

ESI

ENGINEERING STRATEGIES, INC.

Consulting Engineers
Marietta, Georgia

CONTRACT DOCUMENTS
FOR

Henry County Water Authority

Indian Creek WRF Expansion to 3 MGD

August 2016

Prepared by:

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APPENDIX A	AS-SOLD PROPOSAL FOR HENRY COUNTY WATER AUTHORITY, MBR PRESELECTION REQUEST FOR PROPOSALS, INDIAN CREEK WATER RECLAMATION FACILITY, LOCUST GROVE, GEORGIA
APPENDIX B	GE WATER & PROCESS TECHNOLOGIES, ZENON MEMBRANE SOLUTIONS, GENERAL CONTRACTOR INSTALLATION INFORMATION PACKAGE



SECTION 00020
ADVERTISEMENT FOR BIDS

**INDIAN CREEK WRF
EXPANSION TO 3 MGD**

for

**HENRY COUNTY WATER AUTHORITY
HENRY COUNTY, GEORGIA**

Separate, sealed bids for furnishing all materials, labor, tools, equipment, and incidentals necessary for construction of the **Indian Creek WRF Expansion to 3 MGD** project will be received by **Henry County Water Authority**, herein referred to as "Owner", at the **Henry County Water Authority Engineering Building** located at **100 Westridge Industrial Boulevard, McDonough, GA 30253**, until **11:00 AM** (local time) on **October 4, 2016**. The project name must be shown on the outside of the bid envelope. **No bids will be accepted after the 11:00 AM deadline.**

Bids will be publicly opened and read aloud at 11:00 AM (local time) on the **Bid Date**, in the **Engineering Conference Room**.

A mandatory pre-bid conference will be held at the Indian Creek Water Reclamation Facility, 1601 Lester Mill Road, Locust Grove, GA 30248, at 10:00 AM on September 13, 2016. Attendance at the pre-bid meeting is mandatory and any bid from a bidder not attending the conference may be rejected at the sole discretion of the Owner.

This project involves increasing the capacity of the Indian Creek Water Reclamation Facility (WRF) from 1.5 MGD to 3 MGD and converting the mechanical treatment process from a contact-stabilization treatment process to a membrane biological reactor (MBR) treatment process. In general, the project will consist of the following major work items:

1. Upgrade existing Influent Pump Station
2. New influent metering flume
3. New influent screening structure and equipment
4. Upgrade to existing headworks
5. New MBR treatment process
6. New ultraviolet disinfection system
7. New plant water system
8. New cascade aeration system
9. New effluent outfall line
10. Upgrade existing aerobic digesters
11. Upgrade existing solids handling facilities
12. Upgrade existing chlorine building
13. New administration building
14. Miscellaneous site work

All qualified contractors are invited to bid on this project; however, the Owner will adjudge qualification based on the "Bidder's Statement of Qualifications" submitted with the bid. Bidders are required to have a State of Georgia Utility Contractor License.

Bidding Documents are available for viewing at the Issuing Office of **Engineering Strategies, Inc. (ESI)**, **3855 Shallowford Road, Suite 525, Marietta, Georgia 30062** and at the Henry County Water Authority Engineering Building. Bid Documents may be purchased for a non-refundable fee of \$300.00, payable to Engineering Strategies, Inc. To purchase a set of bid documents or to obtain a Plan Holders List, call (770) 429-0001.

Bids will only be accepted from Bidders who are listed on the Plan Holders List, signifying that they have purchased a set of documents from Engineering Strategies, Inc.



Each bid must be submitted on the bid form in the contract documents, in accordance with the Instructions to Bidders. No interlineations, additions or deletions shall be made in the bid form by the Bidder. Each bid must be accompanied by a Bid Bond with good and sufficient surety or sureties approved by the Owner for faithful acceptance of the contract, payable to, in favor of, and for the protection of the Owner in an amount equivalent to five percent (5%) of the total amount payable by the terms of the contract. Each Bid must also be accompanied by a notarized non-collusion affidavit for the Bidder. Out-of-state corporations and other entities must submit evidence of authority to conduct business in Georgia as an out-of-state entity.

The Owner will in no way be liable for any costs incurred by any Bidder in the preparation of its Bid in response to this Advertisement for Bid.

The successful Bidder will be required to furnish performance and payment bonds with the executed Agreement meeting the requirements of the Contract Documents and executed on the forms attached to the Agreement. The successful Bidder will also be required to furnish an oath pursuant to O.C.G.A. §36-91-21 from every person who procures the Agreement. The terms and time for payment are set forth in the Agreement.

All Bids will remain subject to acceptance for sixty (60) days after the day of the Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date.

The Owner reserves the right to reject all Bids, to waive informalities and re-advertise.

Sincerely,
Henry County Water Authority

** END OF SECTION **



SECTION 00100
INSTRUCTIONS TO BIDDERS

1. Defined Terms

Terms used in these Instructions to Bidders which are defined in the Standard General Conditions of the Construction Contract have the meanings assigned to them in the General Conditions.

Certain additional terms used in these Instructions to Bidders have the meanings indicated below which are applicable to both the singular and plural thereof.

- 1.1. Bidder – one who submits a Bid directly to Owner as distinct from a sub-bidder, who submits a bid to a Bidder.
- 1.2. Issuing Office – the office named in the Advertisement for Bid from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.
- 1.3. Successful Bidder – the lowest, responsible and responsive Bidder to whom Owner (on the basis of Owner's evaluation as hereinafter provided) makes an award.
- 1.4. Owner – Henry County Water Authority (HCWA), party of the first part to the Contract Agreement, or its authorized and legal representatives.
- 1.5. Engineer – the individual or entity named as such in the Advertisement for Bids and Agreement.
- 1.6. Contractor – the party of the second part to the Contract Agreement or the authorized and legal representative of such party.
- 1.7. Work and Project – shall mean the entire complete construction required to be furnished under the Contract Documents.
- 1.8. Products – shall mean materials or equipment permanently incorporated into the Project.
- 1.9. Provide – shall mean to furnish and install.

2. Copies of Bidding Documents

- 2.1. Complete sets of the Bidding Documents may be obtained from the Issuing Office. Bidding Documents are open for inspection to prospective bidders at the Issuing Office and at the Henry County Water Authority Engineering Building for the purpose of review in order to determine if the prospective bidders wish to obtain Bidding Documents.
- 2.2. Complete sets of Bidding Documents must be used in preparing Bids; neither Owner nor Engineer assume any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents, whether obtained from the Owner, Engineer, Issuing Office, or other sources.

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

3. Qualifications of Bidders

- 3.1. Owner reserves the right to reject any Bidder who does not satisfy the Owner as to its ability to successfully perform the Work.



- 3.2. Previous pre-qualification notwithstanding, the Owner reserves the right to require submittal of Contractor's updated financial data, work load, key personnel, etc., and to reject any Bidder who fails to satisfy the Owner as to its ability to successfully perform the Work.
- 3.3. The Bidder will be required to provide evidence of compliance with the requirements of O.C.G.A. 43-14 and O.C.G.A. 43-41 (Construction Industry Licensing Board Acts and Rules and Regulations) with respect to the requirements of the code.
- 3.4. The Owner may make such investigations as it deems necessary to determine the ability of the Bidder to perform the work and the Bidder shall furnish to the Owner all such information and data for this purpose as the Owner may request, including information on subcontractors that are intended to perform work on the project. By submission of his bid the Bidder acknowledges the right of the Owner to make such investigations, to contact references and utilize this information as a basis of determining award of the contract. The Owner reserves the right to reject any Bid if the evidence submitted by, or investigation of, such Bidder fails to satisfy the Owner that such Bidder is properly qualified to carry out the obligations of the contract and to complete the work contemplated therein.

4. Examination of Contract Documents and Site

- 4.1. It is the responsibility of each Bidder before submitting a Bid to:
 - 4.1.1. Examine thoroughly the Contract Documents and other related data identified in the Bidding Documents (including "technical data" referred to below);
 - 4.1.2. Visit the site to become familiar with and satisfy Bidder as to the general, local and site conditions that may affect cost, progress, performance or furnishing of the Work;
 - 4.1.3. Consider federal, state and local Laws and Regulations that may affect cost, progress, performance or furnishing of the Work;
 - 4.1.4. Study and carefully correlate Bidder's knowledge and observations with the Contract Documents and such other related data; and
 - 4.1.5. Promptly notify Engineer of all conflicts, errors, ambiguities or discrepancies which Bidder has discovered in or between the Contract Documents and such other related documents.
- 4.2. Reference is made to the Supplementary Conditions for identification of:
 - 4.2.1. Those reports of explorations and tests of subsurface conditions at or contiguous to the site which have been utilized by Engineer in preparation of the Contract Documents. Bidder may rely upon the general accuracy of the "technical data" contained in such reports but not upon other data, interpretations, opinions or information contained in such reports or otherwise relating to the subsurface conditions at the site, nor upon the completeness thereof for the purposes of bidding or construction.
 - 4.2.2. Those drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the site that have been utilized by Engineer in preparation of the Contract Documents. Bidder may rely upon the general accuracy of the "technical data" contained in such drawings but not upon other data, interpretations, opinions or information shown or indicated in such drawings or otherwise relating to such



structures, nor upon the completeness thereof for the purposes of bidding or construction.

- 4.2.3. Copies of such reports and drawings will be made available for review to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.02 of the General Conditions has been identified and established in Paragraph SC-4.02 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion drawn from any "technical data" or any such data, interpretations, opinions or information.
- 4.3. Information and data shown or indicated in the Contract Documents with respect to existing Underground Facilities at or contiguous to the site is based upon information and data furnished to Owner and Engineer by owners of such Underground Facilities or others, and Owner and Engineer do not assume responsibility for the accuracy or completeness thereof unless it is expressly provided otherwise in the Supplementary Conditions.
- 4.4. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to subsurface conditions, other physical conditions and Underground Facilities, and possible changes in the Contract Documents due to differing or unanticipated conditions appear in Paragraphs 4.02 and 4.03 of the General Conditions.
- 4.5. Before submitting a Bid each Bidder will be responsible to obtain such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise, which may affect cost, progress, performance or furnishing of the Work or which relate to any aspect of the means, methods, techniques, sequences or procedures of construction to be employed by Bidder and safety precautions and programs incident thereto or which Bidder deems necessary to determine its Bid for performing and furnishing the Work in accordance with the time, price and other terms and conditions of the Contract Documents.
- 4.6. On request, Owner will provide each Bidder access to the site to conduct such examinations, investigations, explorations, tests and studies as each Bidder deems necessary for submission of a Bid. Bidder must fill all drilled or augured holes with a neat cement grout and clean up and restore the site to its former conditions upon completion of such explorations, investigations, tests and studies.
- 4.7. Reference is made to the Supplementary Conditions for the identification of the general nature of any work that is to be performed at the site by Owner or others (such as utilities and other prime contractors) that relates to the work for which a Bid is to be submitted. On request, Owner will provide to each Bidder for examination access to or copies of Contract Documents (other than portions thereof related to price) for such work.
- 4.8. The submission of a Bid will constitute an incontrovertible representation by Bidder that Bidder has complied with every requirement of this Article 4, that without exception the Bid is premised upon performing and furnishing the Work required by the Contract Documents and applying the specific means, methods, techniques, sequences or procedures of construction (if any) that may be shown or indicated or expressly required by the Contract Documents, that Bidder has given Engineer written notice of all conflicts, errors, ambiguities and discrepancies that Bidder has discovered in the Contract Documents and the written resolutions thereof by Engineer is acceptable to Bidder, and that the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work.



The provisions of ITB-4.1 through 4.8, inclusive, do not apply to Asbestos, Polychlorinated biphenyls (PCBs), Petroleum, Hazardous Waste or Radioactive Material covered by Paragraph 4.06 of the General Conditions.

5. Availability of Lands for Work, etc.

The lands upon which the Work is to be performed, rights-of-way and easements for access thereto and other lands designated for use by Contractor in performing the Work are identified in the Contract Documents. All additional lands and access thereto required for temporary construction facilities, construction equipment or storage of materials and equipment to be incorporated in the Work are to be obtained and paid for by Contractor.

6. Interpretations and Addenda

- 6.1. All questions about the meaning or intent of the Bidding Documents are to be directed to the Engineer. Every request for such interpretation and all questions must be made in writing and addressed to:

W. Scott Hennessey, P.E.
Engineering Strategies, Inc.
3855 Shallowford Rd., Suite 525
Marietta, GA 30062.

In lieu of mail, questions may be made by e-mail to shennessey@esi-ga.com.

Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addendum mailed or delivered to all parties recorded by Issuing Office as having received the Bidding Documents. Questions received less than nine days prior to the date for opening of Bids may not be answered. Only questions answered by formal written Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

- 6.2. Addenda may also be issued to modify the Bidding Documents as deemed advisable by Owner or Engineer.
- 6.3. Failure of any Bidder to receive any such addendum or interpretations shall not relieve such bidder from any obligation under his Bid as submitted.
- 6.4. Failure of any Bidder to acknowledge any such addendum or interpretations shall not relieve such Bidder from any obligation under his Bid as submitted, if Bidder has knowledge of any such addendum, or interpretations. If Bidder has knowledge of any such addendum or interpretation but fails to acknowledge, this will be considered an informality.

