacturer's

latest literature. Installation shall be in accordance with the coupling manufacturer's latest published instructions.

2.2 DUCTILE IRON PIPE (DIP OR DI)

A. Pipe

1. Standards
 - a. Flanged: ANSI/AWWA C115/A21.15.
 - b. Non-flanged: ANSI/AWWA C151/A21.51.
 - c. Thickness: If not otherwise specified, use Class 53 for three-inch to 54-inch diameter pipe and Pressure Class 350 for 60-inch and 64-inch diameter pipe.
 - d. Lining: Cement-mortar lining, ANSI/AWWA C104/A21.4.
 - e. Grooved end pipe shall be Class 53 (min), with ends that comply with ANSI / AWWA C606.
2. Coating
 - a. Buried pipe: 1 mil asphalt coating, AWWA C151.
 - b. Exposed pipe to be painted: Factory prime coat compatible with finished coat system.

B. Joints

1. As shown on the Drawings. If not designated, use grooved or flanged joints for exposed piping and restrained joints for buried piping.
2. Flanged
 - a. Ductile iron, ANSI A21.10.
 - b. Bolt Circles and Bolt Holes: Class 125.
 - c. Gaskets: 1/8 inch EPDM full-faced.
 - d. Bolts and nuts.
 - 1) Buried and exposed: 304 stainless steel bolts, 304 stainless steel nuts.
 - 2) Submerged: Type 316 stainless steel.
3. Grooved joint couplings shall consist of two or more ductile iron housings to ASTM A536, a Flush Seal pressure-responsive gasket to ASTM D2000, and zinc-electroplated steel bolts and nuts to ASTM A449. Basis of Design: Victaulic Style 31.
4. Mechanical or Push-on
 - a. ANSI A21.11.
 - b. Gaskets: plain tipped.
 - c. Bolts and nuts: 304 stainless steel bolts, 304 stainless steel nuts.
5. Restrained
 - a. Use restrained joints for all exterior, buried, ductile iron process pipe.
 - b. Restraining wedges shall be made of ductile iron; conform to ASTM A536.
 - c. Where restrained joints are required for fittings only, provide a full length of pipe on both sides of the fitting.
 - d. Manufacturers
 - 1) Megalug by EBAA Iron Sales.

- 2) TR Flex or FIELD LOK by US Pipe.
- 3) Super-Lock or Restrained Tyton Joint by Clow.
- 4) Flex-Ring or Lok-Ring by American Cast Iron Pipe Company.
- 5) Or equal.

C. Fittings

1. Types: Flanged, grooved or mechanical, as indicated on Drawings.
2. Flanged: ANSI/AWWA C110/A21.10.
3. Grooved end fittings shall comply with ANSI A21.10 /AWWA C110 for center to end dimensions, and ANSI A21.10 /AWWA C110 or AWWA C153 for wall thickness, with ends to AWWA C606. Basis of Design: Victaulic AWWA Fittings.
4. Grooved joint couplings shall consist of two or more ductile iron housings to ASTM A536, a Flush Seal pressure-responsive gasket to ASTM D2000, and zinc-electroplated steel bolts and nuts to ASTM A449. Basis of Design: Victaulic Style 31.
5. Mechanical joint
 - a. 3 inches -16 inches: Full body ANSI/AWWA C110/A21.10 or short body ANSI/AWWA C153/A21.53.
 - b. Larger than 16 inches: Full body ANSI/AWWA C110/A21.10.
6. Pressure rating: 250 psi minimum.
7. Coating and lining: Identical to connecting piping.
8. Base tees and bends: Drill and furnish with anchor bolts. Machine when used as pipe kicker.

D. Polyethylene Encasement

1. Conform to ANSI/AWWA A21.5/C-106.
2. 8 mil black virgin polyethylene.
3. Wrap all ductile iron pipe and fittings.

2.3 PVC PIPE AND FITTINGS

- A. Pipe: Pipe shall be Schedule 80, Type I, Grade I (Class 12454-B) conforming to ASTM D 1784 and D 1785.
- B. Nipples: Short nipples shall be the same as the PVC pipe.
- C. Fittings: Fittings shall be schedule 80 and shall conform to ASTM D 2464 for threaded fittings 6-inches and smaller and ASTM D 2467 for socket-type fittings 8-inches and smaller. For threaded fittings larger than 6-inches and for solvent welded fittings larger than 8-inches the fittings shall be schedule 80 per the manufacturer's standards. All fittings shall successfully pass the required pressure test.

- D. Flanges: PVC flanges shall be made of the same material as the pipe. Flanges shall match the bolt pattern of ANSI B16.5, Class 150. Flanges shall be flat face.
- E. Unions
 - 1. Unions shall have socket-type ends, EPDM o-rings, and shall be schedule 80. Material shall be Type 1, Grade I PVC, cell class 12454, per ASTM D 1784.
 - 2. Provide Unions at connections to equipment, valves, and other accessories to facilitate equipment removal.
- F. Joints
 - 1. Pipe and fitting joints shall be socket-welded except where grooved, threaded, and flanged joints are required to connect to unions, valves, and equipment
 - 2. Screwed joints that are necessary to match up to threaded valves or fittings shall be made up with Teflon Tape only.
 - 3. Flanged joints shall be made with solvent-welded PVC flanges.
- G. Solvent Cement: IPS Corporation Weld-On 724, without exception, unless the Contractor provides certification from the pipe and cement supplier that a superior type of cement is available for the application.
- H. Gaskets for flanges: Shall be PROCO Series 9013 or equal based on chemical compatibility.
- I. Bolts and Nuts for Flanges
 - 1. Bolts: Type 316 stainless steel conforming to ASTM A 193, Grade B8M
 - 2. Nuts: silicon-bronze
 - 3. Provide a washer under each nut and under each bolt head. Washers shall be of the same material as the bolts.
 - 4. Lubricant shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or equal
- J. Threaded ends: Taper pipe threads. All threaded female fittings shall be 316 stainless steel reinforced.
- K. Manufacturer
 - 1. Pipe: Harvel or equal.
 - 2. Fittings: Spears or equal.

2.4 CPVC

- A. Rigid CPVC pipe shall be Schedule 80, Type IV, Grade I. Compound used in the manufacture of the pipe and fittings shall conform to ASTM D1784, Cell Class 23447. The compound shall contain the specified amounts of pigment, stabilizers and other additives approved by the National Sanitation Foundation (NSF) for the conveyance of potable water. Pipe dimensions shall be in accordance with ASTM F-441.

- B. Nipples: short nipples shall be the same as the CPVC pipe.
- C. Fittings: All fittings shall be schedule 80 injection molded CPVC, cell classification 23447, conforming to ASTM D1784. Fittings shall be listed for potable water service by NSF and manufactured in strict compliance to ASTM F 437 for threaded fittings, and ASTM F 439 for socket type.
- D. Flanges: CPVC flanges shall be made of the same material as the pipe. Flanges shall match the bolt pattern of ANSI B16.5, Class 150. Flanges shall be flat face.
- E. Unions
 - 1. Unions shall have socket-type ends and shall be schedule 80. Material shall be Type IV, Grade 1 CPVC, cell class 23447, per ASTM D1784.
 - 2. O-rings: For all systems, check chemical compatibility.
 - 3. Provide Unions at connections to equipment, valves, and other accessories to facilitate equipment removal.
- F. Joints
 - 1. Pipe and fitting joints shall be socket welded except where grooved, threaded and flanged joints are required to connect to unions, valves, and equipment.
 - 2. Screwed joints that are necessary to match up to threaded valves or fittings shall be made up with Teflon Tape only.
 - 3. Flanged joints shall be made with solvent welded CPVC flanges.
- G. Solvent Cement: IPS Corporation Weld-On 724 without exception
- H. Gaskets for flanges shall be of the following materials:
 - 1. Shall be Proco Series 9013 or equal low torque gasket based on chemical compatibility.
 - 2. Shall be Proco Series 9013 or equal low torque gasket based on chemical compatibility.
- I. Bolts and Nuts for Flanges
 - 1. Bolts: Type 316 stainless steel conforming to ASTM A 193, Grade B8M.
 - 2. Nuts: silicon-bronze.
 - 3. Provide a washer under each nut and under each bolthead. Washers shall be of the same material as the bolts.
 - 4. Lubricant shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or equal.
- J. Threaded joints: Taper pipe threads. All threaded female fittings shall be 316 stainless steel reinforced.

- K. Manufacturer:
 - 1. Pipe: Harvel or equal.
 - 2. Fittings: Spears or equal.

2.5 POLYPROPYLENE PIPE (PP)

- A. Pipe shall be extruded from Group 1, Class 2, Alpha nucleated homopolymer material in accordance with ASTM D-4101. AP polypropylene resin shall achieve a minimum tensile strength of 300 bar when tested at 23 deg C according to ASTM D 638.
- B. Material shall allow continuous operating temperatures to 95 deg C. AP resin shall comply with relevant food substance regulation, US FDA guidelines as specified in Code of Federal Regulators (CFR), Title 21, Chapter 1: Section 177.1520 and Section 178.3297 suitable for contact with foodstuff, pharmaceutical use and potable water.
- C. Pipe shall be stress relieved by post-extrusion annealing to eliminate inherent stresses in the pipe wall created by the extrusion process.
- D. System (pipe and fittings) shall be pressure rated in accordance with ASTM D-2837 and Din 8077 for hydrostatic design basis. Pipe shall be manufactured to an SDR (standard dimension ratio) in order to provide the same pressure rating in all diameters.
- E. Pipe shall be SDR 11 series that defines the wall thickness and outer diameter of the pipe.
- F. All pressure pattern fittings (elbows, tees, flanges and reducers) from 1/2" (20 mm) through 16" (400 mm) shall be injection molded and shall have the same pressure rating as the pipe.
- G. Socket fusion fittings dimension are in accordance with ISO 7279 and DIN 16962. Butt fusion conform to SDR (standard dimension ratio) series that defines the wall thickness and outer diameter.
- H. All pressure fitting 1/2" (20 mm) through 4" (110 mm) shall be socket fusion type joints. Pressure fittings, drainage pattern fittings and pipe 2" and larger shall be joined by butt fusion welding. All fusion-welded joints to be performed in accordance with ASTM D-2657 and piping manufacturers recommendations.
- I. Installer shall have a paid certification by the manufacturer. Only certified installers shall install and weld pipe.
- J. Gaskets: PTFE film low torque PROCO - 9013 (www.procoproducts.com). Gasket shall be full faced, low torque, fully molded EPDM with dual concentric, convex sealing rings and PTFE film bonded to the rubber. The dimensions shall comply with 150# ANSI B16.5 drilling. Chemical compatibility shall be confirmed.
- K. Bolts and Nuts for Flanges
 - 1. Bolts: Type 316 stainless steel conforming to ASTM A 193, Grade B8M

- L. Pipe shall be Simtech, SIMTECH 877-777-2467 (www.SimtechUSA.com), or Approved equal.

2.6 PVDF (KYNAR) PIPE

- A. System (pipe and fittings) shall be pressure rated in accordance with ASTM D-2837. Pipe shall be manufactured to an SDR (standard dimension ratio) in order to provide the same pressure rating in all diameters. Pipe shall be:

$$SDR\ 21\ *PN16\ (3/8'' - 4'') = 232\ psi$$

** PN = Nominal pressure rating in bar*

- B. Materials: Pipe shall be extruded from virgin, pure, unpigmented homopolymer KYNAR 740® resin, as manufactured by Atofina Chemicals, Inc. Material shall meet or exceed requirements of Table 1 of ASTM D-3222. Pipe manufacturing shall not employ any stabilizers, antioxidants, fillers, pigmentation or additives of any kind.
- C. Pipe shall be stress relieved by post-extrusion annealing to eliminate inherent stresses in the pipe wall created by the extrusion process.
- D. All pipe and fittings shall comply with the dimensions and tolerances outlined in ASTM D3261. Pipe shall have a 2.5 safety factor for a 50-year life. Pipe shall be furnished in 16.4 feet length.
- E. All pressure pattern fittings (elbows, tees, flanges and reducers) from 3/8 inch through 4 inch shall be injection molded and shall have the same pressure rating as the pipe. Fittings shall not contain any stabilizer, antioxidants, fillers, pigmentation or additives of any kind. All fittings shall have a 2.5 safety factor for a 50-year life.
- F. All pressure fitting 3/8 inch through 4 inch shall be an interference fit socket fusion type joint. All fusion weld joints to be performed in accordance with ASTM D-2657-87 and piping manufacturers recommendations. Welder certificates, certifying that welders comply with the installation procedures as outlined by ASTM D-2657. All training should be scheduled and completed prior to job start-up.
- G. Gaskets: PTFE film low torque PROCO - 9013 (www.procoproducts.com). Gasket shall be full faced, low torque, fully molded EPDM with dual concentric, convex sealing rings and PTFE film bonded to the rubber. The dimensions shall comply with 150# ANSI B16.5 drilling. Chemical compatibility shall be confirmed.
- H. Bolts and Nuts for Flanges
1. Bolts: Type 316 stainless steel conforming to ASTM A 193, Grade B8M.
 2. Nuts: Silicon-bronze.
 3. Provide a washer under each nut and under each bolthead. Washers shall be of the same material as the bolts.
 4. Lubricant shall be TRX-Synlube by Ramco, Anti-Seize by Ramco, Husk-It Husky Lube O'Seal, or equal.

- I. Markings: all pipe and fittings shall be clearly marked with the manufacturer's name or trademark, size, and country of manufacture.
- J. Installer shall have a paid certification by the manufacturer. Only certified installers shall install and weld pipe.
- K. Manufacturer: All pipe, fittings & valves shall be SIMTECH (Phone: 877-777-2467) www.simtechUSA.com, or Engineer-approved equal

2.7 HIGH DENSITY POLYETHYLENE PRESSURE PIPE (HDPE) AND FITTINGS

- A. Materials: PE3408 High Density Polyethylene (HDPE), ASTM D3350 cell classification 345444C.
- B. The material shall have a minimum Hydrostatic Design Basis (HDB) of 1600 psi at 73 degrees F when tested in accordance with PPI TR-3 and shall be listed in the name of the pipe and fitting manufacturer in PPI TR-4.
- C. NSF Approval: The material used in the production of the greenstripe pipe is not required to have NSF approval. Use greenstripe pipe for the raw water piping and where shown on the drawings.
- D. Pipe
 - 1. HDPE pipe shall be manufactured in accordance with AWWA C901 for sizes 1/2-inch through 3-inch and AWWA C906 for sizes 4-inch and larger.
 - 2. Pipe shall be supplied in Ductile Iron Pipe (DIP) sizes.
 - 3. The pipe supplied shall be designed for the following working conditions, but shall be a minimum of DR 17:
 - a. Working Pressure: 75 psi.
 - b. Dead Load: 8 feet of ground cover, silty sand and gravel.
 - c. Live Load: H-20.
 - 4. Permanent identification of piping service shall be provided by co-extruding longitudinal blue or green stripes into the pipe's outside surface. The striping material shall be the same material as the pipe except for the color.
- E. Fittings
 - 1. HDPE fittings shall be made from material meeting the same requirements as the pipe. Fittings shall be molded or fabricated by the manufacturer of the pipe.
 - 2. Where applicable, fittings shall meet the requirements of AWWA C906.
 - 3. Molded fittings shall be manufactured in accordance with either ASTM D2683 (socket fused) or ASTM D3261 (butt fused) and shall be marked accordingly.
 - 4. Fittings shall be butt-fused to the piping unless otherwise noted.

F. Quality Control

1. The pipe and fitting manufacturer shall have an established quality control program responsible for inspecting incoming and outgoing materials. Incoming polyethylene materials shall be inspected for density, melt flow rate, and contamination. The cell classification properties of the material shall be certified by the supplier. Incoming materials shall be approved by Quality Control before processing into finished goods. Outgoing products shall be tested as required in AWWA C901 or C906.
2. The Manufacturer shall maintain permanent Quality Control and Quality Assurance records. Certification or copy of these records shall be made available upon request.
3. The Manufacturer shall have manufacturing and quality control facilities capable of producing and assuring the quality of the pipe and fittings required by these specifications. Given reasonable notice, the Manufacturer's production facilities shall be open for inspection by the Owner or Engineer.

G. Installation and Testing

1. The Manufacturer shall supply an Installation Manual to the Engineer and Contractor which outlines guidelines for handling, joining, installing, embedding and testing of HDPE pipeline.
2. Joints between plain ends of HDPE pipe shall be made by butt fusion. The pipe manufacturer's fusion procedures shall be followed at all times. The wall thicknesses of the adjoining pipes shall have the same DR at the point of fusion.
3. When mechanical fittings are utilized for transitions between pipe materials, connections to valves, and other locations, the recommendation of the mechanical fitting or valve manufacturer shall be followed. At a minimum, all mechanical joints shall be installed with a mechanical joint restrainer with 316 stainless steel pipe stiffeners. All mechanical joint materials and joining methods shall be approved and/or recommended by the HDPE pipe manufacturer.
4. On each day butt fusions are to be made, the first fusion of the day shall be a trial fusion. The trial fusion shall be allowed to cool completely, then fusion test straps shall be cut out. The test strap shall be 12-inches or 30-times the wall thickness in length (minimum) and 1-inch or 1.5-times the wall thickness in width (minimum). Bend the test strap until the ends of the strap touch. If the fusion fails at the joint, a new trial fusion shall be made, cooled completely and tested. Butt fusion of pipe to be installed shall not commence until a trial fusion has passed the bent strap test.
5. Pressure testing shall be conducted in accordance with the Manufacturer's recommended procedure and as outlined in Part 3 of this specification. Pressure testing shall use water as the test media.
6. Manufacturer: PLEXCO Performance Pipe Division – Chevron Chemical Company, or equal.

2.8 COPPER TUBING

A. Federal Specifications WW-T-799C.

1. Type: Type K, hard drawn, for all pipe cast in concrete, buried or where shown on the Drawings. Type L, hard drawn, for all other pipe applications.
2. Fittings: Nibco or equal, wrought solder type, ANSI B16.22.
3. Joints: Soldered, make with noncorrosive paste flux and solid string or wire solder. Core solder is not permitted.

2.9 STAINLESS STEEL (SS) PIPE

A. Materials: Stainless steel pipe and fittings (300 psi at 200 deg F maximum). All stainless steel pipe and fittings shall be fabricated from Type 304L stainless steel sheet and plate.

B. All stainless steel piping shall have as a minimum the nominal wall thickness dimensioned as shown on the Drawings. The required Schedule/Gauge/Plate and Wall Thickness are to be indicated in the manufacturer's shop drawings and verified by ASME B31.3 calculations. Piping wall thickness shall be designed for the hydrostatic test pressure as required. Calculations for wall thickness shall be based on the minimum wall thickness due to manufacturing tolerances, joint efficiencies, and a safety factors as permitted by ASME B31.3.

C. Pipe

1. Pipe shall conform to ASTM A-312 and be die-formed or rolled true to dimension and round within the applicable ANSI Standard. The two edges of sheet shall be brought to line so as not to leave a shoulder on the inside of the pipe.
2. Pipes shall be straight within the applicable ANSI Standard for ASTM-A-312 welded pipe.
3. Ends of pipe and fittings shall be true and perpendicular to the longitudinal axis with the edges deburred.
4. Fittings shall conform to ASTM A-403-WP in accordance with B16.9.
5. Longitudinal seams on pipe and fittings shall be welded by the GTAW, PAW, FCAW, SAW, or the SMAW methods. Filler metal, if utilized, shall be of same composition or superior to the pipe and fittings material.
6. Weld deposit at the seams shall have a slight crown on both sides of the weld and no cracks or crevices shall be allowed. Excessive weld deposits, slag, weld spatter and projections into interior of pipe shall be removed by grinding. The interior welds shall be smooth, even and shall not have an internal bead higher than 1/16 inch.
7. All pieces shall be marked indicating wall thickness/schedule, grade of stainless steel, and ASTM Standard.
8. All pieces shall be marked indicating wall thickness/schedule, grade of stainless steel, and ASTM Standard. ASTM A312, Type 304/304L or 316/316L, Schedule 5, 10, or 40. Roll or Cut grooved as appropriate to the pipe material, wall thickness,

pressure, size and method of joining. Use Victaulic RX roll sets specifically designed for grooving schedule 5 or 10 stainless steel pipe.

D. Fittings

1. Fittings shall be butt weld type per ASTM-A-403WP and manufactured in accordance with ANSI B16.9. All fittings shall be of the same pressure rating and grade material as the pipe.
2. Elbows shall be long radius Long radius; i.e., centerline to end of elbow equals 1.5 times the nominal pipe size, unless otherwise approved by the Engineer. All elbows up to 24-inch diameter shall be smooth flow. All short radius, special radius, and reducing elbows and long radius elbows greater than 24-inch diameter shall be of mitered construction with at least (5) miter sections for 90 degree bends, (3) mitered sections for 45 and 60 degree bends, and (2) mitered sections for 30 degree and smaller bends. Reducers shall be straight tapered, cone type.
3. Fittings three inches and smaller shall be threaded conforming to ASTM-A-182 forged, Class 3000# and manufactured to ANSI B16.11.
4. Fittings for buried or submerged pipe larger than three inches shall be butt-welded, conforming to ASTM-A-403WP, same pressure rating and material as the pipe and manufactured to ANSI B16.9.
5. Fittings for above ground or exposed pipe larger than three inches shall be butt-welded except when flanged or coupled, as shown on the drawings, conforming to ASTM A 403 WP, same pressure rating and grade material as the pipe and manufactured to ANSI B16.9. Tees shall have no welds in the throat area and the crotch shall be reinforced with long radius design to eliminate sharp corners. Extruded branch outlets may be used in place of reducing outlet tees when properly designed and manufactured per ASME B31.3 to meet the applicable operating, design, and test pressures as specified herein.
6. Grooved End Fittings: Fittings shall be manufactured of stainless steel conforming to ASTM A-403, WPW, WPW/S9, or CR/S9, or shall be fabricated from stainless steel pipe conforming to ASTM A312, with factory grooved ends. Fittings shall be type 304/304L or 316/316L stainless steel.

E. Drain and Instrumentation Branches

1. Outlets of size three inches and smaller in piping 4 inches and larger shall be of the Thredolet type, per AWWA Manual M11 (1964 edition), Figure 19.24. Outlets shall be 3,000-pound WOG stainless steel per ASTM A 182, or ASTM A 403. Threads shall comply with ANSI B2.01. Outlets shall be Bonny Forge Co. "Thredolet," Allied Piping Products Co. "Brachlet," or equal.
2. For outlets three inches and smaller in piping smaller than four inches, use a threaded tee in accordance with Section D above.
3. For outlets larger than three inches, use a tee conforming to ASTM-A-403WP, in accordance with Section D above and with a flanged outlet or as shown on the Drawings.

F. Process Piping Branches

1. Reducing outlets of size 8 inches to 1-1/4 inches for skid process piping headers shall be fabricated of 304L stainless steel, ASTM SA-312, to match the material and construction of the header pipe. Fabricated outlets shall be extruded with a single butt weld in accordance to ASME B31.3 to connect the outlet branch to the header pipe.

G. Joints

1. Joints for pipes three inches and smaller shall be threaded, grooved or socket welded, same material as the pipe, 3,000 pound WOG, conforming to ANSI B16.11.
2. Joints for buried or submerged pipe larger than three inches shall be butt-welded.
3. Joints for aboveground or exposed pipe larger than three inches shall be grooved or butt-welded except where flanges or grooved end joints are shown on the Drawings.

H. Flanges

1. Provide weld-neck flanges conforming to ANSI B16.5 for piping three inches and smaller to connect to flanged valves, fittings, or equipment. Provide slip-on flanges for piping larger than three inches. Provide blind flanges at dead-end connections and where shown on the Drawings.
2. Flanges shall be Class 150 per ANSI B16.5 unless a higher-pressure rating is required. Flanges shall be Class 300 for the reverse osmosis feed water piping. Material for weld-neck, slip-on, and blind flanges shall conform to ASTM-A-182, Grade F304L. Flanges and blind flanges shall match the connecting flanges on the adjacent fitting, valve, or piece of equipment.
3. Where a raised face steel flange connects to a flat face flange, remove the raised face on the steel flange.
4. Bolts and nuts for flanges shall be Type 316 stainless steel conforming to ASTM A 193, Grade B8M, for bolts and ASTM A 194, Grade 8M, for nuts.
5. Provide a washer for each nut. Washers shall be of the same material as nuts.
6. Provide full-face gaskets for flat-faced flanges. Provide ring gaskets for raised face flanges. Gaskets shall be composed of asbestos with rubber binder, 1/8-inch thick, Johns-Manville No. 60, John Crane Co. "Granite", or equal for high temperature air service, and shall be constructed of EPDM for ambient temperature water service.

I. Pipe ends shall be prepared for either mechanical or flexible couplings, where shown on the Drawings.

J. Dead Ends of pipe runs shall have butt-welded ASME Code dished heads designed to meet the test pressures required.

K. Gaskets shall be suitable for the service conditions. The pipe ends shall be roll grooved to the coupling manufacturer's specifications for piping size 6-inches and under. Where roll grooving is not sufficient for the specified pressure, the pipe shall have heavy wall machine grooved pipe nipples or machined ring collars fully welded to the pipe or fitting. Nipples shall be taper bored to the I.D. of the adjoining pipe to allow full weld penetration.

Collars shall be welded on both sides to the piping. Nipples and collars shall be of the same alloy as the piping.

- L. Following final fabrication, all stainless steel pipe spools and fittings shall be cleaned and descaled in accordance with the requirements of ASTM A-380. Descaling shall include immersion in an appropriate pickling solution for the type and grade of material being treated. Caution shall be taken to avoid over-pickling. The type of acid used, acid concentration, solution temperature, and contact time shall be consistent with industry standards for such work. In addition to pickling, piping and fittings shall be scrubbed and washed until discoloration and possible iron, picked up from manufacturing process, is removed. Pickling and passivation of individual pipe lengths and fittings will not be considered equal to pickling and passivation of the finished product(s) following fabrication.
- M. After chemical descaling, surfaces shall be thoroughly rinsed to remove residual chemicals. Surfaces shall not be permitted to dry between successive steps of the acid descaling and rinsing procedure. Following the final rinse, thorough air drying shall be performed.
- N. Quality Control
 - 1. Contractor shall follow the Manufacturer's and Supplier's recommended product quality control specifics as required for the project.
 - 2. Piping subcontractor shall submit a list of welders who will work on this project, along with a welder's current certification (less than one-year-old) and two sample weld coupons. Only approved welders will be allowed to work on this project.
 - 3. The weld should be made as rapidly as possible, with the least amount of generated heat.
 - 4. All shop welds shall be visually inspected by the fabricator's quality control division. Each weld shall be marked with an inspection stamp certifying that the weld is acceptable.
- O. Installation
 - 1. Stainless steel piping shall be installed true to alignment and rigidly supported.
 - 2. After installation, completed pipelines shall be washed clean with steam or hot water to remove any foreign material picked up during transportation.
 - 3. Field Welded Piping: Field joint welding shall be in accordance with the ASME B31.3 standards. The strength of the weld shall develop the strength of the pipe. All field welds shall be descaled and passivated with pickling paste, scrubbed with stainless wire brushes and rinsed until clean.
 - 4. Installation Threaded Piping: Ream, clean and remove burrs from threaded straddling the pipe's horizontal and vertical centerline. Install pipe without springing, forcing, or stressing the pipe or any adjacent connecting valves or equipment.

2.10 HASTELLOY C PIPE AND TUBING

- A. Hastelloy C pipe and tubing shall conform to the requirements of ASTM B 626 Grade C276 (UNS N10276).

2.11 MISCELLANEOUS PIPING MATERIALS/PRODUCTS:

- A. Welding Materials: Except as otherwise indicated, provide welding materials as determined by the Installer to comply with installation requirements.
 - 1. Comply with Section II, Part C, ASME Boiler and Pressure Vessel Code for welding materials.
- B. Soldering Materials: Except as otherwise indicated, provide soldering materials as determined by the Installer to comply with installation requirements.
 - 1. Tin-Lead Solder: ASTM B 32, Grade 50A.
 - 2. Tin-Antimony Solder: ASTM B 32, Grade 95TA.
 - 3. Silver-Lead Solder: ASTM B 32, Grade 96TS.
- C. Brazing Materials: Except as otherwise indicated, provide brazing materials as determined by the Installer to comply with installation requirements.
 - 1. Comply with SFA-5.8, Section II, ASME Boiler and Pressure Vessel Code for brazing filler metal materials.
- D. Gaskets for Flanged Joints: ANSI B16.21; full-faced for cast- iron flanges; raised-face for steel flanges, unless otherwise indicated.
- E. Piping Connectors for Dissimilar Non-Pressure Pipe: Elastomeric annular ring insert, or elastomeric flexible coupling secured at each end with stainless steel clamps, sized for exact fit to pipe ends and subject to approval by plumbing code.
 - 1. Manufacturer: Subject to compliance with requirements, provide piping connectors of the following:
 - a. Fernco, Inc.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install pipes and pipe fittings in accordance with recognized industry practices which will achieve permanently-leakproof piping systems, capable of performing each indicated service without piping failure. Install each run with minimum joints and couplings, but with adequate and accessible unions for disassembly and maintenance/replacement of valves and equipment. Reduce sizes (where indicated) by use of reducing fittings. Align piping accurately at connections, within 1/16" misalignment tolerance.
 - 1. Comply with ANSI B31 Code for Pressure Piping.

- B. Locate piping runs, except as otherwise indicated, vertically and horizontally (pitched to drain) and avoid diagonal runs wherever possible. Orient horizontal runs parallel with walls and column lines. Locate runs as shown or described by diagrams, details and notations or, if not otherwise indicated, run piping in shortest route which does not obstruct usable space or block access for servicing building and its equipment. Hold piping close to walls, overhead construction, columns and other structural and permanent-enclosure elements of building; limit clearance to 1/2" where furring is shown for enclosure or concealment of piping, but allow for insulation thickness, if any. Where possible, locate insulated piping for 1" clearance outside insulation. Wherever possible in finished and occupied spaces, conceal piping from view, by locating in column enclosures, in hollow wall construction or above suspended ceilings; do not encase horizontal runs in solid partitions, except as indicated.
- C. Electrical Equipment Spaces: Do not run piping through transformer vaults and other electrical or electronic equipment spaces and enclosures unless unavoidable. Install drip pan under piping that must be run through electrical spaces.

3.2 PIPE EXPANSION CONTROL: INSTALLATION

- A. Install expansion loops or joints as required to limit strain and movement of the piping.
 - 1. All loops shall be cold-sprung when installed.
 - 2. Install conforming manufactured guides for each loop and joint to maintain the proper pipe alignment and minimize undue stresses on the piping and joints.
 - 3. All mechanical joints and guides shall be installed in accordance with the Manufacturer's recommendations.
 - 4. Install conforming manufactured pipe anchors at the midpoint between loops and joints. Installation and design shall be subject to the approval of the Engineer or Owner.
 - 5. Manufacturer shall be held responsible for the proper capacity of the joints, with a minimum 25% allowance beyond the anticipated expansion and contraction in the piping.
- B. Polyvinyl Chloride (PVC) Pipe: Provide expansion joints in straight piping runs over 50 feet and at least every 50 feet. Shall be Proco Series 261 or equal based on Chemical compatibility.

3.3 EXPOSED PIPING: INSTALLATION

- A. Do not obstruct passageways, headroom, door and window operation, and similar areas with the installation of the piping and supports.
- B. Painting of piping is specified elsewhere in the Contract Documents.
- C. Install straight runs true to line and elevation.
- D. Install vertical pipe plumb in all directions.

- E. Install piping parallel or perpendicular to building walls. Piping at angles and 45 deg runs across corners shall not be accepted unless specifically shown.

3.4 PIPING SYSTEM JOINTS

- A. General: Provide joints of the type indicated in each piping system.
 - 1. Make joints in accordance with the pipe Manufacturer's recommendations and the requirements below.
 - 2. Cut the piping accurately and square. Assemble without forcing or springing.
 - 3. Ream all pipes and tubing to full inside diameter after cutting. Remove sharp edges on end cuts.
 - 4. Remove all cuttings and foreign matter from the inside of pipes and tubing before installation.
 - 5. Thoroughly clean all pipe, fittings, valves, specials, and accessories before installing.
 - 6. Thoroughly wire-brush, wipe clean and dry all spigot mating surfaces immediately before pipe is installed.
- B. Threaded Joints
 - 1. Thread pipe in accordance with ANSI B2.1.
 - 2. Use standard right hand tapered full depth threads on steel piping.
 - 3. Apply before installation an approved joint compound to the male threads only.
 - 4. Leave three pipe threads maximum exposed at each connection.
- C. Braze copper tube-and-fitting joints where indicated, in accordance with ANSI B31.
- D. Solder copper tube-and-fitting joints where indicated, in accordance with recognized industry practice. Cut tube ends squarely, ream to full inside diameter, and clean outside of tube ends and inside of fittings. Apply solder flux to joint areas of both tubes and fittings. Insert tube full depth into fitting, and solder in manner which will draw solder full depth and circumference of joint. Wipe excess solder from joint before it hardens.
- E. Flanged Joints: Use hexagon head nuts and bolts. Match flanges within piping system, and at connections with valves and equipment. Assemble flanged joints with gaskets and gasket compounds in compliance with the applicable material specifications. Tighten flange bolts evenly to provide uniform compression of gaskets.
- F. Plastic Pipe/Tube Joints: Comply with manufacturer's instructions and recommendations, and with applicable industry standards:
 - 1. Heat Joining of Thermoplastic Pipe: ASTM D 2657.
 - 2. Making Solvent-Cemented Joints: ASTM D 2235, and ASTM F 402.
- G. Resulting joint is minimum of 3 times as long as thickness of thinner joint member, and brazed using B-CuP series filler metal.

- H. Mechanically Formed Couplings: In lieu of providing couplings in copper tubing, Installer may, as option, provide mechanically formed couplings, provided they are in accordance with the following:
 - 1. Form couplings by first annealing area at end of tube where expansion will occur. Insert tube expander to die size required and expand tube end to accept tubing of same size.
 - 2. Resulting joint is minimum of 3 times as long as thickness of tube, and brazed using B-CuP series filler metal.
- I. Weld pipe joints in accordance with ASME Code for Pressure Piping, B31.
 - 1. Weld pipe joints in accordance with recognized industry practice and as follows:
 - 2. Weld pipe joints only when the ambient temperature is above 0 deg F (-18 deg C), where possible.
 - 3. Bevel pipe ends at a 37.5 deg angle where possible, smooth rough cuts, and clean to remove slag, metal particles, and dirt.
 - 4. Use pipe clamps or tack-weld joints with 1" long welds; 4 welds for pipe sizes to 10", 8 welds for pipe sizes 12" to 20".
 - 5. Build up welds with stringer-bead pass, followed by hot pass, followed by cover or filler pass. Eliminate valleys at the center and edges of each weld. Weld by procedures which will ensure elimination of unsound or unfused metal, cracks, oxidation, blow-holes, and non-metallic inclusions.
 - 6. Do not weld-out piping system imperfections by tack- welding procedures; refabricate to comply with requirements.
 - 7. At Installer's option, install forged branch-connection fittings wherever branch pipe is indicated; or install a regular "T" fitting.
 - 8. At Installer's option, install forged branch-connection fittings wherever a branch pipe of size smaller than the main pipe is indicated; or install a regular "T" fitting.
- J. Weld pipe joints of steel water pipe in accordance with AWWA C206.
- K. Hubless Cast-Iron Joints: Comply with the coupling manufacturer's installation instructions.
- L. Grooved Pipe Joints: Comply with the fitting manufacturer's instructions for making grooves in pipe ends. Remove burrs and ream pipe ends. Assemble joints in accordance with the manufacturer's instructions.

3.5 FITTINGS

A. Unions

- 1. Install dielectric unions where dissimilar metals are connected except at bronze or brass valves installed in ferrous piping.
- 2. Provide a union downstream of each screwed end valve.

3. Provide screwed or flanged unions at each piece of equipment, where shown, and where necessary to install or dismantle piping.
- B. Eccentric Reducers: Use eccentric reducers where shown and where air or water pockets would occur in mains because of a reduction in pipe size.
- C. Transitions between Types of Pipe: Provide all necessary adapters, specials, and connector pieces when connecting different types and sizes of pipe or connecting pipe furnished by different Manufacturers.
- D. Mechanically Formed Tee Connections: In lieu of providing tee fittings in copper tubing, the installer may, as an option, provide mechanically formed tee connections, provided they are in accordance with the following:
 1. Size and wall thickness of both run tube and branch tube are listed by the manufacturer of forming equipment as "Acceptable Application".
 2. Height of drawn collar is not less than 3 times the wall thickness of run tubing.
 3. End of branch tube is notched to conform to the inner curve of run tube, and dimpled to set the exact penetration depth into the collar.
- E. Restraints, Supports, and Thrust Blocks
 1. Install restrained joints as shown, specified, recommended by the manufacturer, or otherwise required.
 2. Provide concrete and metal cradles, collars, kickers, and blocks as indicated.
- F. Expansion coupling
 1. Install expansion couplings in tension to facilitate their removal.
 2. Set stretcher bolts for maximum allowable elongation of the expansion coupling as recommended by the Manufacturer.
- G. Adjustment: Adjust all parts and components as required to provide correct operation.
- H. Identification of Piping: Paint, identify contents of piping and flow direction, and coordinate color coding of both insulated and non-insulated piping with Division 09 Section.

3.6 PVC AND CPVC PIPE INSTALLATION

- A. General
 1. Do not install pipe when the temperature is below 40 deg F or above 90 deg F. Store loose pipes on racks with a minimum support spacing of 3 feet. Provide shade from direct sunlight for pipes stored outdoors or installed outdoors until the pipe is filled with water.
 2. Store fittings indoors in their original cartons.
 3. Store solvent cement indoors or, if outdoors, shade from direct sunlight. Do not use solvent cements that have exceeded the shelf life marked on the storage container.

4. Before installation, check pipe and fittings for cuts, scratches, gouges, buckling, kinking, or splitting on pipe ends. Remove any pipe section containing defects by cutting out the damaged section as a complete cylinder.

B. Installation

1. Do not drag PVC pipe over the ground, drop it onto the ground, or drop objects on it.
2. Cut pipe ends square and remove all burrs, chips, and filings before joining pipe or fittings.
3. Bevel solvent welded pipe ends as recommended by the pipe manufacturer.

C. Solvent Welded Joints

1. Prior to solvent welding, remove fittings and couplings from their cartons and expose them to the air for at least one hour to the same temperature conditions as the pipe.
2. Wipe away loose dirt and moisture from the ID and OD of the pipe end and the ID of the fittings before applying solvent cement. Do not apply solvent cement to wet surfaces.
3. Make up solvent-welded joints per ASTM D 2855.
4. Allow at least eight hours of drying time before moving solvent-welded joints or subjecting the joints to any internal or external loads or pressures.

D. Flanged Joints

1. Lubricate stainless steel bolt threads with specified materials before installation.
2. Tighten bolts on flanges by tightening the nuts diametrically opposite each other using a torque wrench. Complete tightening shall be accomplished in stages, and the final torque values shall be as shown in the following table:

Pipe Size (inches)	Final Torque (Ft-Lb)
1/2 – 1-1/2	10-15
2-4	20-30
6-8	33-50
10	53-75
12	80-110
14-24	100

E. Threaded Joints

1. Cut threaded ends on pipe to the dimensions of ANSI B2.1. Ends shall be square cut. Follow the pipe manufacturer's recommendations regarding pipe hold-down methods, saw cutting blade size, and saw cutting speed.
2. Pipe or tubing cutters shall be specifically designed for use on plastic pipe.
3. If the hold-down vise is used when the pipe is cut, insert a rubber sheet between the vise jaws and the pipe to protect the pipe from scratching.
4. Thread cutting dies shall be clean and sharp and shall not be used to cut materials other than plastic.
5. Not more than three threads shall remain exposed after installation.
6. All joints shall be wrapped with Teflon tape.