7. Bid Security

- 7.1. Each Bid must be accompanied by a Bid Bond (on the form attached) with good and sufficient surety or sureties approved by the Owner and meeting the requirements of Paragraph 5.01 of the General Conditions, for faithful acceptance of the contract, payable to, in favor of, and for the protection of the Owner in an amount equivalent to five percent (5%) of the total amount payable by the terms of the contract.
- 7.2. The Bid Security of the Successful Bidder will be retained until such Bidder has executed the Agreement, furnished the required contract security and Certifications of Insurance and met the other conditions of the Notice of Award, whereupon the Bid Security will be returned. If the Successful Bidder fails to execute and deliver the Agreement and furnish the required contract security within fifteen days after the Notice of Award, Owner may annul the Notice of Award and Bid Security of that Bidder will be forfeited. The Bid



Security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of the seventh day after the Effective Date of the Agreement or the sixtieth day after the Bid opening whereupon Bid Security furnished by such Bidders will be returned. Bid Security with Bids which are not competitive will be returned within seven days after the Bid opening, if requested by the respective Bidder.

- 7.3. Failure of Bidder to provide qualification information, if requested, within 10 days of notification of request, shall be grounds for forfeiting of the Bid Security of that Bidder.

8. Contract Times

The number of days within which, or the dates by which, the Work is to be substantially completed and also completed and ready for final payment (the term "Contract Times" is defined in paragraph 1.01. A.14. of the General Conditions) are set forth in the Agreement and incorporated therein by reference in the attached Bid Form.

9. Liquidated Damages

Provisions for liquidated damages are set forth in the Agreement.

10. Substitute and "Or Equal" Items

The Contract, if awarded, will be on the basis of materials and equipment described in the Drawings or specified in the Specifications without consideration of possible substitute or "or equal" items which have not received approval of the Engineer. The procedure and timing for submission of any substitution by Contractor and consideration by Engineer is set forth in Paragraph 6.05 of the General Conditions.

11. Subcontractors, Suppliers and Others

- 11.1. If the General Conditions or Supplementary Conditions require the identity of certain Subcontractors, Suppliers and other persons and organizations (including those who are to furnish the principal items of material and equipment) to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening (or other date as may be specified by General Conditions or Supplementary Conditions) submit to Owner a list of all such Subcontractors, Suppliers and other persons and organizations proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, person or organization if requested by Owner. Owner or Engineer who after due investigation has reasonable objection to any proposed Subcontractor, Supplier, other person or organization, may before the Notice of Award is given request apparent Successful Bidder to submit an acceptable substitute, in which case apparent Successful Bidder shall submit an acceptable substitute, provided that Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution and Owner may consider such price adjustment in evaluating Bids and making the contract award.
- 11.2. If apparent Successful Bidder declines to make any such substitution, Owner may award the contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers and other persons and organizations. The declining to make requested substitutions will not constitute grounds for sacrificing the Bid security of any Bidder. Any Subcontractor, Supplier, other person or organization submitted to Owner and Engineer by Bidder and to whom Owner or Engineer does not make written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject



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

12. Bid Form

- 12.1. The Bid Form is included with the Bidding Documents.
- 12.2. All blanks on the Bid Form must be completed by printing in ink or by typewriter.
- 12.3. Bids by corporations must be executed in the corporate name by the president or a vice-president (or other corporate officer accompanied by evidence of authority to sign) and the corporate seal must be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation must be shown below the signature.
- 12.4. Bids by partnerships must be executed in the partnership name and signed by a partner, whose title must appear under the signature and the official address of the partnership must be shown below the signature.
- 12.5. All names must be typed or printed in ink below the signature.
- 12.6. The Bid shall contain an acknowledgement of receipt of all Addenda (the numbers of which must be filled in on the Bid Form).
- 12.7. The address, telephone number, and email address for communications regarding the Bid must be shown.
- 12.8. Evidence of authority to conduct business as an out-of-state corporation in the state where the Work is to be performed shall be provided with the bid form. State utility contractor license number and State general contractor license number must also be shown on the Contractor's License Certificate.
- 12.9. Each bid must be submitted in a sealed envelope bearing on the outside the name of the bidder, his address, and the name of the project for which the bid is submitted. If forwarded by mail, the sealed envelope containing the bid must be enclosed in another envelope addressed as specified in the bid form. Any bid which is not properly prepared and accompanied by required certifications may be rejected by the Owner.

13. Submission of Bids

Bids shall be submitted at the time and place indicated in the Advertisement or Invitation to Bid and shall be enclosed in an opaque sealed envelope, marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted) and name and address of Bidder, and accompanied by the Bid security, Contractor's License Certification, Non-collusion Affidavit of Bidder, Bid Form, Corporate Certificate, and other required documents for a complete, responsive and responsible bid. If the Bid is sent through the mail or other delivery system, the sealed envelope shall be enclosed in a separate envelope with the notation "BID ENCLOSED" on the face of it.

14. Modification of Bids

- 14.1. Bids may be modified or withdrawn by an appropriate document duly executed (in the manner that a Bid must be executed) and delivered to the place where Bids are to be submitted at any time prior to the closing time.



15. Opening of Bids

- 15.1. Bids will be opened and (unless obviously non-responsive) read aloud publicly at the place where Bids are to be submitted. An abstract of the amounts of the base Bids and major alternates (if any) will be made available to Bidders after the effective date of the Contract.
- 15.2. The Owner is not obligated to consider a Bidder's proposal, if Bidder is not on record with the Issuing Office as having attended the Pre-Bid Conference and received complete Bidding Documents from the Issuing Office.
- 15.3. No bid shall be considered unless a proper bid bond or other security authorized in Paragraph 7 of these Instructions to Bidders is submitted.

16. Bids to Remain Subject to Acceptance

All Bids will remain subject to acceptance for sixty (60) days after the day of the Bid opening, but Owner may, in its sole discretion, release any Bid and return the Bid security prior to that date. Owner shall release any Bid and return the Bid Security if a Bidder requests the withdrawal of its Bid and basis of withdrawal is in accordance with O.C.G.A. § 36-91-52.

17. Award of Contract

- 17.1. Owner reserves the right to reject all Bids, including without limitation the rights to reject any or all nonconforming, nonresponsive, unbalanced or conditional Bids and to reject the Bid of any Bidder if Owner believes that it would not be in the best interest of the Project to make an award to that Bidder, whether because the Bid is not responsive or the Bidder is unqualified or of doubtful financial ability or fails to meet any other pertinent standard or criteria established by Owner. Owner also reserves the right to waive all informalities not involving price, time or changes in the Work and to negotiate contract terms with the Successful Bidder. In the event a Bid is rejected by Owner or a Bidder is permitted by Owner to withdraw its Bid, Owner reserves the right to preclude such Bidder from resubmitting a Bid at any subsequent re-bidding of the Work. Discrepancies between the multiplication of units of Work and unit prices will be resolved in favor of the unit prices. Discrepancies between the indicated sum of any column of figures and the correct sum thereof will be resolved in favor of the correct sum. Discrepancies between words and figures will be resolved in favor of the words.
- 17.2. In evaluating Bids, Owner will consider the qualifications of Bidders, whether or not the Bids comply with the prescribed requirements as indicated in the Advertisement for Bid, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award. Conditional Bids will not be accepted.
- 17.3. Owner may consider the qualifications and experience of Subcontractors, Suppliers, and other persons and organizations proposed for those portions of the Work as to which the identity of Subcontractors, Suppliers, and other persons and organizations must be submitted as provided in the Supplementary Conditions. Owner also may consider the operating costs, maintenance requirements, performance data and guarantees of major items of materials and equipment proposed for incorporation in the Work when such data is required to be submitted prior to the Notice of Award.
- 17.4. Owner may conduct such investigations as Owner deems necessary to assist in the evaluation of any Bid and to establish the responsibility, qualifications and financial ability of Bidders, proposed Subcontractors, Suppliers and other persons and organizations to perform and furnish the Work in accordance with the Contract Documents to Owner's satisfaction within the prescribed time.



- 17.5. If the contract is to be awarded, it will be awarded to the responsible and responsive Bidder submitting the lowest Bid whose evaluation by Owner indicates to Owner that the award will be in the best interests of the Project.
- 17.6. If the contract is to be awarded, Owner will give Successful Bidder a Notice of Award within sixty days after the day of the Bid opening.

18. Contract Security

Paragraph 5.01 of the General Conditions and the Supplementary Conditions set forth Owner's requirements as to Performance and Payment Bonds. When the Successful Bidder delivers the executed Agreement to Owner, it must be accompanied by the required Performance and Payment Bonds in the form as shown on Exhibits B and C of the Contract Documents.

19. Signing of Agreement

When Owner gives a Notice of Award to the Successful Bidder, it will be accompanied by the required number of unsigned counterparts of the Agreement with all other written Contract Documents attached. Within fifteen days thereafter Contractor shall sign and deliver the required number of counterparts of the Agreement, Contractor Affidavit and Agreement, Subcontractor Affidavit(s) and Agreement(s), and attached documents to Owner with the required Bonds and Certification of Insurance. Within fifteen days of the Owner's receipt from the Contractor of the following documents in proper form: the required number of executed counterparts of the Agreement, the Bonds, the oath pursuant to O.C.G.A. § 36-91-21(e), the Certification of Insurance, and any other documents required by the Bidding Requirements, Owner shall deliver one fully signed counterpart to the Contractor. Each counterpart is to be accompanied by a complete set of the Drawings with appropriate identification.

20. Laws and Regulations

All applicable federal and state laws, municipal ordinances, and rules and regulations of all authorities having jurisdiction over construction of the project shall apply to the contract throughout, and they will be deemed to be included in the contract the same as though herein written out in full.

21. Security and Immigration Act

- 21.1 Contractors and Subcontractors who enter into contracts with public employers are required to register and participate in the Federal Work Authorization Program to verify work eligibility information of new employees. Bidders are required to fill out the following forms located in the Bidding Documents attesting to their status under this program and that they will pass on the same requirements to their Subcontractors as required by O.C.G.A. 13-10-90 and 13-10-91; GA Department of Labor 300-10-1:

21.1.1 Affidavit Verifying Status for Henry County Water Authority;

21.1.2 Security and Immigration Compliance Act Certification.

- 21.2 Pursuant to O.C.G.A. 13-10-90 et. seq., the Georgia Security and Immigration Compliance Act of 2006, the following forms located in the Bidding Documents shall be completed prior to Award:

21.2.1 Contractor Affidavit and Agreement;

21.2.2 Subcontractor and Sub-subcontractor Affidavit and Agreement.



- 21.3 Contractor understands and agrees that compliance with the requirements of O.C.G.A. 13-10-90, O.C.G.A. 13-10-91, and Georgia Department of Labor Rule 300-10-1 are conditions of this Agreement.
- 21.4 Contractor further agrees that such compliance shall be attested by Contractor and its Subcontractors and Sub-subcontractors by execution of the appropriate Contractor Affidavit and Agreement and Subcontractor Affidavit forms included in the Contract Documents.

** END OF SECTION **

SECTION 00300
BID

PROJECT IDENTIFICATION:

**HENRY COUNTY WATER AUTHORITY
INDIAN CREEK WRF EXPANSION TO 3 MGD**

THIS BID IS SUBMITTED TO:

Henry County Water Authority
100 Westridge Industrial Boulevard
McDonough, GA 30253

1. The undersigned Bidder proposes and agrees, if this Bid is accepted, to enter into an agreement with Owner in the form included in the Contract Documents to perform and furnish all Work as specified or indicated in the Contract Documents for the Bid Price and within the Bid Times indicated in this Bid and in accordance with the other terms and conditions of the Contract Documents.
2. Bidder accepts all of the terms and conditions of the Advertisement for Bid and Instructions to Bidders, including without limitation those dealing with the disposition of Bid security. This Bid will remain subject to acceptance for sixty (60) days after the day of Bid opening. Bidder will sign and deliver the required number of counterparts of the Agreement with the Bonds, Certifications of Insurance, and other documents required by the Bidding Requirements within fifteen (15) days after the date of Owner's Notice of Award.
3. In submitting this Bid, Bidder represents, as more fully set forth in the Agreement, that:
 - (a) Bidder has examined and carefully studied the Bidding Documents and the following Addenda receipt of all of which is hereby acknowledged: (List Addenda by Addendum Number and Date)

 - (b) Bidder has visited the site and is familiar with and is satisfied as to the general, local and site conditions that may affect cost, progress, performance and furnishing of the Work, and bidder has not relied upon any oral representations by employees or agents of Owner or Engineer.
 - (c) Bidder is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress, performance and furnishing of the Work.
 - (d) Bidder has carefully studied all reports of explorations and tests of subsurface conditions at or contiguous to the site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the site which have been identified in the Supplementary Conditions as provided in paragraph 4.02.A of the General Conditions. Bidder accepts the determination, if any, set forth in paragraph SC-4.02.A of the Supplementary Conditions of the extent of the "technical data" contained in such reports and drawings upon which Bidder is entitled to rely as provided in paragraph 4.02 of the General Conditions. Bidder acknowledges that such reports and drawings are not Contract Documents and may not be complete for Bidder's purposes. Bidder acknowledges that Owner and Engineer do not assume responsibility for the accuracy or completeness of information and data shown or indicated in the Bidding Documents with respect to Underground Facilities at or contiguous to the site. Bidder has obtained and carefully studied (or assumes responsibility for having done so) all such additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the site or otherwise which may affect cost, progress, performance or furnishing of the Work or which



relate to any aspect of the means, methods, techniques, sequences and procedures of construction to be employed by Bidder and safety precautions and programs incident thereto. Bidder does not consider that any additional examinations, investigations, explorations, tests, studies or data are necessary for the determination of this Bid for performance and furnishing of the Work in accordance with the times, price and other terms and conditions of the Contract Documents.

- (e) Bidder is aware of the general nature of Work to be performed by Owner and others at the site that relates to Work for which this Bid is submitted as indicated in the Contract Documents.
- (f) Bidder has correlated the information known to Bidder, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.
- (g) Bidder has given Engineer written notice of all conflicts, errors, ambiguities or discrepancies that Bidder has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Bidder, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performing and furnishing the Work for which this Bid is submitted.
- (h) This Bid is genuine and not made in the interest of or on behalf of any undisclosed person, firm or corporation and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation; Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid; Bidder has not solicited or induced any person, firm or corporation to refrain from bidding; and Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

Instructions for unit price bid form: For each Bid item, Bidders shall enter a price for each single unit, then multiply by the estimated quantity shown and enter the total amount in the space indicated in numerals. Also write out in words each Bid Item Unit Price in the space provided. Bidder acknowledges that estimated quantities are not guaranteed and final payment will be based on actual quantities determined in accordance with the Contract Documents. The Project will be awarded in one contract on the basis of the lowest Total Bid or lowest Alternate Bid if requested in the Bid Form, as determined by Owner to be in Owner's best interest. As defined in Division 01, General Requirements, Bidder shall complete the Work in accordance with the Contract Documents for the following bid prices:



All Bid items shall include costs for furnishing to Owner all materials, equipment and supplies and for all costs incurred in completing the Work including design services and the installation of all materials, equipment and supplies furnished, complete in place and ready for continuous service, all other labor, permit fees, taxes, insurance, miscellaneous costs, overhead and profit.

Item No.	Description	Total Price
1.	Lump Sum Price for Indian Creek WRF Expansion to 3 MGD, complete, in accordance with the work described in the Contract Documents.	\$
2.	Major Equipment Allowance for the purchase of the Membrane Biological Reactor System as described in GE Water & Process Technologies "As-Sold Proposal for Henry County Water Authority, MBR Preselection Request for Proposals, Indian Creek Water Reclamation Facility, Locust Grove, Georgia," GE Proposal Number: 089928. Allowance does not include federal, state, or local taxes. Taxes, if applicable, and any other associated costs shall be included in Item 1.	\$ 2,802,249.00
3.	Major Equipment Allowance for the purchase of a Gorman-Rupp self-priming centrifugal pump and control panel for the relocated belt filter press. Allowance does not include federal, state, or local taxes, unloading, or installation. Taxes, if applicable, and all other associated costs shall be included in Item 1.	\$ 23,840.00
4.	Major Equipment Allowance for the purchase of equipment from Keystone Conveyor Corporation required to extend the existing sludge conveyor to the relocated belt filter press. Allowance does not include federal, state, or local taxes, unloading, installation, controls, or motor starters. Taxes, if applicable, and all other associated costs shall be included in Item 1.	\$ 45,880.00
5.	Extra Work Allowance, for additional work as directed by the Owner. No payments shall be made to the Contractor for extra work unless specific work items are negotiated and authorized by the Owner. Allowance in the amount of:	\$ 350,000.00

TOTAL BASE BID, ITEMS 1 THROUGH 5, INCLUSIVE: \$ _____

TOTAL BASE BID, IN WORDS: _____ DOLLARS



The Total Bid in Part 1 shall include the costs for the circled Manufacturers/Suppliers listed in the Major Equipment Schedule, exclusive of any alternate bid items.

The Major Equipment Schedule lists the base bid equipment manufacturer/supplier as applicable for major equipment items and key suppliers for the Indian Creek WRF Expansion to 3 MGD project. The Bidder must indicate which named manufacturer/supplier of major equipment it intends to be provide by circling one of the manufacturers/suppliers listed. Listed equipment suppliers must meet the terms and conditions and technical requirements of the Contract.

If Bidder does not circle one of the equipment manufacturers/suppliers for each piece of major equipment, the Owner will select the manufacturer/supplier that is to be provided. No adjustments will be made to Total Base Bid if Owner is required to make selection.

Deductive alternates will be considered for certain equipment. Bidder may enter the name of the manufacturer along with the deductive price that will be deducted from the Total Base Bid if the deductive alternate is selected. If a deductive alternate is proposed, the Bidder must still circle the listed Manufacturer/Supplier whose equipment is included in the Total Base Bid. Award will be based on the Total Base Bid not including any deductive alternates.

Major Equipment Schedule		
<i>Specification Section Number</i>	<i>Equipment Description</i>	<i>Manufacturer/ Supplier</i>
11202	Fabricated Gates	Fontaine Waterman Whipps, Inc.
11245	Submersible Pumps	Flygt (Xylem) Ebara
11246	Self-Priming Centrifugal Pumps	Gorman-Rupp
11251	Packaged Water Booster System	Flo-Pac Aqua-Pac Flowtronex
11256	Polymer Feed System	Neptune Polymaster Fluid Dynamics Polyblend Velodyne Velocity Dynamics
11259	Peristaltic Chemical Feed Pumps	Watson Marlow Verderflex



Major Equipment Schedule		
<i>Specification Section Number</i>	<i>Equipment Description</i>	<i>Manufacturer/ Supplier</i>
11290	Internally Fed Drum Screens	Parkson Corporation WesTech Engineering
11320	Grit Removal System	Smith & Loveless WesTech Engineering Lakeside Equipment Corporation
11365	UV Disinfection System	Trojan Wedeco
11377	Fine Bubble Aeration Equipment	Sanitaire Environmental Dynamics, Inc. Aquarius Technologies, Inc.
11500	Polyethylene Storage Tanks	Poly Processing Company Snyder Industries, Inc. Assmann Corporation of America
11510	Fiberglass Shelters	Tracom, Inc. Warminster Fiberglass Company



6. Bidder agrees that the Work will be **substantially complete** within **545 consecutive calendar days** after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within **575 consecutive calendar days** after the date when the Contract Times commence to run.

Bidder accepts the provisions of the Agreement as to **Liquidated Damages** in the event of failure to complete the Work within the time(s) specified in the Agreement.

7. The following documents are attached to this Bid Form and are made a condition of this Bid:

Bid Bond
Statement of Qualifications
Non-collusion Affidavit of Bidder
Corporate Certificate
Contractor's License Certification
Affidavit of Status
Security and Immigration Certification
Contractor Affidavit and Agreement
Subcontractor Affidavit and Agreement (if applicable)

The required bid security in the form of bid bond must be included and attached to the Bid Bond form.

8. Communications concerning this Bid shall be addressed to:

The address of Bidder indicated below.

BIDDER'S NAME _____

Primary Contact Person _____

Secondary Contact Person _____

Bidder's Street Address _____

Bidder's Phone Number _____

Bidder's Email Address _____

9. Terms used in this Bid which are defined in the General Conditions or Instructions will have the meanings indicated in the General Conditions or Instructions.
10. Bidder agrees that the Owner has the right to accept or reject any bid or all proposals and to waive all formalities.



THIS BID SUBMITTED on _____, 20__.

Company

By: _____
Signature

Name

Title

Address

CORPORATE SEAL

City/State/Zip Code

() _____
Telephone

Georgia Utility Contractor License No.

** END OF SECTION **



SECTION 00400
BID BOND

STATE OF GEORGIA

COUNTY OF HENRY

KNOW ALL MEN BY THESE PRESENTS, that we, _____, as
[Insert Proper Name of Contractor]

Principal, and _____, as Surety, are held and firmly bound
[Insert Proper Name of Surety]

unto the HENRY COUNTY WATER AUTHORITY for the sum of _____
[Insert Penal Sum in words and numerals]

Dollars (\$ _____) lawful money of the United States, for the payment of which sum
will and truly to be made, we bind ourselves, our heirs, personal representatives, successors and assigns,
jointly and severally, firmly by these presents.

WHEREAS, the Principal has submitted to the Owner a Proposal for construction of:

INDIAN CREEK WRF EXPANSION TO 3 MGD

NOW THEREFORE, the conditions of this obligation are such that if the Bid be accepted, the Principal shall within ten (10) days after receipt of confirmed contract documents execute a contract in accordance with the Bid upon the terms, conditions and prices set forth therein, and in the form and manner required by the Owner and execute a sufficient and satisfactory Performance Bond and Payment Bond payable to the Owner, each in an amount of one hundred percent (100%) of the total contract price, in form and with security satisfactory to the Owner, or in the event of the failure of the Contractor to execute and deliver the Contract Agreement and give said Performance and Payment Bonds, the Contractor shall pay the Owner the difference not to exceed the penalty hereof between the amount specified in said Proposal and such larger amount for which the Owner may in good faith contract with another party to perform the work covered by said Proposal, and execute the Special Assurance form, then this obligation shall be void; otherwise, it shall be and remain in full force and virtue in law; and the Surety shall, upon failure of the Principal to comply with any or all of the foregoing requirements within the time specified above, immediately pay to the aforesaid Owner, upon demand, the amount hereof in good and lawful money of the United States of America, not as a penalty, but as liquidated damages.

This bond is given pursuant to and in accordance with the provisions of O.C.G.A. § 36-10-1 et seq. and all the provisions of the law referring to this character of bond as set forth in said sections or as may be hereinafter enacted and these are hereby made a part hereof to the same extent as it set out herein in full.

IN WITNESS WHEREOF, the said Principal has hereunder affixed its signature and said Surety has hereunto caused to be affixed its corporate signature and seal, by its duly authorized officers, on this _____ day of _____, 20____.

PRINCIPAL:

SURETY:

(Typed Name)

(Typed Name)

BY: _____ (SEAL)
(Signature)

BY: _____ (SEAL)
(Signature)

(Printed Name, Title, Address)

(Printed Name, Title, Address)

ATTEST:

ATTEST:

(Typed Name)

(Typed Name)

BY: _____ (SEAL)
(Signature)

BY: _____ (SEAL)
(Signature)

(Printed Name, Title, Address)

(Printed Name, Title, Address)

Bid Bond (2016)

**** END OF SECTION ****



SECTION 00410
STATEMENT OF BIDDER'S QUALIFICATIONS

Name of Bidder: _____

BIDDER'S STATEMENT OF QUALIFICATIONS

INDIAN CREEK WRF EXPANSION TO 3 MGD

GENERAL

- A. Any contractor who wishes to bid on the Indian Creek WRF Expansion to 3 MGD project is required to complete this *Bidder's Statement of Qualifications* regardless of whether the firm has previously prequalified for other treatment plant projects for the Henry County Water Authority.
- B. The completed *Statement* and all associated documents must be submitted with the bid and no later than the time and date instructed in Section 00020, Advertisement for Bids. Bids received without the *Statement* will be rejected.
- C. The *Statement* shall be filled out in full by typing or in legible hand lettering in ink. All sections included in this package must be submitted. Any additional pages attached to the *Statement* must include the applicant's name, project name and number, and cross references to item numbers on the application form.
- D. The *Statement* will be evaluated on the basis of the information presented, and on an analysis of other publicly available information. The Owner and/or the Engineer may conduct such investigations or interviews as they deem necessary to assist in the evaluation of any proposal submitted and to establish to Henry County Water Authority's satisfaction the responsibility, qualifications, and financial ability of any prospective bidder.
- E. In determining the Contractor's qualifications and evaluating the *Statement*, the following factors will be considered:
 - Evidence of appropriate relevant construction experience of personnel in the key staff positions noted on the prequalification statement.
 - Satisfactory completion, with a focus on the last ten years, of construction projects of comparative scope and contract value to this project.
 - Client references.
 - Ability to perform the work.
 - Acceptable safety record with a focus on the last three years.