3.7 SLEEVES: INSTALLATION

- A. Provide and accurately locate all sleeves required under this Section. Set sleeves true to line, grade, and position, plumb or level, and maintain as such during the work under other Divisions.
- B. Sufficient advance notice shall be supplied to SLEEVES: INSTALLATION, the proper trade, to enable the installation to progress.
- C. Whenever improper location or insufficient notice is provided for the installation of the sleeves, such work shall be done as Work of this Section, with no change in the Contract Sum or the Date of Substantial Completion.
- D. Sleeves shall not penetrate any structural member except as shown on the Drawings.
- E. Provide 8-inch clear space between sleeves unless otherwise indicated on the Drawings.
- F. Sleeves shall be of the full thickness, with the exposed ends flush and smooth, with the structure in which they are installed.
- G. Wherever water might get into the sleeve, the sleeves shall extend 1 inch above the finished surface and be made watertight. The exposed end shall be smooth and neatly finished.
- H. On all piping passing through a sleeve, the piping insulation shall be continuous through the sleeve. The sleeve shall be sized to allow a 1-inch annular space between the sleeve and the bare pipe or insulation.
- I. Sealing of Sleeves and Penetrations
 1. Where sleeves are embedded through cast-in-place concrete walls or slabs on or below grade, the joints between the concrete and the sleeve shall be sealed with a polyurethane sealer.
 2. Where sleeves pass through boxed-out or cored openings in concrete walls or floor slabs on or below grade, a bonding agent shall be applied to the concrete surface

and a non-shrink grout shall be installed between the concrete and the sleeves. After the grout has cured, the joints between the grout and the sleeves on both sides of the wall or floor shall be sealed with a polyurethane sealer.

3. Where sleeves pass through exterior building walls above grade, the joints between the wall and sleeve on both sides of the wall shall be sealed with silicone sealer, or the opening shall be sealed with silicone foam.
- J. The 1-inch annular space around pipes passing through sleeves shall be filled with silicone foam having a minimum service temperature rating at least 15 deg F higher (8.3 deg C higher) than the temperature of the pipe service passing through it.

3.8 TESTING

A. General

1. All pipelines shall be tested to prove the tightness of the final assembly. The Engineer shall be given 24 hours' notice before each test.
2. All tests required by governing authorities shall be satisfactorily made.
3. Provide all necessary testing apparatus, including gages, pumps, hoses, and fittings.
4. Repair and retest pipelines that fail to hold specified test pressure or that exceed the allowable leakage rate.
5. Test pressures specified apply at the lowest elevation of the pipeline section being tested unless otherwise noted.
6. The Contractor is responsible for all testing and shall pay all costs incurred during the specified testing.

B. Hydrostatic Pressure Testing

1. General
 - a. Conduct hydrostatic pressure testing on all process piping in accordance with AWWA C600.
 - b. Slowly fill the section to be tested with water and expel all air. Install corporation cocks as necessary to remove air.
 - c. Apply test pressure for two (2) hours.
 - d. Observe each test section for leakage at the end of the test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
2. Exposed Piping
 - a. Allow any concrete that may be affected by the testing to reach design strength before testing.
 - b. Ensure that all supports and restraint protection are securely in place.
3. Buried Piping
 - a. Place and compact backfill to at least the pipe centerline before testing, unless otherwise required or acceptable to the Engineer. Backfill and compact around all blocking before testing and as required to assure restraint by harnessed joints.
 - b. Allow concrete for blocking to reach design strength before testing.

4. Test Pressure
 - a. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are a lower Class or pressure rating.
 - b. Test each piping system at 150% of the operating pressure indicated, but not less than 25 psi test pressure.
 - c. Piping connected to pump suction and discharge: 150% of the specified maximum operating head of the pump.
 - d. Gravity flow ductile iron pipe: 150% of the maximum static water head of the pipe section being tested.
 - e. Liquid chemical feed piping: 100 psi

C. Allowable Leakage: Leakage shall not exceed:

$$L = \frac{SD(P)^{0.5}}{133,200}$$

Where

L = Allowable leakage, gallons per hour.

S = Length of pipe tested, feet.

D = Nominal diameter or pipe, inches.

P = Average test pressure, psig.

3.9 CLEANING, FLUSHING, INSPECTING

A. General

1. All piping systems shall be cleaned and flushed out prior to operation. If it is necessary to place the system in operation by sections, then the cleaning shall be done by sections. Notify Owner prior to start of Work.
2. Inspect the inside of piping 24-inch diameter and larger and remove all debris, dirt, and foreign matter.
3. All piping, including equipment installed in connection with the piping, conveying liquids, shall be filled and flushed several times to eliminate all debris and contaminants.
4. Where pumps are installed, install temporary strainers ahead of pumps and circulate the medium through several cycles. The system shall be flushed out and the temporary strainers removed. Strainers shall have a free area of at least 3 times the cross-sectional area of the attached pipe.
5. Prior to turning over the Work, this Contractor shall remove and clean all strainers, traps, and dirt pockets.
6. All process piping shall be pigged and flushed.

B. Disinfection

1. Standard: AWWA C651 unless otherwise acceptable to the Engineer or Owner.
2. Disinfect all potable water piping.

3. Flush piping with water at 2-1/2 feet per second minimum velocity prior to disinfection.
 4. Water for flushing, testing, and chlorination will be furnished by Owner at no cost to Contractor.
 5. Chlorine shall be supplied by Contractor.
 6. All other labor, material, and equipment, including chlorination taps and blow-off taps, shall be furnished and paid for by the Contractor.
 7. Chlorine Concentration
 - a. Maintain chlorine concentration between 50 and 100 parts per million for water entering the pipe.
 - b. 25 parts per million minimum residual concentration shall remain after 24 hr. retention period.
 - c. Repeat the operation as necessary to provide complete disinfection.
 8. Provide two safe total coliform samples taken 24 hours apart prior to placing the pipe in service. Provide results to the Ohio EPA and the Engineer.
- C. Test pressure piping in accordance with ASME B31.
- D. General: Provide temporary equipment for testing, including a pump and gauges. Test the piping system before insulation is installed, wherever feasible and remove control devices before testing. Test each natural section of each piping system independently, but do not use piping system valves to isolate sections where the test pressure exceeds the valve pressure rating. Fill each section with water and pressurize for the indicated pressure and time.
1. The required test period is 2 hours.
 2. Test long runs of Schedule 40 pipe at 150 psi, except where fittings are a lower Class or pressure rating.
 3. Test each piping system at 150% of the operating pressure indicated, but not less than 25 psi test pressure.
 4. Observe each test section for leakage at the end of the test period. Test fails if leakage is observed or if pressure drop exceeds 5% of test pressure.
- E. Repair piping systems sections that fail the required piping test, by disassembly and reinstallation, using new materials to the extent required to overcome leakage. Do not use chemicals, stop-leak compounds, mastics, or other temporary repair methods.
- F. Drain test water from piping systems after testing and repair work has been completed.

END OF SECTION 402336

SECTION 402337 – EXPANSION JOINTS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.

1.2 SUMMARY

- A. This Section includes pipe expansion fittings for process piping systems, including the following:
 - 1. Rubber expansion joints

1.3 PERFORMANCE REQUIREMENTS

- A. Compatibility: Products suitable for piping system fluids, materials, working pressures, and temperatures.
- B. Capability: Absorb 200 percent of maximum piping expansion between anchors.

1.4 SUBMITTALS

- A. Product Data: For each type of expansion fitting indicated.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Rubber Expansion Joints:
 - a. Flexicraft Industries
 - b. Or approved equal.

2.2 RUBBER ULTRASPOOL EXPANSION JOINTS

- A. Expansion joints shall be a rubber spool type of a single and double, open wide arch design. Joint construction shall consist of an elastomer tube and cover, reinforced with a suitable woven fabric and steel rings support. Tube cover elastomers shall be selected to accommodate the process and environment conditions. Joints shall be designed to meet the design pressure and temperature for the system.
- B. Expansion joints ends shall be steel flanges drilled to 300 lbs class standards, and be full rubber faced and integral to the body. Split flange backing rings of galvanized carbon steel shall be provided.
- C. Expansion joints shall be capable of accommodating piping system and equipment movements and vibration as needed.
- D. Control units with tie rods of galvanized carbon steel shall be included to prevent overextension of the expansion joints from pressure thrust loads. The number and size of the control unit cables shall be sufficient for the maximum system test pressure.
- E. Coordinate expansion joint pressure and temperature rating with piping system. The upper temperature limit shall be 230°F.
- F. Backing rings and control units shall be provided in galvanized steel.

PART 3 - EXECUTION

3.1 EXPANSION FITTING INSTALLATION

- A. Install expansion fittings according to manufacturer's written instructions.
- B. Install expansion fittings in sizes matching pipe size in which they are installed.
- C. Align expansion fittings to avoid end-loading and torsional stress.

END OF SECTION 402337

SECTION 432110 - PROGRESSING CAVITY PUMPS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- B. References
 - 1. AISI American Iron and Steel Institute
 - 2. ASTM American Society for Testing and Materials
 - 3. IEEE Institute of Electrical and Electronics Engineers
 - 4. NEMA National Electrical Manufacturers Association
 - 5. SSPC Steel Structures Painting Council
 - 6. NFPA 70 National Electric Code (NEC)

1.2 SUMMARY

- A. This section includes the furnishing and installation of two (2) self-priming, positive displacement, progressing cavity pumps for conveying anaerobically digested sludge from Anaerobic Digesters No. 1 and 2 to the sludge dewatering equipment. The Equipment Schedule is provided at the end of this section.
- B. Pumps shall be rated for installation in hazardous areas and shall be explosion-proof, Class I, Division 2.
- C. Manufacturer shall provide pumps with an in-place maintenance design, which allows to replace the rotor and stator without having to disconnect the pump from the suction or discharge piping.
- D. Each pump assembly shall include drive shafts, couplings, in-line motor assemblies, drive bases, pump bases, anchor bolts, and all required appurtenances and instrumentation, furnished complete and installed, ready for service, as shown on the Drawings and specified herein.
- E. Each pump shall be connected to the existing Local Control Panels serving Sludge Pumps P-11 and P-12, located on the first-floor electrical room of the Sludge Handling Building. Each Local Control Panel includes an ABB 15 HP Variable Frequency Drive (VFD) and local speed controller; "Hand-Off-Auto" selector switch with "Auto" pilot light; "Start" and "Stop" push buttons; "Fault Reset" push button, and a run-time meter. The Screw Press Vendor shall integrate the existing local control panels into their control system. See Control System Appendix #1.
- F. Each existing pump utilizes an obsolete ONYX SMART BOX and sensor as an interlock to the existing VFD to prevent the pump from running dry. Press Vendor

shall furnish and install a new monitor system to prevent the pump from running dry. See Control System Appendix #1.

- G. Each Sludge pump shall have a field disconnect located at the pump. The disconnect shall have an AUX contact of the handle wired back to the VFD as an interlock. When the disconnect is in the OFF position, the VFD will stop and NOT be allowed to start.
- H. The Work shall include all manufacturer-supplied motors, instrumentation, and all electrical and control work necessary for proper operation, including conduit, wiring, and control interfacing, in accordance with the requirements of Division 26 by the Electrical Contractor.
- I. The Contractor shall furnish all labour, materials, equipment, products, incidentals, and testing necessary to provide a complete and operational system. Install the system at the locations indicated on the Drawings and in accordance with these Specifications.
- J. Coordinate all work with this equipment with any other related equipment installed or specified under other sections of these Specifications.
- K. The Supplier shall examine the Site conditions, intended application, and operational requirements of the pump system and shall recommend the pump that best satisfies the specified requirements.
- L. All work performed under this section shall be in accordance with all approved trade practices and manufacturer's recommendations.

1.3 QUALITY ASSURANCE

- A. In addition to the requirements of these specifications, comply with the manufacturer's instructions and recommendations for work.
- B. Provide equipment that is a standard product of the manufacturer.
- C. The pumps, gear reducers, and motors shall be a product of the manufacturers regularly engaged in the manufacturing of equipment having similar service and equal size for a minimum of ten (10) years and a minimum of 20 installations at equivalent applications. Supplier shall provide a list of names and dates of installations for verification by the engineer or Owner's Representative.
- D. Factory test each pump using water with a factory-certified motor, the same size as that specified. Tests shall consist of checking each pump at its rated speed, head, capacity, efficiency, and brake horsepower; and at such other conditions of head and capacity to properly establish the performance curve. Submit copies of the performance curves to the Contractor for the Engineer's review before releasing the pumps to the Contractor. The standards of the Hydraulic Institute shall govern the procedures and calculations for these tests.

- E. All pumping equipment furnished under this Section shall be of a design and manufacture that has been used in similar applications, and it shall be demonstrated to the satisfaction of the Owner that the quality is equal to equipment made by that manufacturer specifically named herein.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with the conditions of the Contract and Division 1 Specification Sections.
- B. Product Data: Submit the manufacturer's technical data and installation instructions, including certified pump curves with efficiency, capacity, head, speed, brake horsepower required, and operating point required for each pump.
- C. Shop Drawings: Submit the manufacturer's technical data and installation instructions, including certified pump curves with efficiency, capacity, head, speed, brake horsepower required, and operating point required for each pump.
 - 1. Complete description in sufficient detail to permit an item-by-item comparison with the Specification. Complete description in sufficient detail to permit an item-by-item comparison with the Specification,
 - 2. Dimensions and required clearances,
 - 3. Pump with motor weights
 - 4. Performance data, including pump curves showing overall pump efficiencies, low rate, head, break horsepower, motor horsepower, speed, and shut-offhead.
 - 5. Materials of construction
 - 6. Layout drawings for all equipment showing installation details and anchor bolt layout.
 - 7. Wiring diagrams for all electrical equipment.
 - 8. Deviations from Contract Documents.
 - 9. Manufacturer's installation and testing instructions.
 - 10. Manufacturer's standard guarantee.
 - 11. Certification from the pump supplier that site conditions have been examined.
- D. Maintenance and Operating Instructions, including the following additional information:
 - 1. Recommendations for short and long-term storage.
 - 2. Explanation of operating safety considerations.
 - 3. Detailed installation instructions, with clear step-by-step points on the correct mechanical and electrical installation procedures.
 - 4. Repair parts and maintenance materials.
 - 5. Troubleshooting data.
 - 6. Repair data.

7. Manufacturer's warranty.

1.5 DELIVERY, STORAGE, AND HANDLING

- A. All equipment shall be delivered in the largest pieces practical for field assembly by the Contractor. Individual pieces shall be permanently tagged with welded erection marks or stainless-steel tags cross-referenced with information on the manufacturer's erection and assembly drawings.
- B. Packing, Shipping, Handling, and Unloading.
 - 1. Comply with Section 016600, Product Handling and Protection.
- C. Acceptance at Site.
 - 1. Inspect all equipment and materials against the reviewed Shop Drawings at the time of delivery.
 - 2. Equipment and materials damaged or not meeting the requirements of the reviewed Shop Drawings shall be immediately returned for replacement or repair.
- D. Storage and Protection
 - 1. Carefully prepare for storage and label all equipment and materials after they have been inspected.
 - 2. Store all equipment and materials in a dry, covered, ventilated location and protect from harm according to the manufacturer's instructions.

1.6 SEQUENCING

- A. Comply with Section 011100 Summary of Work.

1.7 WARRANTY

- A. The pump manufacturer shall guarantee the complete pumping assemblies for a period of 12 months after acceptance or 18 months after shipment, whichever occurs first. The warranty as specified here shall cover all defective parts, materials, and workmanship.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with specified requirements, supply the progressing cavity pumps from one of the following manufacturers:
 - 1. Netzsch Pumps
 - 2. Moyno Pumps, EZStrip type

3. Or Engineer Approved equal.

- B. Contractor choosing an alternative shall refer to the Bid Form. Any proposed alternative must provide all of the qualities described within this specification along with the bid.

2.2 PUMP CONSTRUCTION

A. General:

1. The pumps shall be heavy-duty, positive displacement, single-stage, progressing cavity type. The pumps shall be cradle-mounted, allowing the normally vertical suction port to be rotated 90 degrees clockwise or counter-clockwise to facilitate piping connections.
2. Progressive cavity pumps shall be provided with an in-place maintenance design that permits removal of the rotor, stator, drive shaft, and joint components without disconnecting suction or discharge piping, removing the pump casing, or re-aligning the drive

B. Pump Suction and Discharge Casing

1. The pump casing shall be designed for the type of service specified and shall be of sufficient strength, weight, and metal thickness to ensure long life, accurate alignment, and reliable operation.
2. The casing shall have multiple 3/4-inch FNPT connections (minimum 4) for vents, drains, and gauges. The connections shall be at the highest and lowest points of the housing regardless of suction orientation.
3. The pump housing shall be constructed as such to allow for easy access to both joints without having to disconnect piping or remove most of the housing.
4. The suction body of the pump shall be oversized at the entrance of the rotor and stator pumping elements to allow the free flow of high solids materials.
5. The rotor joint head shall be set back from the stator, and the leading edge of the stator shall be chamfered so as not to restrict the flow into the pumping elements. If the pump does not incorporate the aforementioned features, the use of a rag deflector shall be required

C. Stator

1. The pump's stator shall be formed from a single piece of Buna-N rubber molded inside a single-piece carbon steel casing. Additional hardware to seal around the stator shall not be accepted. Split stators or stators with sealing lines are not acceptable as they can potentially leak.
2. The stator shall be affixed to the suction casing by the use of four (4) tie-bar bolts for easy removal and replacement. Stators shall not be affixed to the suction casing by threaded connections or by snap rings. The stators not using tie bar bolts shall not be accepted.
3. The suction edge of the stator shall be chamfered to allow for unrestricted flow into the pumping elements.

4. The seal shall be integral to the stator sleeve at the suction and discharge to prevent leakage. The use of separate O-rings or flat rings for stator sealing shall not be required.
5. Stator designs that limit pressure capability to less than 90 PSI per stage shall not be acceptable. Each stage shall be rated at 90 psi with the capability of a 1.5x hydrostatic test.
6. The removal of the stator shall not require any disconnection of the suction or discharge piping. Pump shall be full service in place. Deviations or special adaptors are not allowed.

D. Rotor:

1. The rotor shall be precision machined from SAE 4140 tool steel or Type 316 stainless steel and coated with N.Durance® tungsten carbide fusion coating to a surface hardness of 1300 to 1500 Vickers to resist abrasion.
2. Tungsten carbide coating shall be applied using a high-velocity spray process with particle velocities in the range of 2,000 to 3,300 ft/sec and an application temperature of approximately 1,830°F to ensure uniform coating thickness and proper metallurgical fusion to the base metal. Hard chrome coating is acceptable as an alternative.
3. Rotors coated using the HVOF (High-Velocity Oxygen Fuel) process are not acceptable. HVOF operates at higher flame temperatures, which may cause metal warping, provides reduced fusion depth into the base metal due to lower particle velocity, and results in lower ductility with an increased potential for cracking.
4. Coating powder particle size shall not exceed 45 microns, and coating porosity shall be no greater than 1.5 percent. Rotors coated using the HVOF process are not acceptable due to porosity levels that may be up to six (6) times higher.
5. The rotor shall extend beyond both ends of the stator when assembled to ensure full sealing line engagement and maximum stator utilization. Rotors that are shorter than, or do not extend past, the stator ends when assembled are not acceptable.
6. Rotor removal shall not require disconnection of suction or discharge piping. Rotor disengagement shall be accomplished by the removal of a single bolt only. The use of multiple fasteners, snap rings, sleeves, clips, wedges, special adaptors, or disconnection of the drive joint is not acceptable.
7. Removal of the rotor and stator shall be accomplished with the rotor joint remaining intact to allow complete inspection and maintenance.
8. Access to the rotor disconnection area shall provide a minimum of 2 inches of clear working space in all directions to permit safe and efficient servicing.

E. Joints

1. The rotor shall be connected to the drive shaft by means of a connecting rod with high-strength, shock-resistant universal joints. The universal joints shall be sealed pin-type, lubricated by oil. Grease is not acceptable.