Name of Bidder: _____

BIDDER'S STATEMENT OF QUALIFICATIONS

INDIAN CREEK WRF EXPANSION TO 3 MGD

QUALIFICATIONS

1. Provide the names, titles and resumes of key personnel who will be assigned to this project. Key personnel include: Principal-in-Charge, Project Manager, and Project Superintendent. Resumes should outline the qualifications of the project personnel who will perform key functions. Minimum information to be contained on the resume of each individual shall include: technical experience, managerial experience, education, dates of relevant assignments, position occupied on each assignment, description of duties on each assignment, occupational training and certification, trade societies and affiliations, and number of years with the organization. The personnel identified in the Application will be construed as committed for the duration of the project, unless changes are approved by the Henry County Water Authority.
2. Submit information regarding the Bidder's experience (using the attached Form for Similarly Scoped Projects and References) for a minimum of three projects completed by your firm over the last ten years that most closely resemble the previously described project. Highlight projects that involved construction activities within or adjacent to an operating wastewater or water treatment plant. The information provided on these forms will be used to evaluate your organization's ability to perform the work described in a timely manner. One Form for Similarly Scoped Projects and References shall be completed for each project, using the blank form attached at the end of the *Bidder's Statement of Qualifications*. Supplemental information in other formats may also be attached if desired, but only in addition to the Form.
3. List all companies, firms, or organizations that own any part of your organization:

4. How many persons does your company permanently employ? _____
5. How many years of experience in the proposed type and size of construction work has your organization had: _____
6. Has the Bidder been assessed liquidated damages on any project in the past five years?

Yes: _____ No: _____

➔ *If Yes, attach a separate sheet with a detailed explanation.*



Name of Bidder: _____

BIDDER'S STATEMENT OF QUALIFICATIONS

INDIAN CREEK WRF EXPANSION TO 3 MGD

7. Safety Information: Provide the Average Lost Workday Incident Rates, Average Recordable Incident Rates, and Experience Modification Rates for the past three years in the spaces provided below. Use only data from construction operations (not home office staff) in calculations.

a. Average Lost Workday Incident Rate (LWIR):

$$LWIR = \frac{\text{Total Number of Lost Workday Incidents} \times 200,000}{\text{Total Employee Hours Worked}}$$

Year	No. of Lost Workday Incidents	Total Employee Hours Worked	Lost Workday Incident Rate
20			
20			
20			

b. Average Recordable Incident Rate (RIR):

$$RIR = \frac{\text{Total Number of Recordable Incidents} \times 200,000}{\text{Total Employee Hours Worked}}$$

Year	No. of Recordable Incidents	Total Employee Hours Worked	Recordable Incident Rate
20			
20			
20			

c. Experience Modification Rate (EMR):

Year	Experience Modification Rate
20	
20	
20	

d. Has the Bidder received any OSHA violations (citations) in the past five years?

Yes: _____ No: _____

→ *If Yes, attach a separate sheet describing the citations, including information about the dates of the citations, the nature of the violation, the project on which the citation was issued, the amount of penalty paid, if any. This question must be answered "Yes" and information provided if citations have been appealed or contested, but have not yet been resolved. If the citation was appealed and a decision has been issued, state the case number and the date of the decision.*



Name of Bidder: _____

BIDDER'S STATEMENT OF QUALIFICATIONS

INDIAN CREEK WRF EXPANSION TO 3 MGD

8. Has the Bidder been involved in claims, arbitration, mediation, and lawsuits on public works projects, as a plaintiff, defendant or participant, in the last five years?

Yes: _____ No: _____

➔ *If Yes, attach a separate sheet listing the name of the claim, the nature of the claim, when and where filed, status, final disposition if resolved, and the name and location of the project.*

9. Does the Bidder (including any member, officer, partner, subsidiary or affiliate thereof) have a pending citation for violating any provision of the Code of the Henry County Board of Commissioners McDonough, Georgia at the current time?

Yes: _____ No: _____

➔ *If Yes, attach a separate sheet with a detailed explanation of the Code violation and the status of the resolution of the citation.*

10. What percentage of the work pertaining to this contract will you perform with your own employees?

_____ (Must be over 50%)

11. What type of work do you anticipate subcontracting? _____

Note: This symbol (➔) indicates required attachments.

THE REMAINDER OF THIS PAGE HAS BEEN LEFT BLANK INTENTIONALLY



Name of Bidder: _____

BIDDER'S STATEMENT OF QUALIFICATIONS

INDIAN CREEK WRF EXPANSION TO 3 MGD

FORM FOR SIMILAR SCOPE PROJECTS AND REFERENCES

Facility/Project Name: _____

Address of Project: _____

Bid amount: _____ Final Contract amount: _____

Contract time: _____ days Completion time: _____ days

Year completed: _____

Description of work: _____

Explanation of any time extensions and/or changes in contract amount: _____

Owner Contact:

Name: _____ Title: _____

Telephone No.: _____

Architect/Engineer Contact:

Name: _____ Title: _____

Telephone No.: _____

This form should be copied as necessary to provide one page per similarly scoped project (Item 2). Other descriptive information (in addition to this form) may also be attached if desired.



Name of Bidder: _____

AFFIDAVIT FOR CONTRACTOR

I, the undersigned, _____ (typed name) as the authorized representative for _____ (typed company name), an interested contractor on Henry County Water Authority projects, do hereby attest that all statements and representations made herein are true and correct to the best of my knowledge. These statements are made openly and freely without intent to influence or embellish actual conditions or circumstances that occurred.

I understand that the Henry County Water Authority will investigate any and all statements and representations made by my firm and me and we freely give our permission for them to do so. I agree to waive any claims against the Henry County Water Authority for the release of the information necessary to evaluate this submittal.

I am hereto sworn _____ (signature)

_____ (title)
_____ (firm name)

This date _____, 20____
County of _____, State of _____

The foregoing instrument was acknowledged before me this ____ day of _____, 20____

_____ (Notary signature)
_____ (typed Notary name)

My commission expires: _____

**** END OF SECTION ****



SECTION 00420
NON-COLLUSION AFFIDAVIT OF BIDDER

State of _____

County of _____

_____, being first duly sworn, deposes and says that:

1. He or she is _____ of
(Owner, Partner, Officer, Representative or Agent)
_____, the Bidder that has submitted the attached Bid;
2. He or she is fully informed respecting the preparation and contents of the attached Bid and of all pertinent circumstances respecting such Bid;
3. Such Bid is genuine and is not a collusive or sham Bid;
4. Neither the said Bidder nor any of its officers, partners, owners, agents, representatives, employees or parties in interest, including this Affiant, has in any way colluded, conspired, connived or agreed, directly or indirectly with any other Bidder, firm or person to submit a collusive or sham Bid in connection with the Contract for which the attached Bid has been submitted or to refrain from bidding in connection with such Contract, or has in any manner, directly or indirectly, sought by agreement or collusion or communication or conference with any other Bidder, firm or person to fix the price or prices in the attached Bid or of any other Bidder, or to fix any overhead, profit or cost element of the Bid price or the Bid price of any other Bidder, or to secure through any collusion, conspiracy, connivance or unlawful agreement any advantage against the Henry County Water Authority or any person interested in the proposed Contract; and
5. The price or prices quoted in the attached Bid are fair and proper and are not tainted by any collusion, conspiracy, connivance or unlawful agreement on the part of the Bidder or any of its agents, representatives, owners, employees, or parties in interest, including this Affiant.

(Signed) _____

(Title) _____

Subscribed and Sworn before me this _____ day of _____, 20____.

(Notary Public) (signature) My Commission Expires: _____

(SEAL)

** END OF SECTION **



SECTION 00430
CORPORATE CERTIFICATE

I, _____, certify that I am the Secretary of the Corporation named as Bidder in the foregoing Bid; that _____, who signed said Bid on behalf of the Contractor was then _____ of said Corporation; that said Bid was duly signed for and on behalf of said Corporation by authority of its Board of Directors, and is within the scope of its corporate powers; that said Corporation is organized under the laws of the State of _____.

This _____ day of _____, 20____.

Corporate
Secretary:

(signature)

(printed name)

(SEAL)

** END OF SECTION **



SECTION 00440
CONTRACTOR'S LICENSE CERTIFICATION

Bidder/Contractor's Name: _____

Georgia Utility Contractor's License Number: _____

Expiration Date of License: _____

Georgia General Contractor's License Number: _____

Expiration Date of License: _____

I certify that the above information is true and correct and that the classification noted is applicable to the Bid for this Project.

BIDDER: _____

By: _____
(signature)

(printed name)

Title: _____

Date: _____

** END OF SECTION **



SECTION 00450
AFFIDAVIT OF STATUS

**Affidavit Verifying Status
For Henry County Water Authority
Public Benefit Application**

By executing this affidavit under oath, as an applicant for a Henry County Water Authority contract or other public benefit as referenced in O.C.G.A. § 50-36-1, I am stating the following with respect to my application for a Henry County Water Authority contract or other public benefit:

1. _____ I am a United States citizen

OR

2. _____ I am a legal permanent resident 18 years of age or older or I am an otherwise qualified alien or non-immigrant under the Federal Immigration and Nationality Act 18 year of age or older and lawfully present in the United States*.

In making the above presentation under oath, I understand that any person who knowingly and willfully makes a false, fictitious, or fraudulent statement or representation in an affidavit shall be guilty of a violation of Code Section 16-10-20 of the Official Code of Georgia.

By: _____
(signature)

(printed name)

Date: _____

Subscribed and Sworn before me this _____ day of _____, 20____.

(Notary Public) (signature)

My Commission Expires: _____

(SEAL)

*Note: O.C.G.A. § 50-36-1 (e)(2) requires that aliens under the federal Immigration and Nationality Act, Title 8 U.S.C., as amended, provide their alien registration number. Because legal permanent residents are included in the federal definition of "alien", legal permanent residents must also provide their alien registration number. Qualified aliens that do not have an alien registration number may supply another identifying number below:

**** END OF SECTION ****



SECTION 00460
SECURITY AND IMMIGRATION ACT COMPLIANCE CERTIFICATION

Pursuant to the Georgia Security and Immigration Compliance Act of 2006, Contractor understands and agrees that compliance with the requirements of O.C.G.A. 13-10-91 and Georgia Department of Labor Rule 300-10-1 et. seq. are conditions of Agreement. Contractor further agrees that such compliance shall be attested through execution of Contractor Affidavit and Agreement required by Georgia Department of Labor Rule 300-10-1-.07, or a substantially similar contractor affidavit. Contractor's fully executed affidavit is attached and is incorporated into this Agreement by reference herein.

By initialing in the appropriate line below, Contractor certifies that the following employee number category as identified in O.C.G.A. 13-10-91 is applicable to Contractor:

1. _____ 500 or more employees;
2. _____ 100 or more employees;
3. _____ Fewer than 100 employees.

Contractor understands and agrees that, in the event Contractor employs or contracts with Subcontractor in connection with this Agreement, Contractor shall:

1. Secure from each Subcontractor an indication of the employee-number category as identified in O.C.G.A. 13-10-91; and
2. Secure from each Subcontractor an attestation of Subcontractor's compliance with O.C.G.A. 13-10-91 and Georgia Department of Labor Rule 300-10-1-.02 by causing each Subcontractor to execute the attached Subcontractor Affidavit required by Georgia Department of Labor Rule 300-10-1-.08, or a substantially similar subcontractor affidavit. Contractor further understands and agrees that Contractor shall require the executed Subcontractor Affidavit to become a part of the agreement between Contractor and each Subcontractor. Contractor agrees to maintain records of each Subcontractor attestation required hereunder for inspection by Owner.

By: _____
(signature)

(printed name)

Title: _____

Date: _____

Subscribed and Sworn before me this _____ day of _____, 20____.

(Notary Public) (signature)

My Commission Expires: _____

(SEAL)

** END OF SECTION **



SECTION 00470
CONTRACTOR AFFIDAVIT AND AGREEMENT

By executing this affidavit, the undersigned contractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is contracting with the Henry County Water Authority has registered with and is participating in a federal work authorization program [any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91.

The undersigned further agrees that, should it employ or contract with any subcontractor(s) in connection with the physical performance of services pursuant to this contract with the Henry County Water Authority, contractor will secure from such subcontractor(s) similar verification of compliance with O.C.G.A. § 13-10-91 on the Subcontractor Affidavit provided in Rule 300-10-01-.08 or a substantially similar form. Contractor further agrees to maintain records of such compliance and to provide a copy of each such verification to the Henry County Water Authority at the time the subcontractor(s) is retained to perform such service.

Contractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

EEV/Basic Pilot Program User Identification Number: _____

Contractor Name: _____

By: _____
(signature of authorized agent)

(printed name of authorized agent)

Title: _____

Date: _____

Subscribed and Sworn before me this _____ day of _____, 20____.

(Notary Public) (signature)

My Commission Expires: _____

(SEAL)

** END OF SECTION **



SECTION 00480
SUBCONTRACTOR AFFIDAVIT AND AGREEMENT

By executing this affidavit, the undersigned subcontractor verifies its compliance with O.C.G.A. § 13-10-91, stating affirmatively that the individual, firm or corporation which is contracting with _____ (name of contractor), which has a contract with the Henry County Water Authority, has registered with and is participating in a federal work authorization program [any of the electronic verification of work authorization programs operated by the United States Department of Homeland Security or any equivalent federal work authorization program operated by the United States Department of Homeland Security to verify information of newly hired employees, pursuant to the Immigration Reform Control Act of 1986 (IRCA), P.L. 99-603], in accordance with the applicable provisions and deadlines established in O.C.G.A. § 13-10-91.

Contractor hereby attests that its federal work authorization user identification number and date of authorization are as follows:

EEV/Basic Pilot Program User Identification Number: _____

Subcontractor Name: _____

By: _____
(signature of authorized agent)

(printed name of authorized agent)

Title: _____

Date: _____

Subscribed and Sworn before me this _____ day of _____, 20____.