2. The Pin joint shall be sealed with a stainless steel 316 sleeve with O-rings and held in place with circlips. Joints that use band clamps and hoses are not acceptable as they are not as robust.

F. Drive Train

1. The rotor shall be driven by means of a heavy-duty sealed drive train. The rotor shall be joined to the drive shaft by means of a connecting rod with sealed pin-type universal joints at each end.
2. The connecting rod shall be a two-piece design to allow for the rotor and stator to be removed from the suction housing together, either up or off to the side. Horizontal removal is not acceptable. Disassembly of a joint is not acceptable.
3. The connecting rod shall be joined and driven by hardened pins. Using screws or bolts to transfer rotational thrust is not acceptable.
4. The sealed pin-type universal joints shall be factory lubricated with oil and completely sealed from the abrasive fluid being pumped, utilizing a metal cover over the pin and a flexible rubber seal on the connecting rod end. Grease lubrication shall not be accepted.
5. The joint seal shall not employ sacrificial parts such as clamp bands and shall not require special tools to assemble.
6. To optimize seal and pin joint life, the connecting rod shall be of sufficient length to maintain its operating angle within 1 degree. Flexshafts, cardin joints, gear joints, and unsealed pin joints are not acceptable.

G. Pump Drive Shaft

1. The drive shaft shall be of the solid drive shaft design in order to avoid clogging and/or trapping of solids, which could either interrupt the movement of the connecting rod or disturb the seal of the rear pin joint. Maximum shaft deflection under normal operating conditions shall not exceed 0.002". Hollow or telescoping drive shafts are not acceptable.
2. The drive shaft shall be connected to a flanged gear reducer by a pin in a close-coupled design to reduce the space needed for a coupling.

H. Bearings (if applicable to pump configuration)

1. The bearings shall be of the grease-lubricated, tapered roller bearing type with diverging pressure angles for maximum shaft stability. Bearings are to be designed for a minimum B-10 life of 100,000+ hours under maximum operating conditions and will not require periodic re-lubrication. The bearings shall be protected from contaminants by means of a bearing cover plate bolted to the bearing housing.
2. The bearings shall be enclosed in separate housing, incorporating a bearing spacer and bolted bearing cover, eliminating bearing shimming.

I. Shaft Seal

1. Progressive cavity pump shall be furnished with a factory-assembled, cartridge- or component-type mechanical shaft seal. The seal shall be pre-set, pre-aligned, and fully unitized by the manufacturer to eliminate field adjustment and minimize installation errors.
2. Seal design shall be suitable for continuous operation with abrasive sludge service and shall withstand the full range of pump operating pressures and temperatures without leakage.
3. Seals shall be constructed of corrosion-resistant materials. Stationary and rotating seal faces shall be designed for long service life and be rated for the specified pump duty conditions.
4. Seal flush, quench, or barrier arrangements, when required for specified service, shall be factory-provided and fully compatible with the pumped media.
5. Shaft seals shall be designed for operation without the use of external flushing water.
6. Acceptable manufacturers include John Crane, A.W Chesterton, or an approved equal.

J. Drive arrangement

1. The pumps shall be directly connected to the motor via a motor-to gear reducer, with or without a flexible coupling.

K. Gear Motor:

1. Gear motors shall be furnished with Totally Enclosed Fan Cooled (TEFC), premium-efficiency motors with Class F insulation and a minimum service factor of 1.15.
2. Motors shall be inverter duty and suitable for operation with a variable frequency drive with a minimum 5:1 constant-torque turndown ratio.
3. Motors shall be 4-pole and shall be integrally mounted to the gear reducer.
4. Gear motors shall be manufactured by NORD. No substitutions or exceptions will be permitted.
5. Gear reducers shall be parallel in-line or right-angle type with a minimum service factor of 1.4. The gear housing shall be a single-piece SAE 30 gray cast iron casing with internal reinforcements to provide strength and rigidity. Split housings, bolt-on output covers, or bolt-on flanges are not acceptable. The housing design shall prevent oil leakage, oil contamination, and gear-set misalignment.
6. Gearbox drive shafts shall be solidly mounted in two antifriction bearings (ball or tapered roller), oil-lubricated. The gearbox or gear motor shall be removable without requiring the disassembly of the pump.
7. Gearboxes or gear motors shall comply with the Anti-Friction Bearing Manufacturers Association (ABMA) minimum B-10 bearing life requirements

and shall provide a calculated bearing life exceeding 100,000 hours at the maximum operating conditions specified.

8. The thermal power rating of each gear reducer shall equal or exceed the nameplate power rating of the drive motor. During continuous operation, sump oil temperature shall not rise more than 100°F above ambient air temperature and shall not exceed 200°F.
9. Gear reducers shall be totally enclosed, oil-lubricated units utilizing antifriction bearings throughout.

2.3 ACCESSORIES

A. Pump dry-run protection

1. The pump shall have a thermal probe attached to the stator to monitor stator temperature.
2. The probe shall be connected to a control that would trigger a switch to activate an alarm and/or shut the pump down to prevent a dry run (not ruin the stator).

B. Over-Pressure Protection: Each pump unit shall be supplied with a silicone-filled isolation ring with a dual-mounted gauge and single-point pressure switch. The pressure ranges for the switch and gauge shall be selected specifically for each specified service. The isolation ring shall be mounted between ANSI flanges, be sized according to the discharge pipe as shown on the plans, and be constructed with a carbon steel body and fittings with a Buna sleeve.

1. A discharge pressure gauge and pressure switch shall be furnished by the pump manufacturer for each pump. The pressure shall read in pounds per square inch. The range of each pressure transmitter shall be 0-200 psig.
2. The pressure switch and gauge shall be protected by a radial gauge isolator capable of covering the full pressure range. Flat diaphragm isolators are not acceptable.
3. The switch shall be SPDT, NEMA 4.

C. Pressure gauges:

1. Pump flanges shall be tapped for gauge connection.
2. Gauge connection shall be 4-inch diameter.
3. Each connection shall include a shutoff needle valve and the necessary length of pipe to allow the mounting of a pressure gauge. The open end of the gauge connection shall be plugged to prevent the accumulation of debris.
4. Each pump shall be supplied with liquid-filled pressure gauge(s) with snubber and diaphragm seal. Liquid shall be a glycerin-water mixture. The suction gauge shall be adequately sized to indicate suction conditions. The gauges shall be properly installed on the pump suction and discharge lines.
5. For the pressure gauges installed on the suction side, the operation range is 0-20 psig.

6. For the pressure gauges installed on the discharge side: the operation range is 0-30 psig
 7. Manufacturer: Gauges shall be a product of H.O. Trerice, Ashcroft, Wika, or equal.
- D. The Contractor shall provide expansion joints for pump suction and discharge lines. Flexible Expansion Pump Connectors: Expansion joints shall be a rubber spool type of a single, open wide arch design. Joint construction shall consist of a Butyl tube and cover, reinforced with a suitable woven fabric. Joints shall be designed to meet the design pressures and temperature for the system. Expansion joints' ends shall be flanges drilled to 150 lbs class standards and be full rubber-faced and integral to the body. Flange backing rings of cast iron with a built-in support sleeve shall be provided. Expansion joints shall be Flexicraft Industries, Flextra 150 Model, or equal.
- E. Data Plates: Attach stainless steel data plates to the pump, showing the manufacturer's name, pump size and type, serial number, capacity, and head rating, and other pertinent data. Attach a special data plate to the pump frame listing the identification of the frame and bearing numbers.
- F. Hardware: All machine bolts, nuts, and cap screws shall be hex head. Hardware or parts requiring special tools or wrenches shall not be used.

2.4 CONTROLS

- A. Each pump shall be provided with easily identifiable terminal points to facilitate the exchange of the central control functions between the pumps and the process control system, as indicated on the Contract Drawings.
- B. The existing Sludge Feed Pumps Local Control Panel Nos. 1 and 2 include the following:
1. Selector switches
 - a. Power On/Off selector switch
 - b. Hand/Off/Auto modes of operation
 - c. Auto pilot light
 2. Start/Stop push buttons
 3. Fault Reset Button
 4. VFDs are included in the Pump Control Panel
 5. VFDs pump speed control potentiometer 0-100%
- C. General Description
1. The Screw Press PLC system shall control and monitor the Existing Sludge Feed Pumps Local Control Panels No. 1 and 2 via hard-wire signals, including, but not limited to, run command (DO), run feedback (DI), VFD fault feedback (DI), in remote feedback (DI), and speed command (AO).

2. The Screw Press PLC system shall have Manual/Auto selector switches that allow running the Sludge Feed Pump from the PLC panel in Auto or Manual modes. In Manual mode, the operator will be able to start and stop the Pumps from the HMI screen, as well as adjust the pump running speed.
 - a. In the Auto mode of operation, a flow path needs to be established for Pump #1 or Pump #2 with respect to the manual valves located on the pump suction and discharge sides.
 - b. Note: Only manual valves are provided on the pump suction and discharge piping, as well as on the feed line to the Screw-Press. Before starting the system in Remote mode, the required flow path shall be established by opening the appropriate pump suction and discharge valves and the Screw-Press feed line valve.
3. The flowmeter is located in the Sludge Handling Building on the sludge feed pump force main to the Screw Press control panel and is used for flow monitoring.
4. “Local” mode of operation: The “Local” mode of operation is mainly for equipment maintenance; it operates the sludge feed pump directly from the Local Control Panel. This allows an operator to manually run the sludge pump in the event the Screw Press PLC system fails.
5. Interlocks: If the Screw Press stops running, it shall stop the respective sludge feed pump.
6. The sludge pump shall be monitored to prevent the pump from running dry.
7. Alarms - Pump shall automatically stop running if the following conditions occur:
 - a. Pump running dry.
 - b. Overpressure.
 - c. Motor overload
 - d. Low-Level alarms and Low-Low Level pump stop.

2.5 SPARE PARTS AND SPECIAL TOOLS

- A. Complete mechanical seal, one rotor, one stator, one joint kit, and one complete set of any special tools required to dismantle the pump.

2.6 SURFACE PREPARATION AND PAINTING

- A. Shop Finishing
 1. Protect all exposed ferrous metals with a minimum of one coat of shop primer. Apply an additional coat of two-part epoxy to motors, pumps, gearboxes, and other similar equipment.
 2. All surfaces must be dry, clean, and free of rust, scale, oil, and grease. Clean steel surfaces by pickling or blasting to a minimum of SSPC-SP6.
 3. Surface preparation, application, and minimum DFT millage to be as per the paint manufacturer's published recommendation.

4. Painting shall be in accordance with the manufacturer's standards.

B. Field Painting

1. All rust, scale, dirt, or other foreign matter shall be removed by solvent cleaning, wire brushing, short blasting, or other standard commercial cleaning procedure.
2. Grinders shall be field-painted and finish-coated in accordance with the Owner's Color Coding and Process System Identification color with the standard commercial finish per Specification Section 099700 Special Coating.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install equipment and accessories in accordance with reviewed Shop Drawings and manufacturer's instructions, as specified herein and shown on Contract Drawings.
- B. Furnish and set stainless steel anchor bolts with nuts and washers in accordance with the manufacturer's recommendations.
- C. All electrical equipment, conduit, and wiring not indicated on the Drawings, but necessary to provide a complete operating system, shall be provided at no additional cost to the Owner.
- D. Electrical Wiring: The external conduit and wiring required for power supply and control to electrical equipment supplied in this Section shall be furnished and installed in Division - 16, Electrical.
- E. Motor size: Any deviation in motor size must be approved by the Engineer. Any electrical equipment or wiring that must change to accommodate a different size motor will be at no additional cost to the Owner.
- F. The grade and amount of oil and grease shall be in accordance with the manufacturer's recommendations.
- G. Initial lubrication required for startup and field test operation shall be furnished and applied in accordance with the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- A. The manufacturer shall furnish the services of a qualified representative for a period of not less than one day to inspect and adjust the equipment furnished in this section. This qualified representative shall also conduct such tests as necessary to demonstrate satisfactory operation and to instruct the Owner's personnel in the care and operation of the equipment.
- B. The service representative of the Manufacturer shall be present at the site for one (1) workday to furnish the startup services and training of the Owner's personnel

covering the operation, mechanical maintenance, and electrical requirements. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.

- C. For the purposes of this section, a workday is defined as eight hours at the Site, excluding travel time.

3.3 TESTING

- A. After completion of installation, the pumps shall be completely tested to demonstrate compliance with operating requirements as specified.

3.4 PUMP SCHEDULE

A. Sludge Dewatering Feed Pumps

1. Location	- Solids Handling Building
2. Service	- Transfer solids from Primary/Secondary Digesters to the dewatering equipment
3. Fluid type	- Anaerobically digested blended Primary & WAS
4. Percent of Solids	- 2% to 7%
5. Quantity	- 2
6. Number of stages	- 1
7. Maximum flow	- 150 gpm
8. Pump Head	- 60 ft (26 psi)
9. NPSHr	- 2.4 ft
10. Maximum pump speed	- 350 RPM
11. Duty	- Constant
12. Minimum motor size	- 7.25 Hp, 460 V/ 60Hz / 3-phases, Class I, Div. 2 Explosion Proof
13. Motor Speed	- 1770 RPM
14. Drive	- Existing ABB 15 HP VFDs
15. Ambient environment	- Indoors
16. Fluid temperature	- 60-80°F
17. Type of suction port	- Flanged
18. Suction	- 6" 125# FF ANSI per ASME 16.5B
19. Discharge	- 4" discharge 125# FF ANSI per ASME 16.5B

3.5 APPENDIX 1 - EXISTING CONTROL SYSTEM

A. Existing Sludge Feed Pumps and Polymer Blending System - Photographs



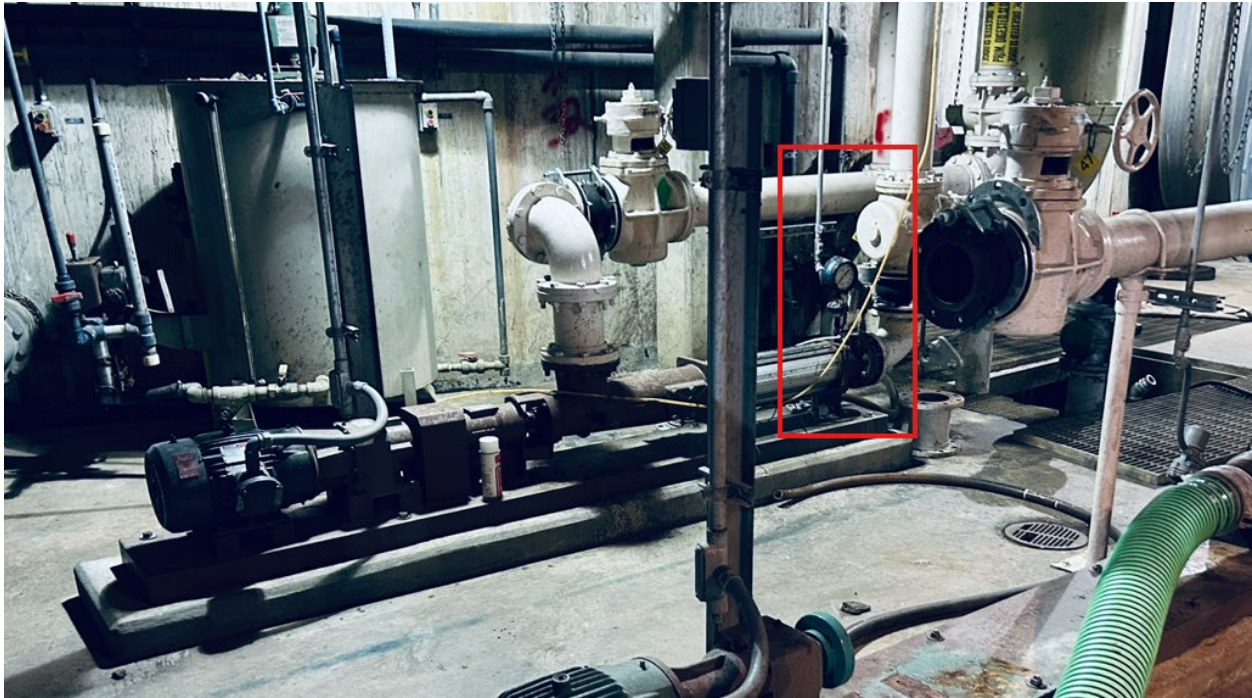
Existing Sludge Pumps P11 & P12 Local Control Panels with ABB 15HP VFDs. Located on the first floor, in the Electrical Room.



Existing Sludge Pumps P11 & P12 ONYX Valve Smart Box located next to the local control panels.



Existing Progressive Cavity Sludge Pumps P11 & P12. Located in the basement.



Typical existing sludge pumps pressure sensor/gauge used with the ONYX Valve Smart Box for monitoring pump pressure.





Existing Poly Feed Pumps P17, P18, P19 & Smart Boxes.
Located on the 1st Floor Polymer Room



Existing Polymer Blend #1 on the left.
Polymer Blend #2 on the right.
Located on the 1st Floor, Polymer Room.



Existing Polymer Tote Transfer Pump.
Located on the 1st Floor, Polymer Room



Existing Poly Feed Pumps P17, P18, P19 & Aging Tank. Located in the Basement

END OF SECTION 432110

SECTION 461211 – SCREW SHAFTLESS CONVEYOR

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary conditions, Division-1 Specifications sections, and all Specification Sections apply to work of this section.
- B. The following equipment and related work are specified and furnished under other items:
 - 1. Division 26 – Electrical
 - 2. Section 330900 PLC and HMI Control system for panel requirements
 - 3. Section 467331 – Sludge Dewatering, Section
- C. Reference Standards:
 - 1. American National Standards Institute (ANSI).
 - 2. American Institute of Steel Construction (AISC).
 - 3. American Society of Testing and Materials (ASTM).
 - 4. American Gear Manufacturers Association (AGMA).
 - 5. Conveyor Equipment Manufacturers Association (CEMA 300).
 - 6. National Electrical Manufacturers Association (NEMA).
 - 7. Occupational Safety and Health Administration (OSHA).
 - 8. American Welding Society (AWS D.1.1-90).
 - 9. American Iron and Steel Institute (AISI).
 - 10. National Electric Code (NEC).
 - 11. Society for Protective Coatings (SSPC).
 - 12. Anti-Friction Bearing Manufacturers Association (AFBMA).

1.2 SUMMARY

- A. The Contractor shall provide, install, test, and commission one (1) horizontal shaftless screw conveyor system, including interconnecting chutes, supports, and all other necessary ancillary equipment for a fully operational system. The screw conveyor system is intended to transport dewatered sludge from the dewatering equipment into the cake hopper.
- B. The conveyor spiral shall be designed to collect dewatered cake from opposing sides of the screw press and convey it to the chute opening in accordance with the Contract Drawings.

- C. The conveyor performance, design parameters, and material of construction are identified in Schedule 461211 – A.
- D. The contract drawings and this section outline the equipment descriptions, minimum requirements, and mandatory features for the equipment to be provided. It is the manufacturer's responsibility to design and supply complete equipment that meets all specified details, performance standards, and reliability criteria, in accordance with the intent and requirements of the contract drawings and specifications.
- E. The equipment shall be supplied complete with all accessories, special tools, spare parts, and any other appurtenances specified herein or necessary for a proper and satisfactory installation.
- F. The exact final dimensions to be determined by the Contractor to suit the dewatering equipment, conveyor system, and final arrangement. The Contractor is responsible for the coordination of all mechanical and electrical equipment and all structural components interfacing with the conveyor, and for obtaining all site measurements necessary to support detailed conveyor submittals.
- G. Screw Conveyor with shafts and intermediate hanger bearings will not be acceptable for this project.

1.3 PERFORMANCE REQUIREMENTS

- A. The shaftless screw conveyor shall meet the performance and design requirements as listed in Schedule 461211 – A.