(Notary Public) (signature)

My Commission Expires: _____

(SEAL)

** END OF SECTION **



SECTION 00490
NOTICE OF AWARD

Date

Bidder's Name
Bidder's Address

Project or Contract Name: Indian Creek WRF Expansion to 3 MGD

You are hereby notified that your Bid dated _____ for the above referenced project has been considered. You are the apparent "successful bidder" and have been awarded a Contract for the **Indian Creek WRF Expansion to 3 MGD** project, which includes the following: _____.

The Contract Price of this Contract is \$ _____ (_____ dollars).

Six (6) copies of each of the proposed Contract Documents (except Drawings) accompany this Notice of Award. Six (6) sets of Drawings will be delivered separately or otherwise made available to you immediately.

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

1. Deliver to the Owner six (6) fully executed counterparts of the Contract Documents. Each of the Contract Documents must bear your signature on the Agreement, Payment Bond, Performance Bond, Pre-Construction Oath, Certification of Contractor's Attorney, Contractor Affidavit and Agreement, and required Subcontractor Affidavit and Agreements.
2. Deliver with the executed Contract Documents the Contract security (Bonds) as specified in the Instructions to Bidders and General Conditions (paragraph 5.01).
3. Execute the Performance and Payment Bonds, but DO NOT DATE. Henry County Water Authority will date the bonds with the same date as the Agreement.
4. Deliver with the executed Contract Documents evidence of all insurance which Contractor is required to provide under the Contract Documents.
5. Deliver with the executed Contract Documents the Insurance Certificate Checklist filled out by Contractor's insurance agent.
6. (List other conditions.)

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

Within ten (10) days after you comply with the above conditions, Owner will return to you one fully executed counterpart of the Contract Documents.

HENRY COUNTY WATER AUTHORITY

By: _____

Date: _____

** END OF SECTION **



SECTION 00500
AGREEMENT

AGREEMENT made by and between the **Henry County Water Authority** (hereinafter called Owner) and _____ (hereinafter called Contractor).

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

Article 1. WORK.

The Project for which the Work under the Contract Documents may be the whole or only a part is identified with the following Project Name:

Indian Creek WRF Expansion to 3 MGD

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

Increasing the capacity of the Indian Creek Water Reclamation Facility (WRF) from 1.5 MGD to 3 MGD and converting the mechanical treatment process from a contact-stabilization treatment process to a membrane biological reactor (MBR) treatment process. In general, the project will consist of the following major work items:

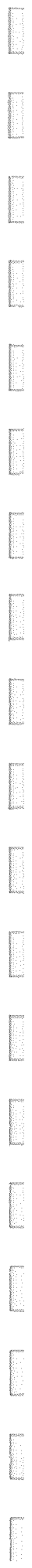
1. Upgrade existing Influent Pump Station
2. New influent metering flume
3. New influent screening structure and equipment
4. Upgrade to existing headworks
5. New MBR treatment process
6. New ultraviolet disinfection system
7. New plant water system
8. New cascade aeration system
9. New effluent outfall line
10. Upgrade existing aerobic digesters
11. Upgrade existing solids handling facilities
12. Upgrade existing chlorine building
13. New administration building
14. Miscellaneous site work

Article 2. ENGINEER.

The Project has been designed by Engineering Strategies, Inc. who is hereinafter called Engineer and who is to act as Owner's representative, assume all duties and responsibilities and have the rights and authority assigned to Engineer in the Contract Documents in connection with completion of the Work in accordance with the Contract Documents.

Article 3. CONTRACT TIMES.

- 3.1 The Work will be substantially completed within **545 consecutive calendar days** after the date when the Contract Times commence to run as provided in paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within **575 consecutive calendar days** after the date when the Contract Times commence to run. Construction sequencing constraints and limitations are described in Section 01010, Summary of Work.
- 3.2 Liquidated Damages. Owner and Contractor recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in paragraph 3.1 above, plus any extensions thereof allowed in accordance with Article



12 of the General Conditions. Any delays in completing this work will have significant impacts on the Owner. They also recognize the delays, expense and difficulties involved in proving the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty) Contractor shall pay Owner one thousand five hundred dollars (\$1,500) for each day that expires after the time specified in paragraph 3.1 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse or fail to complete the remaining Work within the time specified in paragraph 3.1 for completion and readiness for final payment or any proper extension thereof granted by Owner, Contractor shall pay Owner five hundred dollars (\$500) for each day that expires after the time specified in paragraph 3.1 for completion and readiness for final payment.

Article 4. CONTRACT PRICE.

Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the sum of the amounts determined pursuant to paragraphs 4.1, 4.2 and 4.3 below:

4.1 For all Work other than Unit Price Work, an amount equal to the sum of the established Lump Sum item(s) of Work as indicated in the Contractor's Bid. All specific cash allowances are included in the appropriate items of work and have been computed in accordance with paragraph 11.02.A of the General Conditions;

plus

4.2 For all Unit Price Work, an amount equal to the sum of the established unit price for each separately identified item of Unit Price Work multiplied by the quantity of the item as indicated in Contractor's Bid;

plus

4.3 For all additional Work authorized by the Owner to be compensated from the Contingency Allowance(s).

SUM OF ALL LUMP SUM PRICES, ALL UNIT PRICES AND CONTINGENCY ALLOWANCES:

_____ DOLLARS.

(Total Contract Price to be written in words)

As provided in paragraph 11.03 of the General Conditions, estimated quantities are not guaranteed, and determinations of actual quantities and classification are to be made by Engineer as provided in paragraph 9.07 of the General Conditions. Unit prices have been computed as provided in paragraph 11.03.A of the General Conditions.

Article 5. PAYMENT PROCEDURES.

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

5.1. Progress Payments; Retainage.

Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment as recommended by Engineer, on or about the 25th day of each month during construction as provided in paragraphs 5.1.1 and 5.1.2 below.

5.1.1. All such payments will be measured by values of work completed as provided by the schedule established in paragraph 2.07 of the General Conditions, plus the value of materials and equipment suitably stored, insured, and protected at the construction site,



and with the Owner's consent, such materials and equipment suitably stored, insured, and protected off-site at a location approved by the Engineer, less a retainage of ten percent (10%) of each progress payment requested; provided, however, when fifty percent (50%) of the Contract Price, including change orders and other additions to the Contract, is due and the manner of completion of the contract work and its progress is reasonably satisfactory to the Engineer, in the Engineer's sole discretion, the Owner shall withhold no more retainage on additional work completed.

5.1.2 The Contractor shall be entitled to withhold retainage from subcontractors in accordance with this Agreement and Georgia Law. Provided that the value of each subcontractor's work complete and in place equals fifty percent (50%) of his or her subcontract value, including approved change orders and other additions to the subcontract value, and provided that the work of the subcontractor is proceeding satisfactorily and the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete his or her work including any warranty work as the Contractor in its reasonable discretion may require, including but not limited to a payment and performance bond, then the Contractor shall reduce or discontinue each subcontractor's retainage in the same manner as the Contractor's retainage is reduced or discontinued by the Owner. At the discretion of the Owner, upon recommendation of the Engineer and with consent of the Contractor, the retainage of each subcontractor may be released separately as the subcontractor completes his work. If the Contractor does not give such consent, the Contractor shall promptly give the Owner a written explanation of its reason.

5.1.3 If, after discontinuing the retainage, the Engineer determines that the work is unsatisfactory or has fallen behind schedule, retention shall be resumed at the previous level. If retention is resumed, the Contractor shall be entitled to resume withholding retainage from any affected subcontractors.

5.2. Final Payment.

At substantial completion of the contract work and as the Engineer determines the work to be reasonably satisfactory, the Owner shall within 60 days after presentation of Application and other appropriate documentation as required by Article 14 of the General Conditions are provided, pay the retainage to the Contractor. If at that time there are any remaining incomplete minor items, an amount equal to 200 percent of the value of each item, as determined by the Engineer, shall be withheld until such item or items are completed. The reduced retainage shall be shared by the Contractor and subcontractors as their interests may appear. The Contractor shall, within ten (10) days from Contractor's receipt of retainage from the Owner, pass through payments to subcontractors and shall reduce each subcontractor's retainage in the same manner as the Contractor's retainage is reduced by the Owner provided that the value of each subcontractor's work complete and in place equals fifty percent (50%) of his subcontract value, including approved change orders and other additions to the subcontract value and provided, further, that the work of the subcontractor is proceeding satisfactorily and the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete his work including any warranty work as the Contractor in his reasonable discretion may require, including, but not limited to a payment and performance bond.

If pursuant to paragraph 14.04 of the General Conditions Engineer issues a certificate of Substantial Completion for a part of the Work prior to the Substantial Completion of all of the Work, the Owner shall within 45 days after presentation of Application and other appropriate documentation as required by Article 14 of the General Conditions are provided, pay the retainage for such part of the Work to the Contractor. If at that time there are any remaining incomplete minor items for such part of the Work, an amount equal to 200 percent of the value of each item, as determined by the Engineer, shall be withheld until such item or items are completed. The reduced retainage shall be shared by the Contractor and subcontractors as their interests may appear. The Contractor shall, within ten (10) days from Contractor's receipt of retainage from the Owner, pass through payments to subcontractors and shall reduce each



subcontractor's retainage for such part of the Work in the same manner as the Contractor's retainage for such part of the Work is reduced by the Owner provided that the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete his work including any warranty work as the Contractor in his reasonable discretion may require, including, but not limited to a payment and performance bond.

The subcontractor shall, within ten (10) days from the subcontractor's receipt of retainage from the Contractor, pass through payments to the lower tier subcontractors and shall reduce each lower tier subcontractor's retainage in the same manner as the subcontractor's retainage is reduced by the Contractor, provided that the value of each lower tier subcontractor's work complete and in place equals fifty (50%) percent of his subcontract value, including approved change orders and other additions to the subcontract value and provided, further, that the work of the lower tier subcontractor is proceeding satisfactorily and the lower tier subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete his work including any warranty work as the subcontractor in his reasonable discretion may require, including, but not limited to, a payment and performance bond.

All prior certificates or estimates upon which payments have been made are approximate only, and subject to correction in the final payment.

5.3 In the event of a conflict, O.C.G.A. Sections 13-10-80 through 13-10-83 shall supersede and control any provisions to the contrary in this Article 5.

5.4 Contractor's Agreements with Subcontractors.

The Contractor hereby covenants and agrees with Owner to obtain written agreements from each subcontractor setting forth payment procedures in accordance with the foregoing provisions of this Section. Nothing contained herein shall preclude the Contractor, prior to making payment to a subcontractor, from requiring the payee to submit satisfactory evidence that all payrolls, material bills, and other indebtedness connected with the work have been paid.

Article 6. INTEREST.

6.1 The Current Market Rate will be the rate of interest stipulated in Article 14.02.E of Section 00700, "Standard General Conditions of the Construction Contract" (General Conditions) of this agreement.

6.2 All moneys not paid by Owner to Contractor when due as provided in Article 14 of the General Conditions shall bear interest at the Current Market Rate.

6.3 On contracts relating to installation, extension, improvement, maintenance or repair of any water or sewer facility, retainage shall be invested at the Current Market Rate and any interest earned on the retained amount shall be paid to the Contractor when the project has been completed within the Contract Times and for the Contract Price specified in the Contract, or in any amendments or change orders approved in accord with the terms of the Contract.

Article 7. CONTRACTOR'S REPRESENTATIONS.

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

7.1 Contractor has examined and carefully studied the Contract Documents (including the Addenda listed in paragraph 8) and the other related data identified in the Bidding Documents including "technical data."

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



- 7.3. Contractor is familiar with and is satisfied as to all federal, state and local Laws and Regulations that may affect cost, progress, performance and furnishing of the Work.
- 7.4. Contractor is aware of the general nature of work to be performed by Owner and others at the site that relates to the Work as indicated in the Contract Documents.
- 7.5. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the site, reports and drawings identified in the Contract Documents and all additional examinations, investigations, explorations, tests, studies and data with the Contract Documents.
- 7.6. Contractor has given Engineer written notice of all conflicts, errors, ambiguities or discrepancies that Contractor has discovered in the Contract Documents and the written resolution thereof by Engineer is acceptable to Contractor, and the Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

Article 8. CONTRACT DOCUMENTS.

The Contract Documents which comprise the entire agreement between Owner and Contractor concerning the Work consist of the following:

This Agreement (pages 1 to 7, inclusive).

Advertisement for Bidders

Instructions to Bidders

Bid Form

Bid Bond

Statement of Bidder's Qualifications (where applicable).

Non-Collusion Affidavit of Bidder

Security and Immigration Ace compliance Certification

Affidavit Verifying Status for Henry County Water Authority Public Benefit Application

Corporate Certificate

Contractor's License Certification

Performance Bond

Payment Bond

Certification of Owner's Attorney

Pre-Construction Oath

General Conditions

Supplementary Conditions

Insurance Checklist



Contractor Affidavit and Agreement

Subcontractor Affidavit and Agreement

Notice of Award

Notice to Proceed

Specifications bearing the name **Indian Creek WRF Expansion to 3 MGD**, as listed in table of contents thereof, bound separate from this Agreement.