1.4 SUBMITTALS

- A. General: Submit the following in accordance with the conditions of the Contract and Division 1 Specification Sections.
- B. Product Data:
 - 1. Submit Manufacturer's literature, warranty technical data, and installation instructions, complete with accessories, catalog cuts, drawings, specifications, fabrication details, and parts identification for all work of this Section.
 - 2. Manufacturer's certification, signed by a corporate officer, informing that the proposed equipment fully complies with the requirements of this specification.
 - 3. Motor characteristics and performance information.
 - 4. Gear reducer data, including service factor, efficiency, and materials.
 - 5. Parts list, including a list of recommended spare parts.
- C. Shop Drawings:
 - 1. Manufacturer's installation drawings. Dimension drawings depicting all mechanical and electrical equipment dimensions and required clearances.
 - 2. General arrangement drawings for the proposed equipment.

3. Submit support locations and loads to the Engineer with shop drawings for review.
 4. Submit proposed hanger support locations referenced from the steel columns of the Cake Loading Building and dead and live loads at each point.
 5. Cut sheets for electric motors and auxiliary items.
 6. Complete schematic diagrams for electrical control panels.
- D. Maintenance and Operating Instructions: Maintenance and Operation manuals shall completely describe the operation of the shaftless screw conveyor, start-up, optimization, and maintenance operations for the equipment to be furnished under this section.
1. Recommendations for short- and long-term storage.
 2. Detailed installation instructions, with clear step-by-step points on the correct mechanical and electrical installation procedures.
 3. Explanation of operating safety considerations
 4. Troubleshooting instructions.
 5. Electrical diagram.
 6. Manufacturer's warranty.
 7. Repair parts and maintenance material.

1.5 QUALITY ASSURANCE

- A. In addition to the requirements of these specifications, comply with the manufacturer's instructions and recommendations for work.
- B. The design of the conveying system shall be based on the contract drawings, these specifications, and the manufacturer's proven experience of at least ten (10) years in designing and manufacturing wastewater conveyor systems. Equipment that is purchased and resold, or supplied under a license or marketing agreement, shall not qualify to meet the experience requirement.
- C. The screw conveyor system shall be supplied by a single manufacturer and shall include all necessary components, drives, motors, instrumentation, controls, ancillary items, and supports.
- D. Any shaftless screw conveyor proposed as an "or equal" design will be subject to the Engineer's approval. If such approval is granted, the Contractor and conveyor Manufacturer will nonetheless be responsible for the resolution of any technical problems arising from the use of the "or equal" design.

1.6 WARRANTY

- A. The manufacturer shall warranty the equipment furnished under this section to be free from defects in material and workmanship for a period of twelve (12) months after the equipment was first placed into operation at the jobsite or eighteen (18) months after the equipment was first delivered to the site, whichever date occurs first. Any warranted

material defects found to exist shall be corrected (repaired or replaced) at no cost to the Owner.

- B. Liner: For a wear indicator (two colors) liner, excessive wear shall be indicated by the appearance of the bottom indicator layer (second color) along more than 30% of the conveyor length during the first three years of service. If these wear indications occur, the conveyor supplier shall provide a new formed and banded liner to replace all the liners in the conveyor that have excessive wear.
 - 1. Screw: Excessive wear on the screw shall be indicated by loss of more than 50% of the height of the main outer screw section over 30% of the total length of the screw. If excessive screw wear is found, the conveyor supplier shall provide a new screw to replace the screw in the conveyor that has excessive wear.

1.7 JOB CONDITIONS

- A. To be delivered in assembled match-marked sections ready for final installation, without the need for field welding. Knocked-down kits of parts will not be acceptable.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers
 - 1. Esmil Group
 - 2. Or an Engineer approved equal.

2.2 GENERAL

- A. The conveying system shall be of the shaftless screw type with end bearings. Screw conveyor system with intermediate hanger bearings will not be accepted for this project.
- B. All welds to be continuous unless otherwise specified. Facing surfaces of field-welded components shall be beveled and match-marked.
- C. Sharp corners of all cuts and sheared edges shall be made smooth by edge grinding.
- D. The shaftless screw conveyor equipment shall include the following components:
 - 1. Troughs, Liners & Covers
 - 2. Spiral Flighting
 - 3. Chutes
 - 4. End Shaft
 - 5. Electric motor & gear
 - 6. Mounting and support Structure
 - 7. Safety Accessories

8. Spare Parts

2.3 MATERIALS

- A. Materials used in the fabrication of the equipment under this section shall conform to the Schedule 461211 – A:
- B. Trough:
 - 1. The U-shaped trough shall be fabricated from AISI 304 stainless steel.
 - 2. The minimum trough thickness shall be 14 gauge (2 mm).
 - 3. Trough end flanges, welded to each trough section, shall be provided for connecting adjacent sections or attaching end plates to the trough sections.
 - 4. Conveyors longer than the maximum individual trough segment length shall be constructed in two or more sections, bolted together at the trough end joining flanges.
 - 5. The screw conveyor trough shall be fitted with a 2-inch diameter NPT drain nipple at the lower end, complete with a threaded cap.
- C. Covers:
 - 1. A sectional AISI 304 stainless steel plate shall cover the entire trough, except where the inlet chute connections are located. The cover segments at the inlet chute connections shall extend beyond the connections on each side and be bolted in place.
 - 2. The covers shall be designed to open for maintenance and cleaning. They shall be bolted in place, and quick-opening covers will not be permitted unless equipped with limit switches to stop the equipment when the cover is opened.
 - 3. Inlet and discharge hoppers or chutes:
 - a. Shall be welded or bolted to the equipment as indicated on the contract drawings.
 - b. Shall be constructed from the same material as the conveyor troughs.
 - c. The conveyor equipment supplier shall provide connection chutes and transition pieces between related equipment.
- D. Screw:
 - 1. The screw for the shaftless screw conveyor shall be designed to convey material without a center shaft or hanger bearings.
 - 2. It shall be fabricated from wear-resistant carbon steel with a minimum thickness of 1 inch.
 - 3. The screw shapes shall be cold-formed from continuous bar stock.
 - 4. Field welds may be required at the jobsite by the installer if any conveyor length exceeds shipping or handling limitations.

E. Liners:

1. Conveyor troughs shall be lined with UHMW PE liners.
2. Liners shall be provided in a maximum length of 3.5 ft (1000 mm) sections for ease of replacement during servicing.
3. Each section of liner shall be made of two layers of the same material, each a different color, to provide a visible indication when the liner is nearing the end of its useful life.
4. The liner shall be secured in place with stainless steel clips, permanently welded to the inside of the trough. No fasteners or penetrations through the trough wall shall be allowed.
5. The minimum liner thickness shall be 3/8 inch (10 mm).

2.4 CONVEYOR SUPPORTS

- A. Support loadings shall be based on a filled trough, the weight of the conveyor, and the dynamic loading during operation.
- B. The Contractor shall coordinate support locations with the conveyor equipment supplier, considering the facility's structural constraints. The conveyor supports shall not restrict access to other process systems and equipment.
- C. The conveyor shall be field adjusted as required to meet the manufacturer's installation tolerances.
- D. At a minimum, the conveyor shall be provided with support at the inlet and discharge ends, with intermediate supports as required.
- E. The supports shall be shop-fabricated from stainless steel shapes and plates and shall be assembled and fitted to the conveyor before its delivery to the jobsite.
- F. Supports shall be constructed from AISI 304 stainless steel.
- G. The Contractor shall be responsible for all fasteners, both for hanging and floor anchors.
- H. All shop welding shall conform to the latest standards of the American Welding Society (AWS). The supports shall be designed to avoid interference with other equipment or equipment supports.

2.5 POWER SUPPLY

- A. All electrical equipment shall conform to the applicable standard of the National Electrical Manufacturers Association (NEMA) and the National Electrical Code (NEC). Both power and control equipment shall be insulated for not less than 600 volts, even though operating voltages may be lower.
- B. Power supply to the equipment shall be 460 volts, 60 Hz, 3-phase.
 1. Power supply for electrical controls shall be 120 volts, 60 Hz, single phase.

2.6 DRIVE SYSTEM

- A. The drive assembly shall consist of an integral gearmotor, mounted directly to the screw shaft. The gearmotor housing shall be made of cast iron, providing complete protection under all operating conditions. Gears shall be manufactured and rated for continuous duty.
- B. The gearmotor shall be a parallel shaft type, designed to drive the screw without the need for additional couplings or joints.
- C. The gear reducer and drive shall be designed to provide sufficient applied torque to start a fully loaded conveyor.
- D. The screw rotational speed shall be achieved through a reduction gear. Input power to the screw drive shall be supplied by an AC variable frequency drive unit.
- E. The motor shall have a Totally Enclosed Fan Cooled (TEFC) enclosure.
- F. The motors shall have a 1.15 service factor and be energy efficient, suitable for 480V, 60Hz, 3-phase power.
- G. Gearboxes and motors shall be factory-assembled on the conveyor, factory-tested, and shipped fully assembled with the conveyors.
- H. The drive unit shall be rigidly supported so there is no visible "wobble" movement under any operating condition. In the event of a prolonged power failure or emergency system shutdown, the drive system shall be designed, at a minimum, to start the conveyor from a dead stop with the trough filled at 2 times the design load for loads designed up to 67% fill rate and 1.5 times for loads designed exceeding 67% fill rate.
- I. The motors have Class B insulation and NEMA Design B speed-torque characteristics, in accordance with NEMA MG1, Section 12.35 and 12.38. Motors shall be C-face type and furnished in standard NEMA frame sizes.
- J. Each spiral conveyor shall be driven by a constant-speed gear reducer motor drive unit mounted to a bellhousing adapter flange attached to the conveyor end plate.
- K. The adapter flange shall be designed to direct any material leakage from the conveyor trough to the atmosphere and prevent ingress into the gear reducer or motor drive unit. Direct coupling of the gear reducer or motor drive unit to the conveyor end flange is not acceptable.
- L. Gear Reducers
 - 1. Gear reducers shall be AGMA Class II, single- or double-reduction, helical gear units equipped with high-capacity roller bearings. Bearings shall be designed to withstand thrust loads associated with a fully loaded startup condition and shall have a minimum AFBMA B-10 life of 30,000 hours.
 - 2. Gear reducers shall be air-cooled and shall not require auxiliary cooling. Each gear reducer shall be sized with a minimum torque service factor of 1.15 times the

absorbed power or 1.10 times the motor nameplate, at the driven shaft speed, whichever is greater.

2.7 SAFETY DEVICES

A. Cable-operated safety stop control:

1. The conveyors shall be equipped with emergency pull cords that activate a dual relay through a mounted emergency stop switch, designed to immediately stop the conveyor and any feeding devices when activated.
2. The pull cord switch shall be housed in an enclosure suitable for the operating environment. The unit shall be model ER6022 by Omron, or an approved equal.

B. Motion sensor:

1. The motion sensor shall be mounted on the side of the conveyor to detect screw or drive shaft failure.
2. The motion sensor shall be housed in an enclosure suitable for the environment. The unit shall be model SITRANS WM100 by Siemens, or an approved equal.

2.8 SPARE PARTS

A. It is recommended that the following spare parts be supplied, as a minimum:

1. One (1) set of liners.
2. One (1) cable-operated safety stop control.
3. One (1) motion sensor.

B. The conveyor manufacturer shall provide any special tools required for the servicing and maintenance of the screw conveyor.

2.9 LUBRICANTS

A. Furnish lubricants of the type and quantity as recommended by the conveyor manufacturer for (start-up) operation.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. The conveyor shall be delivered by the Manufacturer in fully assembled and complete with hardware and instructions, except for the spiral splices. The assembly shall consist only of joining the sections, anchoring the supports, installing the bolt, and electrical hookup.
- B. Install equipment in accordance with reviewed Shop Drawings, and manufacturer's instructions, as specified herein and shown on Contract Drawings.

- C. Initial lubrication required for start-up and field test operation shall be furnished and applied in accordance with the manufacturer's recommendations.

3.2 FIELD QUALITY CONTROL

- A. The conveyor system supplier shall furnish the services at the site of a factory-trained representative for a period of one (1) day in no more than one (1) trip to the jobsite. Service shall be provided as necessary after the Contractor has installed the equipment. These services shall be furnished for the purposes of:
1. The equipment manufacturer's inspection of the equipment following installation by others, to certify that the equipment has been properly installed and is ready to operate, to train the Owner's personnel in the operation and maintenance of the equipment, and to observe and supervise the initial operation of the equipment.
 2. If additional service is required due to the mechanisms not being fully operational at the time of service requested by the contractor, the additional service days will be at the contractor's expense.
 3. For the purposes of this section, a workday is defined as eight hours at the Site, excluding travel time.
- B. After inspection of the installed equipment, the Supplier shall furnish a written report certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchorage, has been operated under full load conditions, and that it operates satisfactorily.

3.3 DEMONSTRATION AND INSTRUCTIONS

- A. Provide the services of a qualified factory-trained manufacturer's representative to conduct training covering operation, mechanical maintenance, and electrical requirements.

3.4 SHAFTLESS SCREW CONVEYOR SCHEDULE

SCHEDULE 461211 – A

Location	Sludge Handling Building
Performance	
Material conveyed	Sludge cake, ~ 22% TS
Density average,	50 lbs/cu ft
Design capacity,	up to 200 ft ³ /hr
Max screw speed	>20 rpm
System Design	
Trough length	As shown on the Drawings
Inclination angle	Horizontal
Rotation direction	Bi-directional
Screw Type	Shaftless
Screw Diameter, inch	12 inches
Feed Inlet	Screw Press

Discharge outlet	Chute to dumpster
Number of Inlets	1
Number of Discharges	1
Drive Type	Helical Gear
Power Supply	3 HP, 460 V/60 Hz/3-ph
Trough Drainage connection	NPS 2, threaded
Screw Material	S355J2G3 steel
Material of Construction	
Body	AISI 304, 11 ga (3 mm)
Cover	AISI 304, 14 ga (2 mm)
End Plate Type	Welded
Liners	UHMW PE, 0.4 in (10 mm)
Screw	S355J2G3 steel
Supports	AISI 304 stainless steel
Gearmotors	painted cast iron
Hardware	AISI 304 stainless steel
Lid Type / Length	Bolted / 5 ft max

END OF SECTION 461211

SECTION 463333 – POLYMER BLENDING AND FEED EQUIPMENT

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. The following equipment and related work are specified and furnished under other items:
 - 1. Division 26 – Electrical
 - 2. Section 467331 – Sludge Dewatering
 - 3. Section 330900 PLC and HMI Control System

1.2 SUMMARY

- A. This section includes furnishing, installing, and placing into successful operation two (2) complete polymer blending skid systems with progressive cavity pump, motors, and controls, including all integral piping, valves, fittings, pipe supports, special equipment, and appurtenances in accordance with this specification, including all incidental work necessary to make it complete, satisfactory, and ready for operation.
- B. The polymer dilution and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution.
- C. Polymer blending system shall operate in conjunction with sludge dewatering equipment as specified in Section 467331– Multi-Disc Screw Press. All equipment shall be delivered as part of the complete dewatering skid-mounted system.
- D. Polymer blending system shall be rated for installation in hazardous areas and shall be explosion-proof, Class I, Division 2.

1.3 SYSTEM DESCRIPTION

- A. The polymer dilution and feed system shall be capable of effectively activating and fully blending with water a homogenous polymer solution ranging from 0.1 to 2% concentration based on neat emulsion polymer with active contents of 30-50%.
- B. Design Requirements for the Polymer Feed System:
 - 1. Polymer shall be drawn from a tote located next to the polymer feed system, as shown on the Drawings.
 - 2. Polymer Type: Emulsion.
 - 3. Polymer Activity (percent active): 30 to 50.
 - 4. Solution Concentration Range: 0.1% to 2% based on neat polymer.
 - 5. Solution Concentration Design Point: 0.5% based on neat polymer.

Neat Polymer Flow Range gph	Dilution Water Range gph
0.5–15	60–1200

- C. Performance Requirements: Polymer Feed System shall be capable of supplying between 0.5 and 15 gallons per hour of liquid emulsion polymer, with the entire flow passing through the preparation unit. Following preparation and mixing, the polymer solution leaving the mixer shall be ready to feed the dewatering volute press unit.

1.4 SUBMITTALS

- A. Product Data: Provide unit capacities, projected effluent values, loading parameters, design parameters, oxygen requirements, dimensions, etc.
- B. Shop Drawings:
1. Submit detailed specifications and shop drawings with both shaded isometric and orthogonal views of the proposed system, including dimensions and weights.
 2. Submit wiring, control schematics, and control logic diagrams for all electrical and control components furnished.
 3. Factory testing documentation.
- C. Provide detailed Operations and Maintenance Manuals, including storage, installation, start-up, and operating instructions. Provide safety precautions and warnings for all hazards operating equipment.

1.5 QUALITY ASSURANCE

- A. In addition to the requirements of these specifications, comply with the manufacturer's instructions and recommendations for work.
- B. All equipment included in this section shall be furnished by a single supplier who shall be responsible for the design, coordination, and satisfactory operation of the system.
- C. Provide evidence of at least fifteen (15) years of demonstrable experience in the design and manufacture of polymer blending systems. The Supplier shall have at least twenty-five (25) polymer feed systems operating successfully for at least five (5) years in North America at municipal wastewater treatment plants that were designed and furnished under the Supplier's own name.
- D. Prior to shipment, the system shall be inspected for quality construction, verifying all fasteners and fittings are tight, all wires are secure, and connections are whisker-free.
- E. The complete system shall be fully factory tested prior to shipment. Testing shall include setting and verification of all instrumentation and sensors per the design requirements of the application; pressure testing all plumbing systems for a minimum of one hour at 100 psi. If leaks are found, they shall be fixed, and a new test shall be conducted for one hour

at 100 psi until the plumbing system is verified to be leak-free: verification of system design flow rates, and complete function simulation of operation.

1.6 DELIVERY AND STORAGE

- A. The equipment shall be shipped in a new, high-quality, completely enclosed weatherproof wooden crate.
- B. The crate shall include a shock sensor to warn of equipment mishandling during shipment.

1.7 WARRANTY

- A. The manufacturer shall warranty the equipment furnished under this section to be free from defects in material and workmanship for a period of twelve (12) months after the equipment was first placed into operation at the jobsite or eighteen (18) months after the equipment was first delivered to the site, whichever date occurs first. Any warranted material defects found to exist shall be corrected (repaired or replaced) at no cost to the Owner.
- B. The mixing chamber shall be warranted for the life of the system against plugging for any reason.

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers:
 - 1. VeloBlend, Model VM-15P-1200-D0A2
 - 2. Or an Engineer approved equal.
- B. The listed equipment is part of the Base Bid and shall be considered as establishing the type, function, appearance, and quality required as defined in the General Conditions.
- C. The drawings and specifications were prepared based on Velodyne. CONTRACTOR shall include in the Bid and shall be responsible for the cost of any changes, including engineering changes, to accommodate the other Base Bid equipment, including but not limited to structural, mechanical, and electrical work.
- D. CONTRACTOR may provide Alternative Bids for equipment from other manufacturers by writing their name into the blank(s) provided on the Bid form. CONTRACTOR shall comply with all provisions regarding substitute items and shall include in the Bid and be responsible for the cost of any changes to accommodate substitute equipment, including, but not limited to, structural, mechanical, and electrical work. CONTRACTOR shall also pay costs of engineering services for review of substitutes and for revisions of drawings and/or specifications by ENGINEER to accommodate substitutes.

2.2 EQUIPMENT PERFORMANCE

- A. The polymer-blending system shall be a complete package that automatically dilutes, activates, and feeds liquid polymer and water. Blenders shall instantaneously invert neat polymer into solution, producing a thoroughly diluted and completely activated homogenous blend, free of “fish-eyes” and unblended polymer.
- B. The polymer blending and feed equipment shall be provided to meet the following performance and design requirements:
 - 1. Polymer Type: Liquid emulsion (30-75 percent active)
 - 2. Neat Polymer Feed Rate: 0.5 to 15 gph
 - 3. Diluted Polymer Concentration: 0.1-1% of Total Active
 - 4. Dilution Water Flow Range: 60-1200 gph at 50 psi minimum.

2.3 MULTIZONE MIXING CHAMBER

- A. To provide control and versatility to optimize the performance of the wide range of polymers available and to optimize system reliability, a multi-stage hydro-mechanical polymer blending technology shall be provided with both a non-mechanical and mechanical mixing stage:
 - 1. Non-Mechanical Stage: To optimize reliability, the device shall be capable of activating and blending polymer based on plant water pressure alone of 30 psi or greater. Polymer shall be injected directly into a water jet by means of an injection quill positioned such that the non-mechanical mixing energy is not diminished prior to polymer and water contact. The non-mechanical zone shall be designed such that the velocity of the mixing energy-producing water jet is maintained or increases as flow decreases. Polymer activation efficiency shall be consistent over the dilution water range.
 - 2. Hydro-Mechanical Mixing Stage: To provide optimal polymer performance under all operating conditions and to provide total control over mixing energy, in addition to the non-mechanical mixing stage, the device shall be capable of producing its mixing energy independent of plant water pressure through a variable intensity, controllable stainless steel hydro-mechanical mixer. The mixing impeller shall be fully controllable and capable of inducing ultra-high, non-damaging recirculation through the impeller. The polymer mixing impeller shall be designed to produce both axial and radial flow to optimize mixing effectiveness and induce high, non-damaging mixing energy across the system's full flow range.
 - 3. To prevent polymer build-up, the mixing chamber shall maintain high velocity in the entire chamber – at no time shall there be low velocity within any portion of the mixing chamber.
- B. Both mechanical and non-mechanical mixing zones shall be clear polycarbonate to view the mixing action and blending effectiveness. Acrylic chambers prone to becoming brittle over time and cracking, or opaque pipe, shall not be acceptable.

- C. The mixing chamber shall have a maximum rated pressure of 100 psi. Provide a 316 stainless steel, adjustable-range pressure relief valve on the mixing chamber set at 75 psi.
- D. Impeller shall be driven by a 0.5-hp, 90-volt DC, washdown-duty, TENV motor with a full-load current of 5.0 amps. Impeller speed shall be not less than 1,750 rpm. Motor shall be directly coupled to the impeller shaft. Mixer speed shall be controlled by an SCR speed controller mounted within the polymer feed motor control panel and located outside the hazardous area, unless otherwise listed for Class I, Division 2 service. Motors mounted beneath the mixing chamber, where leakage or seal failure could damage the motor, shall not be acceptable.
- E. Motor and all associated electrical components shall be listed and approved for installation in a Class I, Division 2 hazardous location in accordance with the National Electrical Code.
- F. The mixer drive shaft shall be sealed by a mechanical seal which shall have an integrally mounted and factory plumbed seal flush. A drain port behind the seal shall be provided in the mixing chamber to drain the polymer solution in case of a seal failure. The seal shall be easily accessible for replacement. All bearings shall be external to the mixing chamber.
- G. Neat Polymer Check Valve: Provide a neat polymer check valve specifically designed to isolate neat polymer from dilution water. The valve shall be designed with an open, unobstructed path to the valve seat. Minimum area to valve seat shall be 3/16 inch. The valve body shall be constructed of Teflon with Viton seals, and the ball shall be stainless steel. The valve shall be readily accessible for cleaning and shall be easily disassembled. Conventional check valves and/or check valves that are installed inside the mixing chamber, or which require mixing chamber disassembly for servicing, will not be accepted.
- H. Dilution Water Control
 - 1. If the manufacturer requires two-stream dilution control, dilution water shall be split into two streams. Primary water flow shall supply the mixing chamber. Secondary water flow shall be used to post-dilute the activated polymer stream.
 - 2. Flow indicators and flow control valves shall be provided for the dilution water stream:
 - a. The dilution water flow rate shall be monitored by a Rotameter flow meter having the range of 60-1200 gph. Unions of flanges shall be provided on the flow meter to allow easy removal for cleaning.
 - 3. Provide a factory-installed and pre-wired 120 VAC electric solenoid valve for on/off control of dilution water flow. Solenoid valve body shall be 316L SS.
 - 4. A differential pressure type low water differential pressure alarm with 120-volt rated contacts shall be provided. The switch shall be adjustable between 9 and 60 psig. Static working pressure shall be at least 150 psi. The pressure switch shall be as manufactured by Ashcroft, or equal.
 - 5. Dilution water and solution output connections shall be 316 stainless steel unions connected to the chassis.

2.4 DILUTION WATER INLET MANIFOLD

- A. The dilution water inlet assembly shall include an inlet fitting, a factory-installed and pre-wired 120 VAC, NEMA 4X dilution water solenoid valve, Rotameter-type flow meter, stainless steel liquid-filled dilution water inlet pressure gauge, and 316L stainless steel water control valves. Plastic control valves shall not be acceptable. The manufacturer shall provide valves in accordance with Division 40.

2.5 NEAT POLYMER METERING PUMP (PROGRESSING CAVITY)

- A. Each skid system shall be provided with one (1) neat polymer metering pump integrally mounted on the system's skid.
 - 1. The neat polymer metering pump shall be a progressing cavity-type pump, constructed of 316 stainless steel rotor and fluoro-elastomer stator. The shaft seal shall be a lip seal type riding on a ceramic sleeve.
 - 2. Motor and all associated electrical components shall be listed and approved for installation in a Class I, Division 2 hazardous location in accordance with the National Electrical Code.
 - 3. The pump shall have a minimum continuous output range of 0.5 to 10 gph.
 - 4. The pump shall contain a minimum of four stages to minimize slip.
 - 5. The pump shall be mounted to the skid frame with a 304 stainless steel bracket that positions the pump suction no more than 18 inches off the base to maintain ideal pump suction conditions.
 - 6. A 120 VAC SCR (Silicon-Controlled Rectifier) variable speed controller with 90-Volt DC, 5.0 FLA, 1/2 HP close-coupled, washdown-duty, TENV motor. Maximum pump shaft speed shall be 545 rpm. The pump speed shall be controlled by an SCR speed controller mounted in the polymer feed motor control panel.
- B. Provide a calibration cylinder with one full port PVC ball valves having Viton O-rings. The column shall be calibrated for a one-minute draw-down at maximum pump rate and read in GPH and milliliters. The calibration column shall be rigidly mounted to the system's frame with a minimum of two heavy-duty brackets. Mounting the calibration to the neat polymer inlet piping shall not be acceptable. Provide a breather plug in the top of the calibration column designed to allow adequate displacement of air during calibration while preventing water or other foreign material from entering the calibration column.
- C. Provide a thermal-type loss of polymer flow sensor.
- D. Pump shall be a progressive cavity pump by Seepex Inc, or equal.
- E. Pump shall allow for manual adjustment of the pumping capacity.
- F. Provide a factory-installed and pre-wired high-pressure switch on the discharge of the pump. Pressure switch shall be Square D Type GAW, or equal. High-pressure setting shall be set by the manufacturer. The high discharge pressure switch shall shut down the pump

in the event of high discharge pressure (On and Remote modes). A manual reset shall be required to restart the pump.

- G. Spare Parts: The spare parts shall be identified, prepared, and packed for long-term storage.

2.6 SOLUTION DISCHARGE ASSEMBLY

- A. Provide a 2-1/2-inch stainless steel liquid-filled pressure gauge to monitor system discharge pressure.
- B. Provide a PVC ball-type check valve to prevent backflow, sized for the total solution flow of the system.

2.7 FRAME/SKID

- A. The system's frame shall be of rugged 304 stainless steel construction. All pipe supports shall be stainless steel. Piping and valves shall be mounted with rigid pipe clamps.
- B. All components of each dilution/feed assembly, including pump, drive, control devices and instruments, and local control panel shall be factory pre-plumbed and pre-wired.

2.8 CONTROL PANEL

- A. The vendor shall furnish, install, and commission a Local control panel for the polymer blending system. The local control panel shall be mounted on the polymer blending skid and pre-wired to all on-skid equipment and instrumentation. Refer to Section 330900 PLC and HMI Control System for panel requirements.
- B. All associated electrical components shall be listed and approved for installation in a Class I, Division 2 hazardous location in accordance with the National Electrical Code.
- C. The local control panel shall be factory-mounted to the polymer system skid and pre-wired to all skid motors and controls. The control panel shall have all logic controllers, SCR motor controllers, digital displays, potentiometers, switches, lights, relays, and other control devices as required for a functioning system.
- D. The polymer system control panel shall have the following devices on the front of the control panel enclosure:
 - 1. Local – Off – Remote selector switch.
 - 2. Manual mixer speed control potentiometer.
 - 3. Manual polymer metering pump speed potentiometer (ten turns).
 - 4. Polymer metering pump flow display (signal based on pump speed).
 - 5. Power on the indicating light.
 - 6. Red “low water differential pressure” alarm indicating light.
 - 7. Red “low polymer flow” alarm indicating light.

- E. The Polymer system control panel shall receive the following inputs from the Screw Press Main Control Panel
 - 1. Polymer system start/stop command (discrete dry contact).
 - 2. Polymer metering pump pacing speed signal (analog 4-20mA).
- F. Polymer system control panel shall provide the following outputs to the Screw Press Main Control Panel
 - 1. Polymer system “in remote” (discrete dry contact).
 - 2. Polymer system “Running” (discrete dry contact).
 - 3. Polymer system common alarm (discrete dry contact) active when any system alarm is active.
- G. Control panel shall accept 120-volt AC, single-phase, 20-amp hardwired branch circuit power. Provide a main control panel circuit breaker disconnect and a dedicated circuit breaker for each motor.
- H. All conduit and wiring from the polymer system control panel to the associated polymer system devices shall be factory-prewired or provided by Polymer Feed Equipment Supplier.

2.9 PIPING AND VALVES

- A. All piping and valves shall conform to Division 40. Piping and fittings shall be Schedule 80 PVC. Solenoid valves shall be 316 or 316L stainless steel.
- B. CONTRACTOR shall provide strainer and all unions, piping, fittings, and appurtenances to connect to the emulsion polymer tote, as shown on the Drawings, including 2-inch NPT connection, isolation ball valves, 1-inch quick-disconnect adapter, vent connection, and 20 feet of 1-inch clear, braided, PVC tubing.

2.10 SPARE PARTS

- A. CONTRACTOR shall provide, along with the shop drawings, a list of the manufacturer’s recommended spare parts for the specified equipment. The list shall include a description of each spare part, current pricing, and expected delivery time for each part. No spare parts shall be provided by CONTRACTOR/manufacturer as part of this Contract.
- B. Manufacturer to supply the following spare parts:
 - 1. One (1) stator for the neat polymer progressive cavity pump
 - 2. One (1) rotor for the neat polymer progressive cavity pump
 - 3. One (1) progressive cavity pump shaft seal
 - 4. Progressive cavity pump with motor and VFD
- C. These parts shall be identified, prepared, and packed for long-term storage.

2.11 FINISHES

- A. It is the intent of these specifications that equipment, support, and accessories be furnished factory shop-primed and finish-painted. Equipment and appurtenances shall be prepared in accordance with commercial grade SSPC specifications No. 6. Priming and finish painting shall be as recommended by the manufacturer and shall be suitable for a corrosive atmosphere. Touch-up paint shall be provided by the manufacturer.

2.12 ANCHOR BOLTS

- A. Provide all anchor bolts required for the equipment furnished. Anchor bolts shall be 316 stainless steel and shall be of ample strength for intended service. Provide anchor bolts in accordance with Division 5.

PART 3 - EXECUTION

3.1 GENERAL

- A. Refer to requirements specified in Division 01 for equipment installation, quality control, testing, supervision, start-up, and operator training.
- B. The complete system shall be fully factory tested prior to shipment. Testing shall include setting and verification of all instrumentation and sensors; pressure testing all skid-mounted plumbing systems as specified in Division 40. If leaks are found, they shall be fixed, and a new test shall be conducted until the plumbing system is verified to be leak-free. The system shall undergo factory verification of system design flow rates and complete functional operation. Documentation of each test shall be maintained and provided to the engineer as part of the shop drawing review.
- C. Refer to Section 467331–Volute Dewatering Press for startup and performance testing requirements of the dewatering process, including performance of Polymer Blending and Feed Equipment.

END OF SECTION 463333

SECTION 467331 – DEWATERING MULTI-DISK SCREW PRESS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division-1 Specification sections, apply to work of this section.
- B. Related Section:
 - 1. Division 26 – Electrical
 - 2. Section 330900 PLC and HMI Control System
 - 3. Section 432110 – Progressive Cavity Pumps
 - 4. Section 461211 – Shaftless Conveyor
 - 5. Section 463333 – Polymer System
- C. This section contains references to the following documents:
 - 1. American National Standards Institute (ANSI)
 - 2. American Society of Testing and Materials (ASTM)
 - 3. American Iron and Steel Institute (AISI)
 - 4. American Welding Society (AWS)
 - 5. American Institute of Steel Construction (AISC)
 - 6. American Bearing Manufacturers Association (ABMA)
 - 7. American Gear Manufacturers Association (AGMA)
 - 8. National Electrical Manufacturers Association (NEMA)
 - 9. Underwriters Laboratory (UL).
 - 10. National Electrical Code (NEC)

1.2 DESCRIPTION OF WORK

- A. All packaged equipment shall be considered Owner-procured equipment furnished under the Procurement Contract.
- B. All equipment furnished under this Section shall be provided by a single Manufacturer, who shall be responsible for fabricating or procuring individual components, integrating the complete system, performing factory testing, and delivering the equipment to the Project site. The Manufacturer shall be responsible for coordinating all equipment, components, and interfaces necessary to provide a complete, properly functioning, and integrated sludge dewatering system.

- C. The Manufacturer shall furnish a complete sludge dewatering packaged system, as specified in the Contract Documents, capable of meeting the specified performance requirements and providing a fully functional and coordinated sludge dewatering system. The packaged system shall include, at a minimum, the following components:
1. Multi-Disc Screw Press (hereinafter Screw Press) dewatering unit with sludge condition (flocculation) tank, including Local and Main Control Panels
 2. Two (2) Polymer Feed skid system
 3. Two (2) Sludge Feed progressive cavity pumps
 4. Flowmeter
 5. Dewatered sludge cake conveyor
 6. Access platforms, as shown in the Contract Drawings
- D. The Screw Press shall include a structural frame capable of accommodating (6) dewatering drums. Six (6) dewatering drums shall be furnished and installed to meet the ultimate current capacity.
- E. The Screw Press system has been designed based on the Esmil Group Multi-Disc Screw Press, Model MDQ-506CS, which serves as the Basis of Design. Other manufacturers may be considered only if the proposed equipment meets or exceeds all specified design, performance, and operational requirements and fully complies with the site constraints identified in the following paragraph. Named or approved equal equipment may differ in structural configuration, electrical power characteristics, or control systems, provided such differences do not require modifications to the existing facility or supporting systems and comply with all Contract requirements.
- F. Equipment Access, Packaging, and/or Engineer-approved as Equal Requirements for the existing Building:
1. Access and Equipment Fit: The Contractor shall demonstrate at the time of bid that all proposed equipment components can be transported and installed within the existing building access limitations. Equipment requiring field modification, disassembly beyond the manufacturer's standard procedures, or alteration of building features to fit shall not be accepted. Any non-compliant equipment furnished shall be corrected entirely at the Contractor's expense, with no adjustment to the Contract Price or Contract Times.
 2. Packaged and Coordinated System: All dewatering equipment shall be furnished as a fully coordinated, complete packaged system. Interface gaps, undefined scope, or missing components necessary for a complete and operable system shall be the sole responsibility of the Contractor and shall be provided at no additional cost to the Owner.
 3. Equipment Modularity: The proposed equipment shall be modular and suitable for transport and installation within the existing facility constraints. Manufacturers' drawings demonstrating the modular breakdown shall be submitted. Equipment

requiring disassembly beyond the manufacturer's recommended procedures shall be rejected.

4. Performance and Future Capacity: The dewatering equipment shall meet the design and operational requirements specified in Paragraph 1.3 and shall be capable of accommodating a minimum of twenty percent (20%) future increase in capacity without structural modification to the equipment, building, or supporting structure. Equipment requiring external aging tanks, oversized vessels, or supplemental process units to meet capacity or performance requirements shall not be accepted.
5. Structural Analysis and Load Certification: The equipment shall be subject to both of the following limits: a maximum floor live load of 250 lb/sf and a maximum total operating equipment weight of 40,100 lb, as shown on the Drawings.
6. Equipment Removal and Clearance: The manufacturer shall certify that all major equipment components can be removed vertically using existing overhead clearances. Equipment requiring horizontal extraction beyond available clearances, crane rail relocation, crane modification, or building structural alterations shall be rejected. The Contractor shall verify all overhead and access clearances for the installation and maintenance requirements as part of the bid.
7. Solids Discharge Alignment: Dewatered solids discharge shall align with the existing cake chute location as shown on the Drawings. New floor penetrations, beam modifications, chute relocation, or structural alterations shall not be permitted.
8. Conveyance System: Where conveyors are required to align the discharge with existing facilities, such conveyors shall be fully integrated with the screw press system and shall be included in the base bid. Field-added conveyance required due to equipment layout non-compliance shall not be permitted.
9. Electrical Constraints: All electrical components and equipment shall be suitable for the designated room classification. Equipment that necessitates increased area classification, special ventilation, or additional electrical or building modifications due to the increased power demand, vapor, heat, or emissions shall be rejected.
10. Approved Equal Requirements: All changes in structural, electrical, mechanical, instrumentation, or plumbing requirements resulting from a proposed "or Engineer-approved equal" shall be the sole responsibility of the Contractor. This shall include the cost of redesign by the Engineer or the Engineer's subconsultants, as well as any additional costs incurred by affected subcontractors. All revised drawings shall be sealed by a professional engineer licensed in the State of West Virginia. No additional compensation shall be made by the Owner.
11. Burden of Proof: The burden of proving equivalency shall rest entirely with the Contractor. Claims of equivalency based solely on performance, capacity, or advertised ratings will not be accepted.

G. All welding shall conform to the American Welding Society Structural Welding Code.

H. All construction shall allow easy access and visual inspection of all internal components.

- I. All electrical work, motors, and drives shall comply with all relevant NEMA standards.

1.3 SYSTEM DESCRIPTION

- A. The sludge dewatering system shall consist of the Dewatering Screw press sized to dewater anaerobically digested sludge with the following parameters:
 - 1. Type of Influent Solids: Anaerobically Digested Primary and Waste Activated Sludge
 - 2. Influent Dry Solids Concentration: 3-5% Total Solids (TS) concentration
 - 3. Max Solids Loading: 2400 lbs DS/hr
 - 4. Each Screw Loading: 400 lbs/DS/hr
 - 5. Max Hydraulic Capacity (total): 150 gpm at 3% TS
 - 6. Dewatered Cake: 20%
 - 7. Polymer usage: 25 lbs of active polymer/dry-ton solids
- B. The dewatering screw press shall be a complete, prefabricated sludge dewatering system, as described herein and shown on the Drawings, consisting of the following:
 - 1. Flocculation and dosing chamber used for flocculation/mixing of the polymer and influent sludge. This tank shall be equipped with a sludge inlet, drainage outlet, polymer (flocculant) inlet, an electric agitator, and a mixer. The feed tubes connect the mixing tank with the dewatering drums.
 - 2. Six (6) dewatering drums run by gearmotors equipped with individual rinsing water systems with nozzles. Each dewatering drum shall have individual fixing elements that can be removed separately while other screws are in operation.
 - 3. The filtrate collection tray shall be provided with flanges for filtrate removal. Side walls of the filtrate collection tray are an integral part of the frame base.
 - 4. A self-contained electrical and control panels, including control for ancillary equipment such as feed pumps, polymer feed, and dewatered solids conveyor.
- C. The dewatering system shall integrate all appurtenances necessary for a complete, functional dewatering system operation, including but not limited to the following:
 - 1. Liquid Polymer Blending System
 - 2. Sludge Feed Pumps
 - 3. Flowmeter
 - 4. Dewatered sludge conveyor

1.4 PERFORMANCE TESTING

- A. Performance testing must demonstrate that the performance of the dewatering equipment, under normal operating conditions, can simultaneously achieve:

- B. The screw press system shall have a sludge processing capacity of 2,400 dry pounds per hour, equivalent to 400 dry pounds per hour per dewatering drum. It shall be capable of dewatering anaerobically digested sludge with influent solids concentrations ranging from 3 to 5 percent to a dewatered cake with an average solids concentration of not less than 20–21 percent. The specified capacity and performance shall be achieved at or below the maximum drum rotation speed specified herein
 - 1. Minimum solids capture rate shall be 95% at the rated capacity of the Multi-Disc Screw Press.
 - 2. Stated average performance criteria shall be obtained with a maximum cationic emulsion polymer, with active polymer concentration $\geq 39\%$, dosage of 18-25 lbs of polymer/dry ton.