Drawings consisting of a cover sheet and sheets as listed in the Drawing Index thereof with each sheet bearing the name **Indian Creek WRF Expansion to 3 MGD**, bound separate from this Agreement.

Addenda number(s) _____ to _____, incorporated herein,

The following which may be delivered or issued after the Effective Date of the Agreement and are not attached hereto: All Written Amendments and other documents amending, modifying or supplementing the Contract Documents pursuant to paragraphs 3.04.A and 3.04.B of the General Conditions.

The documents listed in paragraphs 8.2 et seq. above are attached to this Agreement (except as expressly noted otherwise above).

There are no Contract Documents other than those listed above in this Article 8. The Contract Documents may only be amended, modified or supplemented as provided in paragraphs 3.04.A and 3.04.B of the General Conditions.

Article 9. MISCELLANEOUS.

- 9.1. Terms used in this Agreement which are defined in Article I of the General Conditions will have the meanings indicated in the General Conditions.
- 9.2. No assignment by a party hereto of any rights under or interests in the Contract Documents will be binding on another party hereto without the written consent of the party sought to be bound; and, specifically but without limitation, moneys that may become due and moneys that are due may not be assigned without such consent (except to the extent that the effect of this restriction may be limited by law), and unless specifically stated to the contrary in any written consent to an assignment no assignment will release or discharge the assignor from any duty or responsibility under the Contract Documents.
- 9.3. Owner and Contractor each binds itself, its partners, successors, assigns and legal representatives to the other party hereto, its partners, successors, assigns and legal representatives in respect to all covenants, agreements and obligations contained in the Contract Documents.
- 9.4. Any provision or part of the Contract Documents held to be void or unenforceable under any Law or Regulation shall be deemed stricken, and all remaining provisions shall continue to be valid and binding upon Owner and Contractor, who agree that the Contract Documents shall be reformed to replace such stricken provision or part thereof with a valid and enforceable provision that comes as close as possible to expressing the intention of the stricken provision.



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

This Agreement will be effective on _____, 20____ (which is the Effective Date of the Agreement).

IN WITNESS WHEREOF, the parties hereto have made and executed this Agreement under seal as of the day and year first above-written.

OWNER:

Henry County Water Authority

By: _____
(signature)

(printed name)

Title: _____
[SEAL]

Attest:

By: _____
(signature)

(printed name)

Title: _____

CONTRACTOR:

By: _____
(signature)

(printed name)

Title: _____
[SEAL]

Attest:

By: _____
(signature)

(printed name)

Title: _____

Address for giving notices:

Henry County Water Authority

100 Westridge Industrial Boulevard

McDonough, GA 30253

Address for giving notices:

** END OF SECTION **



SECTION 00610
PERFORMANCE BOND (CONTRACTOR)

_____, a corporation duly
[Insert Proper Name of Surety]

organized and existing under the laws of the State of _____, and duly authorized to issue
bonds in the State of Georgia, as surety ("Surety"), and _____

_____, as principal
[Insert Proper Name of Contractor]

("Contractor"), enters into, execute this bond ("Performance Bond"), and bind themselves, their heirs,
executors, administrators, successors and assigns, both jointly and severally in favor of the **Henry
County Water Authority** as obligee ("Owner"), in the penal sum of

_____ dollars (\$ _____),
[Insert Penal Sum in words and numerals]

as of _____,
[Insert Date of Construction Contract]

WHEREAS, the Contractor has executed a contract with the Owner of even date herewith
("Construction Contract") for construction of:

INDIAN CREEK WRF EXPANSION TO 3 MGD

("Project"); and

WHEREAS, the Owner has required the Contractor to furnish this Performance Bond containing the terms
and conditions set forth herein as a condition to executing the Construction Contract with the Contractor;

NOW THEREFORE, the Surety and the Contractor, both jointly and severally, and for themselves, their
heirs, administrators, executors and successors agree:

1.

The Construction Contract is hereby incorporated herein and by reference made a part hereof to
the same extent and effect as though it were copied verbatim herein. The Surety and the Contractor are
bound for the full performance of the Construction Contract, including, without exception, all of its terms
and conditions, both express and implied.

2.

If the Contractor is in default of the Construction Contract and the Owner, by written notice to the
Contractor and the Surety, declares the Contractor to be in default and terminates the right of the
Contractor to proceed, the Surety shall thereupon give an unequivocal notice in writing to the Owner



within 15 days after receipt of said notice as to which of the actions permitted to the Surety in Paragraph 3 it will take.

3.

Upon default and termination of the Contractor and notice to the Contractor and Surety as provided in Paragraph 2 above, the Surety shall, within 15 days, proceed to take one or, at its option, more than one of the following courses of action:

(A) Proceed itself, or through others acting on its behalf, to complete full performance of the Construction Contract including, without limitation, correction of defective and nonconforming work performed by or on behalf of the Contractor. During such performance by the Surety, the Owner shall pay the Surety from its own funds only such sums as would have been due and payable to the Contractor in the absence of the default and termination.

(B) Applicable law permitting, and with the prior written consent of the Owner, obtain bids or proposals from contractors previously identified as being acceptable to the Owner, for full performance of the Construction Contract. The Surety shall furnish the Owner a copy of such bids or proposals upon receipt of same. The Surety shall promptly select, with the agreement of the Owner, the best responsive bid or proposal and shall promptly tender the contractor submitting it, together with a contract for fulfillment and completion of the Construction Contract executed by the completing contractor, to the Owner for the Owner's execution. Upon execution by the Owner of the contract for fulfillment and completion of the Construction Contract, the completing contractor shall furnish to the Owner a performance bond and a separate payment bond, each in the form of those bonds previously furnished to the Owner for the Project by the Contractor. Each such bond shall be in the penal sum of the (1) fixed price for completion, (2) guaranteed maximum price for completion, or (3) estimated price for completion, whichever is applicable. The Owner shall pay the completing contractor from its own funds only such sums as would have been due and payable to the Contractor under the Construction Contract as and when they would have been due and payable to the Contractor in the absence of the default and termination. To the extent that the Owner is obligated to pay the completing contractor sums which would not have then been due and payable to the Contractor under the Construction Contract, the Surety shall provide the Owner with such sums in a sufficiently timely manner that the Owner can utilize such sums in making timely payment to the completing contractor; or,



(C) Take any and all other acts, if any, mutually agreed upon in writing by the Owner and the Surety.

4.

In addition to those duties set forth hereinabove, the Surety shall promptly pay the Owner all loss, costs and expenses resulting from the Contractor's default(s), including, without limitation, fees, expenses and costs for architects, engineers, consultants, testing, surveying and attorney's fees, court costs, expert witness fees, litigation expenses, liquidated or actual damages, as applicable, for delay in completion of the Project, and fees, expenses and costs incurred at the direction, request, or as a result of the acts or omissions of the Surety.

5.

In no event shall the Surety be obligated to the Owner hereunder for any sum in excess of the Penal Sum. As used in this Performance Bond, the term "Penal Sum" means the amount stated as the penal sum in the preamble of this Performance Bond, as that amount may be adjusted from time to time pursuant to Paragraph 6 below.

6.

No agreement, modification, omission, addition, or change in or to the Construction Contract, change in work covered by the Construction Contract, or extension of time for the completion of the Construction Contract shall impair, affect, or release the Surety of this Performance Bond. The Surety waives notice of any changes to the Construction Contract including, without limitation, changes in the contract time, the contract price, or the work to be performed. If the total amount payable by the terms of the Construction Contract is increased to an amount in excess of the then current Penal Sum, then, automatically and without notice to or any action required of any party, the Penal Sum shall be increased as the total amount payable by the terms of the Construction Contract is increased.

7.

This Performance Bond is provided by the Surety for the sole and exclusive benefit of the Owner, together with its successors or assigns. No other party, person or entity shall have any rights against the Surety hereunder.



8.

Any notice required to be given under the terms of this document shall be deemed to have been given on the date the same is hand-delivered to the parties of this document, deposited in the United States mail to the addresses hereinafter stated with sufficient postage affixed thereto to insure delivery or sent by Certified Mail, Return Receipt Requested:

Surety:

Attn: _____

Contractor:

Attn: _____

Owner:

**Henry County Water Authority
1695 Highway 20 West
McDonough GA 30253
Attn: Lindy Farmer, General Manager**

9.

Any statutory limitation, which may be contractually superseded, to the contrary notwithstanding, any action hereon may be instituted so long as the applicable statute of limitations governing the Construction Contract has not run or expired.



IN WITNESS WHEREOF, the parties have hereunto set their hands and seals the day and year first above written.

CONTRACTOR:

SURETY:

(Typed Name)

(Typed Name)

BY: _____ (SEAL)
(Signature)

BY: _____ (SEAL)
(Signature)

(Printed Name, Title, Address)

(Printed Name, Title, Address)

ATTEST:

ATTEST:

(Typed Name)

(Typed Name)

BY: _____ (SEAL)
(Signature)

BY: _____ (SEAL)
(Signature)

(Printed Name, Title, Address)

(Printed Name, Title, Address)

Performance Bond Contractor (2016)

**** END OF SECTION ****



SECTION 00620
PAYMENT BOND (CONTRACTOR)

_____, a corporation duly
[Insert Proper Name of Surety]

organized and existing under the laws of the State of _____, and duly authorized to issue bonds in the State of Georgia, as surety ("Surety"), and

_____, as principal ("Contractor"), enter
[Insert Proper Name of Contractor]

into, execute this bond ("Payment Bond"), and bind themselves, their heirs, executors, administrators, successors and assigns, both jointly and severally in favor of the Henry County Water Authority, as obligee ("Owner") in the penal sum of

_____ dollars (\$ _____), as of _____
[Insert Penal Sum in words and numerals] *[Insert Date of Construction Contract]*

WHEREAS, the Contractor has executed a contract with the Owner of even date herewith ("Construction Contract") for construction of:

INDIAN CREEK WRF EXPANSION TO 3 MGD

("Project"); and,

WHEREAS, the Owner has required the Contractor to furnish this Payment Bond containing the terms and conditions set forth herein as a condition to executing the Construction Contract with the Contractor;

NOW THEREFORE, the Surety and the Contractor, both jointly and severally, and for themselves, their heirs, administrators, executors and successors agree:

1.

The Construction Contract is hereby incorporated herein and by reference made a part hereof to the same extent and effect as though it were copied verbatim herein. The Surety and the Contractor are bound for the full performance of the Construction Contract including without exception all of its terms and conditions, both express and implied, and, without limitation, specifically including Contractor's obligation to pay for labor, materials, machinery, equipment and insurance provided in connection with the Construction Contract performance.

2.

For purposes of this Payment Bond, Beneficiary is defined as any subcontractor or other person supplying labor, materials, machinery, or equipment in the prosecution of the work provided for in the Construction Contract, or any other person entitled to the protection of this Payment Bond pursuant to the provisions of Title 36, Chapter 91, Official Code of Georgia Annotated.

3.

Every Beneficiary who has not been paid in full for labor or material furnished in the prosecution of the work on the Project before the expiration of a period of ninety (90) days after the day on which the last of the labor was done or performed by such person or the material or equipment or machinery was furnished or supplied by such person for which such claim is made, or when he or she has completed his



or her subcontract for which claim is made, shall have the right to bring an action on this Payment Bond for the amount, or the balance thereof, unpaid at the time of the commencement of such action and to prosecute such action to final execution and judgment for the sum or sums due such person; provided, however, that:

(A) Any person having a direct contractual relationship with a subcontractor but no contractual relationship, express or implied, with the Contractor where the Contractor has not complied with the notice of commencement requirements in accordance with Code Section 36-91-92, Official Code of Georgia Annotated, shall have the right of action upon this Payment Bond upon giving written notice to the Contractor within ninety (90) days from the day on which such person did or performed the last of the labor or furnished the last of the material or machinery or equipment for which such claim is made, stating with substantial accuracy the amount claimed and the name of the party to whom the material was furnished or supplied or for whom the labor was performed or done; provided, however, that: (i) the Contractor's failure to supply a copy of the notice of commencement within ten calendar days of receipt of a written request from a subcontractor, materialman or person shall render the provisions of this paragraph 3(A) inapplicable to such subcontractor, materialman or person, and (ii) the Contractor's failure to file a notice of commencement shall render the notice to contractor requirements of this paragraph 3(A) inapplicable.

(B) Any person having direct contractual relationship with a subcontractor but no contractual relationship express or implied with the Contractor where the Contractor has complied with the notice of commencement requirements in accordance with subsection (a) of Code Section 36-91-92, Official Code of Georgia Annotated, shall have the right of action on this Payment Bond provided such person shall, within thirty (30) days from the filing of the notice of commencement or thirty (30) days following the first delivery of labor, material, machinery or equipment, whichever is later, give to the Contractor a written notice setting forth:

(i) The name, address and telephone number of the person providing labor, material, machinery or equipment;

(ii) The name and address of each person at whose instance the labor, material, machinery or equipment is being furnished;

(iii) The name and the location of the Project; and

(iv) A description of the labor, material, machinery or equipment being provided and, if known, the contract price or anticipated value of the labor, material, machinery or equipment to be provided or the amount claimed to be due, if any; and

(C) Nothing contained in this Payment Bond shall limit the right of action of a Beneficiary to the ninety (90) day period referenced in paragraph 3(A) above.

The notice required under paragraph 3(A) of this Payment Bond may be served by registered or certified mail, postage prepaid, or statutory overnight delivery, duly addressed to the Contractor, at any place at which the Contractor maintains an office or conducts his or her business or at his or her residence, by depositing such notice in any post office or branch post office or any letter box under the control of the United States Postal Service; alternatively, notice may be served in any manner in which the sheriffs of the State of Georgia are authorized by law to serve summons or process.

4.

Contractor and Surety shall promptly make payments of all taxes, licenses, assessments, contributions, penalties, and interest thereon, when, and if, the same may be lawfully due the State of Georgia or any County, Municipality, or political subdivision thereof by reason of and directly connected with the performance of the contract, or any part thereof.



5.

The Surety's obligation hereunder shall not exceed the Penal Sum. As used in this Payment Bond, the term "Penal Sum" means the amount stated as the penal sum in the preamble of this Payment Bond, as that amount may be adjusted from time to time pursuant to paragraph 6 below plus the amount incurred by the Owner under paragraph 9 below.

6.

The Surety waives notice of any changes to the Construction Contract including, without limitation, changes in the contract time, the contract price, or the work to be performed. If the total amount payable by the terms of the Construction Contract is increased to an amount in excess of the then current Penal Sum, then, automatically and without notice to or any action required of any party, the Penal Sum shall be increased as the total amount payable by the terms of the Construction Contract is increased. No agreement, modification, omission, addition, or change in or to the Construction Contract, change in the work covered by the Construction Contract, or extension of time for the completion of the Construction Contract shall impair, affect, or release the Surety of this Payment Bond.

7.

No action can be instituted hereunder after one (1) year from the completion of the Construction Contract and the acceptance of the Project by the Owner and any other applicable public authorities.

8.

The Surety hereby agrees that no final settlement between the Owner and the Contractor shall abridge the right for any beneficiary hereunder whose claim may be unsatisfied.

9.

In the event that the Owner is required to enforce this Bond through any type of legal proceeding, the Contractor and Sureties shall pay all costs, including but not limited to attorney's fees, court costs, expert witness fees, litigation expenses, and any other cost incurred by the Owner in the enforcement of this Bond. Also, if the Owner is named in any type of legal proceeding concerning payment of any funds under the Contract or under this Bond, the Contractor and Sureties shall pay all costs, including but not limited to attorney's fees, court costs, expert witness fees, litigation expenses, and any other cost incurred by the Owner in the defense of such claim.

10.

Any Notice required to be given under the terms of this document shall be deemed to have been given on the date the same is hand-delivered to the parties to this document, deposited in the United States mail to the address hereinafter stated with sufficient postage affixed thereto to insure delivery, or sent by Certified Mail, Return Receipt Requested.

Surety:

Attn: _____



Contractor: _____

Attn: _____

**Owner: Henry County Water Authority
1695 Highway 20 West
McDonough, Georgia 30253
Attn: Lindy D. Farmer, Jr., General Manager**

11.

Notwithstanding any provision herein that may be to the contrary, this Payment Bond is intended to be a statutory payment bond under applicable laws of the State of Georgia and shall be so construed.

CONTRACTOR:

SURETY:

(Typed Name)

(Typed Name)

BY: _____ (SEAL)
(Signature)

BY: _____ (SEAL)
(Signature)

(Printed Name, Title, Address)

(Printed Name, Title, Address)

Payment Bond Contractor (February 2016)

**** END OF SECTION ****



SECTION 00630
PRE-CONSTRUCTION OATH

Project Name: Indian Creek WRF Expansion to 3 MGD

State of _____

County of _____

In accordance with O.C.G.A. 36-91-21(e), each of the undersigned persons affiliated with

(Contractor)

being first duly sworn, deposes and says that:

I have not directly violated O.C.G.A. 36-91-21(d), and more specifically, I have not

1. Prevented or attempted to prevent competition in such bidding or proposals by any means whatsoever;
2. Prevented or endeavored to prevent anyone from making a bid or proposal thereof by any means whatsoever; nor
3. Caused or induced another to withdraw a bid or proposal for the work.

Each undersigned, to the best of his/her knowledge, affirms that no other officers, agents or other persons acted for or represented the Contractor in the bidding for and procurement of this Contract.

Signature	Printed Name	Title	Date
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____
_____	_____	_____	_____

Subscribed and Sworn before me this _____ day of _____, 20____.

(Notary Public) (signature)

My Commission Expires: _____

(SEAL)

** END OF SECTION **



SECTION 00640
CERTIFICATION OF CONTRACTOR'S ATTORNEY

The undersigned Contractor hereby certifies one of the following:

_____ (initial) Prior to execution and delivery of the contract contained herein, the attorney has examined the attached contract, any applicable performance and payment bonds and the manner of execution thereof, as well as all other documents attached hereto and is of the opinion that upon the execution and delivery of these documents, same will constitute a valid and legally binding obligation of the undersigned contractor in accordance with the terms, conditions and provisions thereof.

Signature of Attorney

Printed Name of Attorney

Date

_____ (initial) The undersigned contractor has an attorney but has not obtained any legal opinion regarding the execution and delivery of these documents.

_____ (initial) The undersigned contractor does not have an attorney and has elected not to engage an attorney regarding the execution and delivery of this contract and attached documents.

Name of Contractor: _____

By: _____
(signature)

(printed name)

Title: _____

Date: _____

Subscribed and Sworn before me this _____ day of _____, 20____.

(Notary Public) (signature)

My Commission Expires: _____

(SEAL)

** END OF SECTION **



SECTION 00650
CERTIFICATION OF OWNER'S ATTORNEY

The duly authorized and acting legal representative of the Henry County Water Authority do hereby certify as follows:

Prior to execution and delivery thereof by the Henry County Water Authority, I have examined the attached contract and any applicable performance and payment bonds and the manner of execution thereof, and I am of the opinion that upon the correction of any matters noted hereon, the foregoing contract will be ready for execution and upon execution and delivery will constitute a valid and legally binding obligation upon the parties executing the same in accordance with the terms, conditions, and provisions thereof.

Attorney for Henry County Water Authority

By:

(signature)

(printed name)

Date:

** END OF SECTION **



SECTION 00660
INSURANCE CERTIFICATE CHECKLIST

Name of Vendor/Contractor: _____

Contract Name/Number: _____ Indian Creek WRF Expansion to 3 MGD _____

Reviewed by: _____ Date Reviewed: _____

Workers' Compensation and Employers Liability

Effective Date: _____ Expiration Date: _____

Are Effective Dates Current? Yes No

Insurance Carrier: _____ A.M. Best Rating (A- or better): _____

Coverage A: Workers' Compensation: Statutory Limits Provided? Yes No

Coverage B: Employers Liability: Limits of \$5,000,000 Provided? Yes No

Does policy provide coverage for leased employees, temporary staff and Part-time employees? Yes No

Are officer's/owner's included for coverage? Yes No

Commercial Automobile Liability

Effective Date: _____ Expiration Date: _____

Are Effective Dates Current? Yes No

Insurance Carrier: _____ A.M. Best Rating (A- or better): _____

Combined Single Limit for BI/PD of at least \$2,000,000? Yes No

Is liability coverage provided for owned/leased, hired and non-owned vehicles? Yes No

Commercial General Liability

Effective Date: _____ Expiration Date: _____

Are Effective Dates Current? Yes No

Insurance Carrier: _____ A.M. Best Rating (A- or better): _____

Are the following policy limits provided?

\$5,000,000 General Aggregate Yes No

\$2,000,000 Each Occurrence Yes No

\$5,000,000 Products/Completed Operations Yes No

\$2,000,000 Personal/Advertising Injury Yes No

\$500,000 Fire Damage/Fire Legal Liability Yes No

\$10,000 Medical Expense any one person Yes No

Contractual Liability provided at full policy limits? Yes No

Aggregate Limits apply Per Project/Per Job? Yes No

Coverage stipulated for Products/Completed Operations? Yes No

Occurrence Form or Claims Made Form? _____

If Claims-Made is continuity date at least the start date of the project? Yes No

Is the care, custody, control exclusion for property other than Contractor's property deleted? _____

Yes No



Excess/Umbrella Liability

Effective Date: _____ Expiration Date: _____

Are Effective Dates Current? Yes No

Insurance Carrier: _____ A.M. Best Rating (A- or better): _____

Are the following policy limits provided?

\$5,000,000 Aggregate Yes No
\$5,000,000 Each Occurrence Yes No

Does the excess/umbrella liability policy provide additional limits above the following:

General Liability Yes No
Automobile Liability Yes No
Employers Liability Yes No

Is Contractual Liability coverage included at full policy limits? Yes No

Coverage stipulated for Products/Completed Operations? Yes No

Occurrence Form or Claims Made Form?

If Claims-Made is continuity date at least the start date of the project? Yes No

Property/Builder's Risk-Installation Floater

Effective Date: _____ Expiration Date: _____

Are Effective Dates Current? Yes No

Insurance Carrier: _____ A.M. Best Rating (A- or better): _____

Are policy limits provided at least equal to the value of the project? Yes No

Is a replacement cost valuation provided? Yes No

Is coverage provided for "all-risk" or special perils? Yes No

Is coverage provided for personal property in transit? Yes No

Is coverage provided for damage to property and "soft costs"? Yes No

Is boiler and machinery coverage provided? Yes No

Is coverage provided for testing and start-up? Yes No

General Requirements

Are the Owners and Engineer included as additional insured? Yes No

Is the certificate issued to Henry County Water Authority? Yes No

Does the cancellation clause provide at least 30-day notice? Yes No

Is a waiver of subrogation rights included? Yes No

Is the Insurance Company's name listed on the certificate? Yes No

Does the certificate list the policy numbers next to each coverage? Yes No

Note: Continuous coverage is required for products and completed operations for a minimum of two years following completion of the job. The contractor must furnish an updated certificate of insurance for a period of two years following the completion of the job. Therefore, new certificates which show continuous general liability (including products and completed operations) or "tail liability" for claims-made policies (where the policy is not renewed/maintained) must be submitted to Henry County Water Authority on an annual basis for the two years following completion of the job.

Specific Requirements:

- 1. Insurance certificate must include the following affirmative statement: "Coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty (30) days prior written notice has been given to Owner and to each other additional insured to whom a certificate of insurance has been issued." Language stating that the Insurance Company is not responsible if the notice is not sent is not acceptable.



2. Insurance certificate must also show the following:

Owner's name: Henry County Water Authority
Address: 1695 Highway 20 West
McDonough, GA 30253

** END OF SECTION **



SECTION 00680
NOTICE TO PROCEED

Date

Contractor's Name
Contractor's Address

Project or Contract Name: Indian Creek WRF Expansion to 3 MGD

You are hereby notified to commence work in accordance with the Agreement dated _____, for the construction of the **Indian Creek WRF Expansion to 3 MGD** project on or before _____. In accordance with Article 3 of the Agreement, the date of Substantial Completion is _____ and the date of Final Completion is _____.

Before you may start any work at the site, paragraph 2.01 of the General Conditions provides that you must deliver to the Owner (with copies to Engineer and other identified additional insureds) certificates of insurance which is required to be purchased and maintained in accordance with the Contract Documents.

Also, before you may start any Work at the Site, you must **(add other requirements)**.

HENRY COUNTY WATER AUTHORITY

By: _____

Title: _____

** END OF SECTION **



SECTION 00690
CONTRACT COMPLETION AFFIDAVIT

State of _____

County of _____

(1) I, _____, being duly sworn do hereby affirm that I am duly authorized to make this affidavit on behalf of _____ (hereinafter called "Contractor") as _____ of Contractor in connection with the contract dated _____, between Henry County Water Authority (hereinafter called "Owner") and Contractor, for construction of the **Indian Creek WRF Expansion to 3 MGD** (hereinafter called the "Project").

(2) I affirm under oath that all work has been completed in accordance with contract provisions, and all laborers, sub-contractors and material supplier have been paid in full, and there are no suits or liens outstanding in connection with said contract or the Project.

(3) I affirm under oath that the agreed price for all of the labor, services and materials to be furnished for the Project is \$_____, and that \$_____ has been previously paid by Owner as progress payments for the Project.

(4) I affirm under oath that the balance of \$_____ on said total contract price of \$_____ is simultaneously being paid to Contractor as a final disbursement on the Project. I hereby acknowledge receipt of the same on behalf of Contractor, and I hereby acknowledge that this affidavit is made under the provisions of O.C.G.A. 44-14-316.2 for the purpose of inducing Owner to pay said balance to Contractor.

(5) I affirm under oath that all of the agreed price or reasonable value of the labor, services or materials for the Project has now been paid by Owner.