1.5 QUALITY ASSURANCE

- A. All equipment and components shall be furnished as complete standard type assemblies in accordance with the standards of the industry.
- B. All equipment furnished under this section shall be of a single manufacturer who has been regularly engaged in the design and manufacture of the specified equipment.
- C. To ensure unity of responsibility, the Screw Press, supporting frames, polymer mixing and feeding blend unit, conveyors, and control systems shall be furnished and coordinated by a single supplier. The Contractor shall assume full responsibility for the satisfactory installation and operation of the entire dewatering system package.
- D. The Supplier shall have at least ten (10) full-scale systems utilizing the exact technology at the same scale size proposed for this project operating successfully for at least three (3) years in North America at municipal wastewater treatment plants that were furnished under the manufacturer's own name.
- E. Prior to shipment, the Dewatering Screw Press and control panel shall be factory tested at the place of assembly. Factory test each pre-assembled, pre-wired, Multi-Disc Dewatering Screw Press and its associated control panel to be supplied to the job site. Prior to shipment, verify through a one-hour continuous operating test that the Multi-Disc Dewatering Screw Press and associated equipment operate smoothly, noiselessly, vibration-free, and without overheating of any bearing or motor.
- F. The owner/engineer shall, at their option, be permitted to witness the factory quality control test at the manufacturer's facility. The manufacturer shall give the owner/engineer a minimum of one (1) weeks' notice prior to testing.
- G. The equipment furnished shall be fabricated, assembled, installed, and placed in proper operating condition in full conformity with approved drawings, specifications, engineering data, and/or recommendations furnished by the equipment manufacturer. The equipment manufacturer shall, in addition to the Contractor, assume the responsibility for the proper installation and functioning of the equipment.

- H. In addition to the requirements of these specifications, comply with the manufacturer's instructions and recommendations for work. All equipment shall perform as specified, and accessories shall be provided as required for satisfactory operation.

1.6 SUBMITTALS

- A. Submit manufacturer's technical data and application instructions per Section 013323.
- B. Product Data: Submit manufacturer's technical data and application instructions.
- C. Shop Drawings:
 - 1. Contractor shall submit Shop Drawings for all equipment furnished under this Contract. Shop Drawings shall clearly identify the equipment, materials, and components proposed for incorporation into the Work and shall include quantities, dimensions, orientations, mounting and connection details, layouts, electrical control diagrams, wiring schematics, accessories, and all other information necessary for the Engineer to determine compliance with the Contract Documents.
 - 2. Shop Drawings shall be complete and coordinated and shall be reviewed and approved by the Contractor for completeness and compliance with the Contract Documents prior to submission. Each submittal shall bear evidence of such Contractor review before being transmitted to the Engineer.
- D. Shop Drawings: Submit for review the following:
 - 1. Dimensional drawings depicting all mechanical and electrical equipment dimensions and required overhead clearances.
 - 2. Equipment layout, principal dimensions, with related verifications required for installation, including anchorage location.
 - 3. Details on connectors for solids discharge chutes.
 - 4. Equipment Weigh
 - 5. Electrical control drawings
 - 6. Drive motor data
 - 7. A list of recommended Spare Parts, including any Special Tools required for routine maintenance of the equipment.
 - 8. Certified copies of performance shop test data and reports shall be supplied for approval before shipment from the factory.
- E. Operation and Maintenance (O& M) manuals shall describe the theory of the dewatering system, start-up, optimization, and maintenance operations for the equipment furnished and installed under this Section. The final O & M manuals shall be provided in digital format after equipment starts up in the close-out submittal process. The O & M manuals shall meet the requirements of Sections 013323 and 017823, including the following additional information:

1. As-Built Drawings of the Multi-Disc Screw Press.
2. Electrical diagrams
3. Controls and Accessories
4. Explanation of operating safety considerations
5. Repair Parts and maintenance materials
6. Troubleshooting data
7. Repair data

- F. Warranty: The Equipment Manufacturer shall submit a warranty certificate for review. The date of the warranty begins after commissioning and operational demonstration and will be determined in the field by the Owner's Engineer.

1.7 WARRANTY

- A. The manufacturer shall warrant, in writing, that all equipment supplied by them shall be free from defects in material and workmanship, for a period of twelve (12) months from the date of startup, not to exceed eighteen (18) months from the date of delivery, unless noted otherwise within the specifications.
- B. Any defects found within the warranty period shall be replaced if damaged or defective in the normal use of the equipment at no cost to the Owner.

1.8 DELIVERY, STORAGE, AND HANDLING

- A. Comply with Section 016600, Product Handling and Protection.
- B. Equipment shall be shipped and delivered fully assembled, except where partial disassembly is required in order to conform to transportation regulations or for the protection of components.
- C. Handling, delivery, and storage of the equipment shall be in accordance with the Manufacturer's recommendations. No extra cost shall be charged to the Owner for the handling, delivery, or storage of the equipment.
- D. The Contractor shall be responsible for unloading and shall have equipment on-site at the time of delivery, permitting proper hoisting of the equipment.
- E. Acceptance at Site:
1. Inspect all equipment and materials against the reviewed Shop Drawings at the time of delivery.
 2. Equipment and materials damaged or not meeting the requirements of the reviewed Shop Drawings shall be immediately returned for replacement or repair.

3. The Contractor shall notify the Manufacturer of any damages to equipment within 5 days to effect proper remedial action. Failure to notify the Manufacturer of damage to equipment prior to unloading shall void all warranties pertaining to the subject equipment.

- F. Storage and Protection: Store all equipment and materials in a dry, covered, ventilated location and protect from harm according to the manufacturer's instructions. Carefully prepare for storage and label all equipment and materials after they have been inspected.

1.9 SEQUENCING

- A. Comply with Section 011100, Summary of Work.
- B. The Contractor shall take special note that the City of Wheeling WWTP must remain in operation at all times unless outages are approved by the Owner.

1.10 SPARE PARTS

- A. Furnish the following spare parts:
 1. Spray wash system solenoid valve.
 2. Conveyor motor and VFD
 3. Two (2) conveyor liners
 4. Control Panel spare parts

PART 2 - PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with specified requirements, provide equipment supplied by one of the following manufacturers:
 1. Esmil Group, Multi-Disc Screw Press, Model MDQ-506CS
 2. Or an Engineer approved equal.
- B. The sludge dewatering process, electrical, controls, and structural design have been based on the Esmil Group, Multi-Disc Screw Press, which serves as the Basis of Design. Other named or approved equals may differ in structural configuration, electrical power characteristics, or control systems; however, all proposed equipment shall fully comply with the site-specific constraints identified in the Description of Work, Paragraph 1.2 E.

2.2 EQUIPMENT DESCRIPTION

- A. Design Criteria:
 1. The Screw Press shall be capable of continuous operation without clogging.

2. System shall be designed to operate in the environment for which it is intended, continuously or intermittently on demand, and shall perform the required dewatering operations without spillage of water or sludge beyond the nominal machine envelope.
3. The Screw Press shall be designed to adequately condition and dewater the sludge such that a dewatered sludge cake is produced that easily discharges from the dewatering drum, without binding or plugging.
4. The system shall operate without the need for operator attention other than periodic inspection and chemical replenishment.

B. General

1. The flocculated sludge is fed into the dewatering drum by self-flowing through feeding tubes. Filtrate seeps between the moving and fixed drum disks and drains out into the filtrate tray below the dewatering drum. Next, the filtrate is discharged from the drums through a filtrate discharge pipe and returned to the plant.
2. As the sludge moves through the drum, the water is removed through the gaps between the movable and fixed disks. In the thickening zone, water is removed from the sludge by gravity and the pressure of the screw flights. In the dewatering area, sludge is compressed due to the reduction of the space between the screw flights and the conical shape of the shaft.
3. The final compression of sludge occurs at the end of the dewatering area by an adjustable dam plate mounted on the outlet end of the screw. Through a gap between the plate and the drum end, the dewatered sludge is squeezed out of the drum into a container.

C. The Dewatering Screw Press shall be a complete prefabricated system as described herein and shown on the Drawings, consisting of the following:

1. Flocculation and dosing Chamber:
 - a. Installed on a separate frame.
 - b. Sludge conditioning system consists of a flocculation chamber with a mixer (agitator) with an electric drive motor, which allows efficient mixing of polymer solution with the initial sludge. The mixer is equipped with two adjustable blades to perform the proper flocculation process.
 - c. The flocculation and dosing tank frame is equipped on both sides with eyelets for transportation and holes for anchoring to the concrete base.
 - d. The flocculation and dosing chamber shall be equipped with steps to facilitate operator access to the top of the tank for effective supervision of the flocculation process.
 - e. The flocculation and dosing chamber shall be equipped with a junction box to enable the connection to the main Screw press control panel.

2. Six (6) horizontal dewatering drums with drive-motors, including an individual rinsing water system with nozzles. Each dewatering drum shall have individual fixing elements that can be removed separately while other screws are in operation.
 - a. The dewatering drum consists of a variable flight pitch screw located within a support frame of alternating fixed and moving discs. Fixed discs are equipped with built-in spacers that hold the fixed discs apart and provide a gap for moving discs between them.
 - b. The feed tubes connect the mixing tank with the dewatering drums.
 - c. A spring-loaded dam plate at the end of the drum sets the gap from where the cake exits, providing the back pressure that forces final sludge dewatering.
 - d. Machine frame structure for the dewatering drums includes a filtrate collection tray and outlet flanges. The frame is equipped on both sides with eyelets for transportation and holes for anchoring to the concrete base.
 - e. A self-contained electrical and control panel, including control and monitoring of ancillary equipment such as main equipment: sludge feed pump, polymer preparation and feed equipment, and dewatered sludge cake conveyor for sludge removal equipment, and a flowmeter
- D. Manufacturer shall provide a Flowmeter to control influent sludge flow to the Screw Press, installed as shown on the Drawing. The Flowmeter shall be the electromagnetic type, by Endress Promag W400, or equal. The flowmeter shall have 4-inch flanges, ANSI 150 lbs, and an NEMA 4X enclosure.

2.3 MATERIALS OF CONSTRUCTION

- A. All materials utilized in the construction of the sludge dewatering equipment shall be entirely suitable in every respect for the service required. All metals in contact with polyelectrolyte or sludge, and all other metal components other than those specified in the table below, shall be stainless steel, type 304 or 316, or plastic.
- B. The following table provides the materials and coatings that shall be provided for the Screw Press and related components unless specified otherwise herein:

Equipment	Material
Mixing tank with frame base	Type AISI 304 stainless steel
Rinsing water spray pipes	Type AISI 304 stainless steel, plastic
Technological pipes	Type AISI 304 stainless steel, plastic
Dewatering drum	Type AISI 304 stainless steel
Dewatering drums enclosure and cover	Type AISI 316L stainless steel
Dewatering drum screw	Type AISI 304 stainless steel with FREA-metal blade edge

Gearmotor	Cast iron
Gearmotor coating	Acrylic paint
Spray nozzles	Plastic
Electrical enclosure	Carbon steel with acrylic paint or AISI 304 stainless steel
Electrical wiring housing	Non-metallic flexible liquid-tight conduit and fittings
Valves: wetted sections	Stainless steel or brass, EPDM seating

- C. No carbon steel shall be used for any part of the Screw Press.

2.4 STRUCTURAL COMPONENTS

- A. The structural support frame shall be fabricated of type 304 stainless steel. It shall be a rigid structure, adequately braced to withstand intended loads without excessive vibration or deflection.
- B. The framework shall be of welded and/or bolted construction. The structure shall be designed for installation on a prepared concrete foundation and secured with anchor bolts.

2.5 DEWATERING DRUMS

- A. The dewatering drums shall be constructed of ASTM type 304 Stainless Steel. All circular components shall be laser cut to ensure maximum evenness of wear and operating life. The dewatering drum consists of a screw shaft rotating at a variable speed in the cylindrical body. The body consists of a support structure and a series of alternating fixed and movable disks with gaps between them. In the thickening zone, the gap between the fixed and moving discs is 0.020. In the dewatering zone, the gap decreases from 0.012 to 0.006 inches as the sludge is transported further down the drum. Nominal drum size shall be 20 inches.
- B. Each dewatering drum must have a minimum internal volume of 16 cubic feet. The maximum operational speed of the dewatering drums must not exceed 2.5 rpm at the design loading.
- C. Screw flights side shall be protected by welded hard metal strips “frea-metal” with a thickness of not less than 0.05 inches. Vickers hardness of the metal strips shall be not less than 600 HV.
- D. Screw shaft has a conical shape with a diameter increasing from the initial sludge inlet zone to the cake discharge zone for DS content increase in the dewatered sludge.
- E. Assembly shall be undertaken in such a way that all fixed discs are concentric and parallel. The thickness of both fixed and moving discs shall be no less than 0.114” in the thickening zone and 0.136” in the dewatering zone. Discs shall be evenly spaced within each section of the dewatering drum. Spacers shall be integrated into the fixed discs via threaded connections; the use of separate spacers is not permitted. All discs shall be made

of AISI 304 stainless steel; plastic discs are not allowed. Moving discs shall be replaceable and designed for a service life of no less than 15,000 operating hours.

- F. All fixed discs shall be mounted on a single, rigid support frame forming an integral assembly. Designs utilizing threaded rods, tie rods, or any similar components within the drum for disc support, alignment, or spacing shall not be accepted.
- G. The dewatering drum shall be installed in a horizontal position with two mounting points to the unit frame – at the sludge inlet zone and at the cake discharge zone. Intermediate fixation points along the drum are not allowed. Each drum can be removed separately while the other screws remain in operation.
- H. Cake Dam Plate shall be spring-loaded, self-adjusting, and fabricated from AISI 304.
- I. Each dewatering drum shall be equipped with an individual spray bar. Each spray bar shall consist of a spray pipe fitted with spray nozzles, located above the dewatering drum. The spray pipe and spray nozzle assembly shall be readily removable. Nozzle spacing and spray pattern shall be such that the sprays from adjacent nozzles overlap one another on the dewatering drum surface. The sprays shall operate periodically and shall partly remove solids built up externally on the drum, such that over time no significant buildup of solids occurs on the drum. Each spray bar shall be equipped with a solenoid valve.
 - 1. Nominal rinsing water consumption: 29 gpm
 - 2. Nominal rinsing water pressure: 30-60 psi
 - 3. Typical total consumption: 150 gph for 6 dewatering drums
- J. Each Dewatering Drum shall have a drive motor:
 - 1. The Dewatering Drum drive motor shall be a one-piece gear-motor.
 - 2. Gear-motors shall be hollow shaft design, designed to drive the dewatering drum screws with no additional couplings or joints. Motors shall be filled with grease on assembly and sealed for life. Screw rotational speed shall be obtained through a reduction gear. Input power to the dewatering drum drive shall be supplied through an A.C. variable frequency drive unit.
 - 3. Drive Motor Data:
 - a. Maximum Horsepower: 3 Hp
 - b. Power Requirements: 460 VAC, 3-phase, 60 Hz
 - c. No load motor speed: 1765 RPM, VFD
 - d. Gear Reduction: 435.50:1
 - e. Max output shaft speed: 4.1 RPM @ 60Hz
 - f. Insulation Class: NEMA 4
 - g. Enclosure: TEFC

- h. Enclosure material: Painted Cast Iron

2.6 FLOCCULATION CHAMBER

- A. The Screw Press has a mixing system equipped with an electric agitator with a gearmotor. The agitator has two adjustable blades. Tank dimensions and design shall ensure adequate residence time and mixing conditions to ensure complete flocculation and satisfactory dewatering performance. Tank design shall minimize the possibility of any short-circuiting of flow.
- B. Design and manufacture of the chamber shall ensure no leakage of fluids under normal working conditions.
- C. The flocculation chamber shall be manufactured in type AISI 304 Stainless Steel.
- D. The flocculation chamber shall be equipped with a conductometric level sensor for emergency level and a pressure sensor for flow control.
- E. Each agitator shall have a drive motor:
 - 1. The agitator drive motor shall be a one-piece gearmotor. The gear-motor shall be a hollow shaft type, designed to drive the agitator with no additional couplings or joints. Motor shall be filled with grease on assembly and sealed for life. Screw rotational speed shall be obtained through a hypoid reduction gear. Input power to the agitator drives shall be supplied through an AC variable frequency drive unit.
 - 2. Agitator gearmotor data:
 - a. Maximum Horsepower: 4 Hp
 - b. Power Requirements: 460 VAC, 3-phase, 60 Hz
 - c. No load motor speed: 1760 RPM, VFD
 - d. Gear Reduction: 95.56:1
 - e. Output shaft speed: 18 RPM @ 60Hz
 - f. Insulation Class: F
 - g. Enclosure: TEFC
 - h. Enclosure material: Painted Cast Iron

2.7 CONTROLS

- A. The Screw Press shall have an integrated electrical control system that shall allow for safe, simple, and automated operation of the unit. The electrical control system shall have statuses for the unit in operation and unit alarms to an external plant SCADA system.

External SCADA system connections shall be via fiber and allow monitoring of status and alarms for all system components available at the local control system, at a minimum.

B. Control Panel Features:

1. Refer to Section 330900 PLC and HMI Control system for panel requirements.
2. Variable frequency drives (VFD) shall be provided for the dewatering drums, agitator gearmotors, and conveyor.
3. The control panel shall be capable of receiving and processing all input signals and output signals to and from the equipment.
4. Control Panel shall be capable of receiving and processing all input and output signals “To” & “From” the equipment specified in this Section
 - a. The table below includes, but is not limited to, a summary of additional I/O points to be directly monitored or controlled by the Multi-Disc Screw Press:

Signal Description	Signal Type	I/O Type
External Sludge Pump #1 - Start/Stop Command	Control	N/O Output
External Sludge Pump #1 - Running Feedback	Status	DI
External Sludge Pump #1 - Fault Feedback	Status	DI
External Sludge Pump #1 - In Remote Feedback	Status	DI
External Sludge Pump #1 - VFD speed Command	Control	AO
External Sludge Pump #2 - Start/Stop Command	Control	N/O Output
External Sludge Pump #2 - Running Feedback	Status	DI
External Sludge Pump #2 - Fault Feedback	Status	DI
External Sludge Pump #2 - In Remote Feedback	Status	DI
External Sludge Pump #2 - VFD speed Command	Control	AO
External Polymer Blending Skid #1 - Start/Stop Command	Control	N/O Output
External Polymer Blending Skid #1 - Running Feedback	Status	DI
External Polymer Blending Skid #1 - Common Alarm	Status	DI
External Polymer Blending Skid #1 - In Remote Feedback	Status	DI
External Polymer Blending Skid #1 - Speed Command	Control	AO
External Polymer Blending Skid #2 - Start/Stop Command	Control	N/O Output
External Polymer Blending Skid #2 - Running Feedback	Status	DI
External Polymer Blending Skid #2 - Common Alarm	Status	DI
External Polymer Blending Skid #2 - In Remote Feedback	Status	DI
External Polymer Blending Skid #2 - Speed Command	Control	AO
Screw Press System Alarm & Data to Plant SCADA System	Status	Fiber

Inlet Sludge Flow Meter	Control	AI

5. A programmable logic controller (PLC) shall control all timing and switching functions.
6. The contractor shall furnish, install, and commission a vendor Main Control Panel (VCP) that includes the PLC, HMI, and VFDs / motor starters as outlined. Refer to Section 330900 PLC and HMI Control system for panel requirements. The panel shall include, but not be limited to: VFDs / motor starters as outlined, power supply, main 3-phase disconnect, C/W front door handle, breakers, fuses, line reactors, terminals, etc. Provide adequate panel heating/cooling to meet the panel interior components' environmental requirements. All VFDs shall communicate with the Remote PLC Panel via Ethernet. Each VFD shall have a front door-mounted HIM module. Each motor (VFD/Motor Starters) shall have a front door-mounted HOA with a green run indicator light and a red fault indicator. VFD manufacturer shall be A-B PowerFlex or an approved equivalent.
7. The contractor shall furnish, install, and commission a separate vendor local control panel (VLCP) panel with HMI mounted on the skid for operator control. Refer to Section 330900 PLC and HMI Control system for panel requirements.
8. It is preferred that the operator can run the Screw Press in manual mode in the event the PLC fails. If this is not possible, inform Verdantas during the quote submission.

C. External Enclosure Features:

1. The external door of the control panel shall have the following switches and indicators:
 - a. Main disconnect switch.
 - b. An emergency stop button which shall be a mushroom head style pushbutton that, when depressed, shall immediately de-energize all moving equipment in the system.
2. Refer to Section 330900 PLC and HMI Control system for panel requirements.
3. An H-O-A system switch to switch the system from HAND (Manual) to OFF to AUTO modes. In HAND mode, the HMI shall include manual (local) control of all motors controlled by the Press Control System.

2.8 PROGRAMMABLE LOGIC CONTROLLER (PLC)

- A. Refer to Section 330900 PLC and HMI Control system for PLC requirements.
- B. The Screw Press shall be provided with a PLC, installed, wired, and programmed to perform the listed functions. The PLC shall be a standard unit with no specialist hardware or firmware modifications. Full application software will be generated by the Screw Press

manufacturer to operate the dewatering system using the PLC manufacturer's proprietary software package.

1. Operational Control
 - a. Control of all components of the dewatering system, including the ability to set times, operation, and operating speeds or capacities for the sludge dewatering press feed pump, discharge sludge cake conveyors, dewatering drums, mixers, polymer blending and feed system, and wash-down sprays.
2. System Tuning:
 - a. PLC shall allow suitably qualified operators to adjust operating parameters such as delay timers for fault alarms and system calibration constants.
3. Monitoring Operation:
 - a. PLC shall allow the operator to inspect the operation of all the components, including indicators such as output speed or capacity, elapsed operating times, and any faults present.
 - b. Operators shall be able to view approximated readouts of all operational speeds and flow rates relevant to the operation of the system.
4. Manual Operation of Components:
 - a. Operators shall be able to operate each item of equipment manually from the PLC/HMI interface for inspection and maintenance reasons.
5. Time Clocks:
 - a. Operator shall be able to set the unit to operate at a specific time or on specific days with no operators present.
6. The PLC shall include an Ethernet port for communications and for importing and exporting all dewatering system equipment data from/to the plant SCADA system over Fiber.
7. The PLC shall be capable of monitoring, recording, and outputting all input and output status parameters noted herein to the HMI and the plant SCADA system.
8. The PLC shall be capable of monitoring, recording, and outputting all alarm conditions to the plant SCADA system.

2.9 FUNCTIONAL DESCRIPTION

A. The control panel shall undertake the following operations:

1. Auto-Manual Operation: The Screw Press system shall be able to be set to either AUTO, MANUAL, or OFF on the control panel.
 - a. When set to manual, all items must be switched ON and OFF at the control panel by the switches on the HMI unit.

- b. When set to OFF, no items shall work whether switched ON or OFF, either at the control panel or anywhere else.
- c. When set to AUTO, all items of equipment shall be turned ON into work as per the following descriptions:
 - 1) Under this mode of operation, the Screw Press will run constantly and will shut itself down in the event of any malfunctions detected by the control system. The Screw Press should always be run in automatic mode.
 - 2) Turn automatic mode on by switching the three-position selector switch H-O-A to the automatic position and pressing the automatic mode button on the touch panel.
 - 3) A mixer drive in the flocculation chamber switches “ON” in automatic mode.
 - 4) The screws’ drives are switched on when the preset sludge level in the flocculation chamber is reached.
 - 5) Also, after the screws’ drives are switched on and subsequently operated in the automatic mode, rinsing valves will be activated periodically, according to the predefined stop and start intervals. If there is more than one valve, only one valve opens at a time to reduce the instantaneous water requirement.
- d. Additionally, to “AUTO” mode operation activated by the personal, there must be automatic, auto mode activation scenarios:
 - 1) AUTO mode: sludge level control.
 - 2) AUTO mode: flow control.
 - 3) AUTO mode: conveyor
 - 4) AUTO mode: Polymer
- e. Influent sludge feed pump and polymer feeder switch ON after the predetermined delay time, counting from the moment of turning automatic mode on.

B. The control panel shall provide signals to allow for all input and output parameters and alarms to be taken directly from the Screw Press control panel to the plant SCADA system. Provide a list of addresses for all parameters and alarms. The Plant SCADA system will not monitor the system parameters as a part of this scope, but shall provide the capability for future use.

2.10 ELECTRICAL HARDWARE

- A. Power wiring shall be 460VAC, type SIS insulation, stranded copper, and shall be sized for the required load, 12AWG minimum.
- B. Control wiring shall be 24VDC, type SIS insulation, stranded copper, and shall be sized for the required load, 18AWG minimum.
- C. Main three-pole switch disconnecter Allen Bradley or equal. Circuit breakers shall be LOVATO or equal.
- D. Motor starters shall be full voltage, non-reversing, IEC style across-the-line units. Coils shall be 24VDC. Schneider Electric type or equivalent.
- E. Selector switches shall be heavy-duty, corrosion-resistant units rated for NEMA 4X service. Contact blocks shall be rated for 10A continuous service. Selector switches shall be Harmony XB4 series Schneider Electric or equal.
- F. Pilot lights shall be heavy-duty, corrosion-resistant units rated for NEMA 4X service. Units shall be 24VDC full voltage incandescent type. Pilot lights shall be Harmony XB7 series Schneider Electric or equal.
- G. Terminal blocks shall be high-density, solderless box lug style, with a 600-volt rating. Terminal blocks shall be Wago, Wieland type, or equal.
- H. Control relays shall be general-purpose type with a 6A contact rating, miniature square base, and an internal on status pilot light. Relays shall be Schneider Electric Type RXM4 Series or equal.
- I. Programmable Logic Controller (PLC) shall be Allen-Bradley.
- J. Variable Frequency Drives (VFD) shall be UL-listed and shall be manufactured by Allen-Bradley.

PART 3 - EXECUTION

3.1 INSTALLATION (FUTURE CONTRACT)

- A. Equipment shall be installed in accordance with the Manufacturer's recommendations to provide a complete installation.
- B. All lubrication required for initial operation shall be furnished and applied in accordance with the Manufacturer's recommendations.
- C. It is the intent of this Contract that the final installation shall be complete in all respects, and the Contractor shall be responsible for minor details and any necessary special construction not specifically included in the drawings or specifications.

- D. Equipment shall be installed in strict conformance with the manufacturer's installation instructions, as submitted with Shop Drawings, Operation and Maintenance Manuals, and/or any pre-installation checklists.
- E. Anchor bolts size shall be per the manufacturer's recommendation. Anchors, anchor bolts, nuts, and washers shall be 316 stainless steel and furnished for each item of equipment by the Contractor.
 - 1. Anchor bolt template drawings shall be included in the submittal to permit verification of the location of structural elements, new or existing, in the concrete.
 - 2. Equipment manufacturers shall specify the ample size and strength required to securely anchor each item of equipment. Anchor bolt template drawings shall be included in the submittal to permit verification of the location of structural elements, new or existing, in the concrete.
 - 3. Equipment shall be placed on the foundations, leveled, shimmed, bolted down, and grouted with a non-shrinking grout.

3.2 ELECTRICAL CONNECTIONS AND CONTROLS (FUTURE CONTRACT)

- A. Wiring and conduits for electrical power, control, and instrumentation will be provided as shown in the Drawings and under Division 26 – Electrical.

3.3 TESTING (FUTURE CONTRACT)

- A. After completion of the installation, the equipment shall be tested by the Contractor in the presence of the Engineer under actual operating conditions. The test shall be conducted under the supervision of the manufacturer's technical representative and shall demonstrate that the equipment is fully operational by picking up and depositing materials into the specified containment.
- B. Field certification shall include inspection of the following:
 - 1. Verify equipment is properly aligned and anchored per the installation instructions and drawings. Assure all piping and valves are installed and properly connected, and the dewatering equipment is unobstructed with required clearances maintained.
 - 2. Assure controls and instrumentation work in all modes.
 - 3. Check equipment for proper operation as well as completion of the Start-Up requirements in the installation guide.
- C. Performance Testing.

3.4 EQUIPMENT MANUFACTURER'S SERVICE REPRESENTATIVE (FUTURE CONTRACT)

- A. After completion of the installation, the equipment shall be tested by the Contractor in the presence of the Engineer under actual operating conditions. The test shall be conducted under the supervision of the manufacturer's technical representative.
- B. The equipment system supplier shall furnish the services at the site of a factory-trained representative for a period of three (3) to eight (8) working hours to the job site. Service shall be provided after the Contractor has installed the equipment. These services shall be furnished for:
 - 1. The equipment manufacturer's inspection of the equipment following installation by others, and to certify that the equipment has been properly installed and is ready to operate.
 - 2. Conduct the equipment Performance Testing.
 - 3. To train the Owner's personnel in the operation and maintenance of the equipment, and to observe and supervise the initial operation of the equipment.
- C. If additional service is required due to the mechanisms not being fully operational, at the time of service requested by the contractor, the additional service days will be at the contractor's expense.
- D. After inspection of the installed equipment, the Supplier shall furnish a written report certifying that the equipment has been properly installed and lubricated, is in accurate alignment, is free from any undue stress imposed by connecting piping or anchorage, has been operated under full load conditions, and that it operates satisfactorily.

3.5 DEMONSTRATION AND INSTRUCTIONS (FUTURE CONTRACT)

- A. Provide the services of a qualified factory-trained manufacturer's representative to conduct training covering operation, mechanical maintenance, electrical requirements, troubleshooting, etc.

3.6 OPERATION AND MAINTENANCE MANUALS

- A. Prior to or with the delivery of equipment, the manufacturer shall provide copies of an operation and maintenance manual, including storage, installation, start-up, operating, and maintenance instructions, and a complete parts list and recommended spare parts list. The O & M manuals shall be in compliance with the General Requirements.
- B. Provide a complete P&ID in an 11 x 17 PFD of the system.

END OF SECTION 467331

SECTION 6
STANDARD SPECIFICATIONS

STANDARD SPECIFICATIONS

The 2017 Edition of the West Virginia Department of Transportation, Division of Highways (WV DOH) standard specifications shall govern this improvement, except where noted.

SECTION 7
SPECIFIC PROJECT REQUIREMENTS

SPECIFIC PROJECT REQUIREMENTS

1 - CONTACT DURING BIDDING

- 1.1 All questions during bidding should be addressed to Lucas Skelly, Staff Engineer II at Verdantas LLC, 2001 Main St., Suite 202, Wheeling, WV 26003, lskelly@verdantas.com.

2 - INSURANCE

- 2.1 Section SC-5.04(D) of the Supplementary Conditions shall be deleted and no "all risk builders risk" or "installation floater" insurance need be purchased by the Contractor.
- 2.2 See the following Bid Set Sections for Insurance Requirements:
- A. Section 1, Instructions to Bidders, Part 10 Insurance
 - B. Section 3, General Conditions, Article 5 Bonds and Insurance (EJCDC) or Article 11 Insurance and Bonds (AIA), whichever is used in the Bid Set
 - C. Section 4, Supplemental Conditions

3 - WORKING HOURS

- 3.1 No work shall be performed between the hours of 7:30 p.m. and 7:30 a.m. nor on Saturday, Sunday, or legal Holidays, without written permission of the Owner.

4 - PROJECT COMPLETION

- 4.1 All work including restoration and clean-up shall be completed no later than the contract completion date. Failure to complete all work within the allotted time will result in assessment of liquidated damages. Upon completion of all work and written notification of same by the Contractor, the Engineer and Owner will compile a punch list. The punch list will be sent to the Contractor. All punch list work shall be completed to the satisfaction of the Engineer and the Owner within 14 days after receipt of the punch list. Failure to complete the punch list work within the allotted time will result in assessment of liquidated damages.

5 - TAXES

- 5.1 This project is sales-tax exempt, but there is a 2% B&O tax.
- 5.2 This project shall be Class Code 6611-6630. Refer to Business & Occupation Tax Return Form.
- 5.3 The Contractor shall pay the City Service Fee. Refer to City Service Fee Overview sheet.
- 5.4 Tax releases from both City and State must be received before the release of the final payment will be made.

6 - BUILDING & SITE ACCESS

- 6.1 Access to the building & site for field investigation of existing conditions must be scheduled in advance with the Owner by contacting Mr. Mike Chiazza, WPCD Superintendent, who can be reached at (304) 234-3874.

END OF SECTION

CITY OF WHEELING 1500 Chapline Street Room 115, Wheeling WV 26003-3553 / Phone (304) 234-3653
(QUARTERLY / ANNUAL) BUSINESS & OCCUPATION TAX RETURN

(QUARTERLY / ANNUAL) BUSINESS & OCCUPATION TAX RETURN

- THE TAXPAYER LISTED BELOW IS REQUIRED TO FILE (even if no income is received during this tax period) AND TO PAY BUSINESS & OCCUPATION (B&O) TAXES DUE. TAXES ARE DUE WITHIN (30) DAYS AFTER TAX PERIOD ENDS.
- BUSINESS CLASSIFICATIONS AND TAX RATES ARE LISTED ON THE BACK SIDE OF THIS FORM FOR YOUR INFORMATION.
- PENALTY: TO BE CALCULATED AT 5% FOR THE 1ST MONTH PAST DUE OR FRACTION THEREOF, AND AN ADDITIONAL 1% FOR EACH SUCCEEDING MONTH OR FRACTION THEREOF.
- COMPLETE (PART 1) OF THE B&O TAX RETURN FORM FOR YOUR RECORDS.
- COMPLETE (PART 2) OF THE B&O TAX RETURN FORM, SIGN AND RETURN WITH YOUR PAYMENT.
- IF REPORTING UNDER "CONTRACTOR" and/or "RENTAL" - COMPLETE FORM ON REVERSE SIDE OF (PART 2).
- IF REPORTING TAX CREDIT - COMPLETE FORM ON REVERSE SIDE

MESSAGE:

CITY OF WHEELING BUSINESS & OCCUPATION TAX RETURN
1500 Chapline St Room 115, Wheeling WV 26003-3553 / Phone (304) 234-3653

1500 Chapline St Room 115, Wheeling WV 26003-3553 / Phone (304) 234-3653

(QTR YEAR)

DATE BUSINESS BEGAN IN CITY: _____
DATE BUSINESS QUIT IN CITY: _____
IF BUSINESS SOLD, DATE OF SALE: _____
FURNISH NAME & ADDRESS OF NEW OWNER: _____

CLASS CODE	BUSINESS CLASSIFICATION	TAXABLE AMOUNT	RATE PER \$100	TAX DUE
		NET TAX DUE		
		TAX CREDITS (LIST ON BACK)	-	
		PENALTY ADD PENALTY OF 5% FOR FIRST MONTH OR FRACTION THEREOF AND 1% FOR EACH SUCCEEDING MONTH OR FRACTION THEREOF.	+	
		PAST DUE BALANCE	+	
		TOTAL AMOUNT DUE		
		TOTAL AMOUNT ENCLOSED		

(PART 1) COMPLETE AND RETAIN UPPER PORTION FOR YOUR RECORDS.

(PART 2) **1** COMPLETE LOWER PORTION, SIGN AND RETURN WITH PAYMENT MADE PAYABLE TO "CITY OF WHEELING"

CITY OF WHEELING BUSINESS & OCCUPATION TAX RETURN
1500 Chapline St Room 115, Wheeling WV 26003-3553
Phone (304) 234-3653

1500 Chapline St Room 115, Wheeling WV 26003-3553
Phone (304) 234-3653

DATE BUSINESS BEGAN IN CITY: _____
DATE BUSINESS QUIT IN CITY: _____
IF BUSINESS SOLD, DATE OF SALE: _____
FURNISH NAME & ADDRESS OF NEW OWNER: _____

[illegible]

AUTHORIZED SIGNATURE

DATE _____

CLASS CODE	BUSINESS CLASSIFICATIONS	RATE PER \$100
1000	OTHER NATURAL RESOURCE PRODUCTS	1.00
2111-3999	MANUFACTURED PRODUCTS	.28
5212-5999	RETAILERS AND OTHERS	.365
5111-5199	WHOLESALERS	.15
*6611-6630	CONTRACTING BUSINESS * (List Specific Project/s in excess of \$5,000 Separately)	2.00
*6147-6151	RENTAL/LEASE INCOME PROPERTY FOR HIRE * (List all Rental Property Owned within City Limits)	.73
6211-6599	SERVICES AND ALL OTHER BUSINESS	.88
6111-6152	BANKING AND OTHER FINANCIAL INSTITUTIONS	.94
6600	SHARED SERVICES	.15

EXEMPTION TYPE	AMOUNT	EXEMPTION TYPE	AMOUNT

*IF REPORTING INCOME UNDER CLASS 6611-6630 (CONTRACTING BUSINESS) IT IS NECESSARY FOR YOU TO SEPARATELY LIST SPECIFIC PROJECT(S) IN EXCESS OF \$5000

PROJECT NAME (ADDRESS OR JOB SITE)

Completion date, if complete

Gross Amount

1) _____

\$ _____

2) _____

\$ _____

3) TOTAL OF ALL OTHER GROSS CONTRACTING INCOME RECEIVED (FOR JOBS LESS THAN \$5000)

\$ _____

TOTAL REVENUE THIS QUARTER FOR "CONTRACTING BUSINESS"

\$ _____

(CARRY TOTAL AMOUNT RECEIVED TO FRONT OF FORM UNDER "TAXABLE AMOUNT" COLUMN-CLASS 6611-6630)

*IF REPORTING INCOME UNDER CLASS 6151 "RENTAL BUSINESS" IT IS NECESSARY FOR YOU TO UPDATE AND LIST ALL RENTAL PROPERTY YOU OWN WITHIN THE CITY LIMITS OF WHEELING (USE SEPARATE SHEET IF NECESSARY)

PROPERTY ADDRESS

OF UNITS

(Circle One)

GROSS RENT COLLECTED

1) _____

Commercial (or) Residential

\$) _____

2) _____

Commercial (or) Residential

\$) _____

3) _____

Commercial (or) Residential

\$) _____

4) _____

Commercial (or) Residential

\$) _____



CITY SERVICE FEE OVERVIEW

The City of Wheeling imposes a two dollar (\$2.00) per week City Service Fee ("CSF") upon all full-time employees, part-time employees, and self-employed individuals who regularly report to work at a physical location or work from home within the City of Wheeling. Employers are required to withhold \$2.00 per week from each employee's pay. Withheld fees are remitted quarterly to the City Finance Department. Self-employed individuals are responsible for remitting their own fees. CSF payments not received within one month following the end of the calendar quarter will be subject to penalties.

If you work multiple jobs in Wheeling, and the fee is being deducted by more than one employer, complete a *Prior Payment Form* (CSF-1). Fill out areas one (1) and two (2) and sign area three (3). Your primary employer must sign area four (4). Once the form is completed, it should then be given to your secondary employer(s) and retained by them. ***THE PRIOR PAYMENT FORM SHOULD NOT BE SENT TO THE CITY FINANCE DEPARTMENT.***

If the fee is withheld from your pay in error, complete a *Refund Claim Form* (CSF-4), attach a copy of your pay stub or other employer-provided documentation showing the fee was deducted in error, and return the form to the City Finance Department. This form must be received within thirty (30) days following the receipt of payment from your employer.

Businesses exempt from Wheeling Business & Occupation Tax, but that maintain offices / locations in Wheeling, are required to withhold the fee from employees.