Contractor
Name: _____

By: _____
(signature of authorized agent)

(printed name of authorized agent)

Title: _____

Date: _____

Subscribed and Sworn before me this _____ day of _____, 20_____.

(Notary Public) (signature)

My Commission Expires: _____

(SEAL)

** END OF SECTION **



STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

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and

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ACEC

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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 01 of the Specifications. The General Requirements are applicable to all Sections of the Specifications and to the entire Work.
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.

- 25.1 Liquidated Damages—amounts shall be as stipulated in the Agreement. Liquidated damages shall apply to the Contract Times for the Project. Liquidated Damages shall be both additive and cumulative. Liquidated Damages shall end upon Substantial Completion, Completion of the Work associated with each Milestone Date, and upon final completion of the Work.
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 to provide the following: (i) the Owner full time, uninterrupted, continuous operation of the work; and (ii) all required functional, performance, and operational or startup testing has been successfully demonstrated for all components, devices, equipment, and systems to the satisfaction of the Engineer in accordance with the requirements of the Specifications; and (iii) all required inspections and other work necessary for the Engineer to certify "substantially complete" have been completed. ~~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. See General Conditions Paragraph 14.04 for additional provisions.
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,” “as required” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the requirements of and the information in the Contract Documents and compliance 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.~~

A. When Contractor delivers the executed Agreements to Owner, Contractor shall also deliver to Owner such Bonds and Certifications of Insurance as Contractor may be required to furnish in

accordance with Article 5.

- B. Contract, Performance Bond and Payment Bond shall not be dated prior to submittal to the Owner so that all three can be filled in by the Owner with the same date.
- C. Certified copy of Power of Attorney for Performance Bond and Payment Bond must be dated prior to submittal to the Owner with a date which is within the previous fifteen days.
- D. Performance Bond, Payment Bond and Certified Copy of Power of Attorney must have corporate seal of surety.
- E. Signature of attorney-in-fact for surety company on Performance Bond and Payment Bond must be one of persons authorized to sign on certified copy of Power of Attorney.
- F. The copy of Contract Documents to be kept by the Owner must have original signed certificate version of the certified Power of Attorney. Other copies may have copies of the certificate.
- G. If Contractor is a corporation, Contract, Performance Bond and Payment Bond must have corporate seal of Contractor affixed, must show title of person signing on behalf of Contractor and must be attested by Secretary or Assistant Secretary.
- H. The Payment Bond and the Performance Bond must be on Owner's forms, included herein.
- I. Surety company must be shown on the current Department of the Treasury Circular 570, Surety Companies Acceptable on Federal Bonds, with an underwriting limitation greater than the amount of the Contract.

2.02 *Copies of Documents*

- A. Owner shall will furnish to Contractor up to ten-four printed or hard copies of the Drawings and Project Manual Contract Documents and one counterpart of the executed Contract Agreement. Additional copies will be furnished upon request at the cost of reproduction.
- B. Owner may also, if requested by Contractor, furnish Contractor with electronic copies of the Drawings and other Contract Documents. Contractor agrees it will only use the same for performing the Work and will not disseminate the same except to its subcontractors where necessary to perform the Work. Contractor shall obtain written acceptance of any subcontractor to these limitations before disseminating the same to such subcontractor. Electronic copies of the Contract Documents will be provided as a convenience to the Contractor. The Owner and Engineer assume no liability and shall be held harmless for any discrepancies between the hard copy and electronic copy of the Contract Documents.
 - 1. To receive electronic copies of the Contract Documents, Contractor shall complete and provide to Engineer an Electronic Media Release Form.

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 date established in the Notice to Proceed. A Notice to Proceed may be given at any time within 30-60 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 one-hundred and twentieth day after the Owner receives copies of the Agreement properly executed by the Contractor and the Bonds, evidence of proper insurance and other materials required by the Notice of Award.~~

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. 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.

B. Preliminary Schedules: Within 10 days after the Commencement of the Contract Time ~~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; which indicates each required Submittal and the dates for submitting, time for reviewing and processing each Submittal (periodic Submittals may be listed by a common monthly date); 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~~ in a format acceptable to the Engineer and in accordance with the requirements specified in the General Requirements.

-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~~ Within ten days after the preconstruction conference a conference attended by Contractor, Owner, 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 as being the Contractor's schedule for the 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. The Progress Schedule may subsequently be adjusted in accordance with Paragraph 6.04 and applicable provisions of the General Requirements.~~
 2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals. The Schedule of Submittals may subsequently be adjusted in accordance with Paragraph 6.04 and applicable provisions of the General Requirements.
 3. Contractor's Schedule of Values will be acceptable to the Engineer as to form and substance if it is provided in accordance with the requirements specified in the General Requirements. ~~provides a reasonable allocation of the Contract Price to component parts of the Work.~~

2.08 *Licensing*

Before any work at the site is started which is governed by the Construction Industry Licensing Board of Georgia (O.C.G.A. Section 43-14-1 et seq and Section 43-41 et seq), or its rules or regulations, Contractor shall inform himself of those rules and regulations, and qualifications for licensure, and if requested shall deliver proof of compliance to the Owner and Engineer.

ARTICLE 3 – CONTRACT DOCUMENTS; INTENT, AMENDING, REUSE

3.01 *Intent*

- A. The individual components of 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.
- D. Where the word “similar” occurs in the Contract Document, it shall have a general meaning and not be interpreted as being identical, and all details shall be worked out in relation to their location and their connection with other parts of the Work.
- E. Each and every clause or other provision required by law to be inserted in these Contract Documents shall be deemed to be inserted herein, and they shall be read and enforced as though it were included herein, and if through mistake or otherwise, any such provision is not inserted, or if not correctly inserted, then upon the application of either party, the Contract Documents shall forthwith be amended to make such insertion.
- F. “Imperative” or “Command” type language is used in the Contract Documents. This command language refers to and is directed to the Contractor.
- G. Emphasis, such as italics or quotes, has been used throughout the Contract Documents. Use of emphasis shall not change the meaning of the term emphasized.

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).
2. In resolving inconsistencies within the Contract Documents, precedence shall be given in the following descending order:
 - a. Change Orders.
 - b. Work Change Directives.
 - c. Field Orders.
 - d. Engineer's written interpretations and clarifications.
 - e. Notice to Proceed.
 - f. Addenda.

g. Contract Agreement.

h. Supplementary Conditions.

i. General Conditions.

j. Specifications.

k. Drawings:

i. Figure dimensions on Drawings shall take precedence over scaled dimensions.

ii. Detailed drawings shall take precedence over general drawings.

iii. In case of discrepancy between small-scale detail and large-scale detail, the large-scale detail shall govern. On any of the Drawings where a portion of the Work is drawn out and the remainder is shown in outline, the portion drawn out shall apply also to all other like portions of the Work.

l. Bidding Requirements.

3. In cases where products or quantities are omitted from the Specifications, the description and quantities on the Drawings shall govern.

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.
- D. The Owner has begun to obtain all lands, rights-of-way and easements as indicated in the Contract Documents however, delays obtaining such lands may occur. If the Owner is unable to obtain lands as indicated in the Contract Documents, the Owner will notify the Contractor of those lands which are not yet acquired and those areas where lands are available. Contractor shall begin the Work upon such land and rights-of-way as Owner has acquired.

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 that have been utilized by the Engineer in preparing the Contract Documents; and
- 2. those drawings ~~known to Owner~~ of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been utilized by the Engineer in preparing the Contract Documents.

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.

[See Supplementary Conditions SC-4.02]

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~~are 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.

- C. The dimensions and descriptions given on the Drawings for adjacent work by others, if any, (including any existing facilities or utilities previously constructed for Owner) are based on the design drawings and not as-built drawings. Prior to commencing the Work, the Contractor shall verify all as-built conditions and information whenever existing facilities or utilities may impact the Work. Failure of Contractor to so verify all as-built conditions prior to commencing the Work shall bar Contractor from later seeking additional compensation for conflicts with existing facilities or utilities.
- D. Prior to the construction or installation of any proposed facility or pipeline, the Contractor shall expose all existing utilities true to their vertical and horizontal location, within the vicinity of the Work. In order to avoid conflicts between existing and proposed facilities or utilities, the Contractor shall either relocate the existing or proposed utility on a temporary or permanent basis, or shall take whatever means necessary to protect the existing facilities or utilities during the installation of proposed utilities, as approved by the Engineer. No additional payment will be made for the relocation of existing utilities or for any work associated with the protection of existing facilities or utilities.

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~~ Engineer. 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.
- B. Engineer may check the lines, elevations, and reference marks set by Contractor, and Contractor shall correct any errors disclosed by such check. Such a check shall not be considered as approval of Contractor's work and shall not relieve Contractor of the responsibility for accurate construction of the entire Work.
- C. The Contractor shall review the Contract Documents and the Project site to determine the presence and location of any property or right-of-way monuments or markers, and to assess the possibility of disruption to these monuments or markers. It will be the Contractor's responsibility to flag, erect guard posts, or provide offset references for the protection of these property or right-of-way monuments or markers. In the event these monuments or markers are covered over or disturbed, it will be the Contractor's responsibility to employ a surveyor licensed in the state of Georgia to re-establish those monuments or markers of property or rights-of-way, which were present prior to Work on the Project.

- D. It shall be the Contractor's responsibility to verify all reference points shown on the Contract Documents prior to beginning Work on the site. This verification shall be conducted by professionally qualified personnel in a manner which will verify the accuracy of the information shown in the Contract Documents. On projects which involve the connection to, or additions to existing structures, the elevations of these existing structures shall also be verified. Any findings which differ from those shown on the Contract Documents shall be submitted in writing to the Engineer for resolution.
- E. Additional surveys necessary for the construction staking shall be performed by the Contractor, the cost of which shall be incorporated into the appropriate items of Work. On projects in which payment is classified by depth of cut, the construction staking shall be performed in a manner which will allow for the determination of cut classification. During construction of the project, the Contractor shall keep a daily log and record of the location of all underground pipes, all structures, and any deviation from the Drawings. The Contractor shall keep and furnish this daily log and record in a manner which will allow the Engineer to incorporate these items into the Contract Documents.

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 issue a Work Change Directive or Change Order as appropriate. ~~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~~ is made by the Owner 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 below in the Supplementary Conditions.~~
 1. Surety shall be in good standing with Georgia's Insurance Commissioner's Office.
 2. Surety and Insurers must have an A.M. Best Financial Strength Rating and a Financial Size Category as stated in the insurance requirements specified elsewhere in these Contract Documents.

3. The surety shall have an underwriting limitation in Circular 570 in excess of the Contract Price.

B. All Sureties and Insurers must have an A.M. Best Financial Strength Rating of A- or higher, with a Financial Size Category of X or higher.

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, if any.
- 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.
- F. Notwithstanding provisions of O.C.G.A., Section 33-23-44, insurance certificate must include the following affirmative statement: "Coverage afforded will not be cancelled, materially changed or renewal refused until at least thirty (30) days prior written notice has been given to Owner and to each other additional insured to whom a certificate of insurance has been issued."
- G. Insurance certificate must show proper name and address of Henry County Water Authority, 1695 Highway 20 West, McDonough, GA 30253 and show Owner, Engineer, and Engineer's Consultants as additional insureds.
- H. Insurance certificate must show coverage applies for contractual liability for Contractor's indemnity obligations under Paragraphs 6.07, 6.11 and 6.20 of the General Conditions.
- I. In addition to the requirement for the policy limits specified under S.C. 5.04.A.3-A.5, the applicable insurance certificate must show that the entire aggregate policy limits for general liability coverage will apply specifically for the Project.
- J. Each insurance certificate for coverage other than Worker's Compensation Insurance must show that a waiver of rights of recovery against any of the insureds or the additional insureds is in effect.

- K. Certificate for Contractor's liability insurance must show coverage of claims for damages because of bodily injury, sickness or death of any person or property damage resulting from the ownership, maintenance or use of mobile equipment.
- L. Certificate for Worker's Compensation Insurance must show coverage includes executive officers and Contractor's leased employees, temporary staff and part-time employees.
- M. Owner may waive specific insurance coverages set forth in SC-5.04 where contractor provides equivalent insurance coverage by way of a different combination of policies.
- N. Each insurance certificate must show coverage is underwritten with an insurance carrier which has A.M. Best ratings as stipulated in Paragraph 5.02.B.

5.04 *Contractor's Insurance [See Supplementary Conditions SC-5.04]*

- 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.

C. The limits of liability for the insurance required by paragraph 5.04.B.2 of the General Conditions shall provide coverage specified in the Supplementary Conditions or greater where required by Laws and Regulations.

D. Any renewal of a policy shall have an original retroactive date no later than the date of the Contract.

E. Additional Insureds: The Owner, Engineer, and Engineer's Consultant shall be covered as Additional Insured under any and all Insurance required by this Contract, and such insurance shall be primary with respect to the Additional Named Insured. Confirmation of this shall appear on the Accord Certificate of Insurance, and on any and all applicable Insurance policies. However, this requirement does not apply to Workers' Compensation or Professional Liability Insurance. Copies of endorsements showing that the Owner and each additional insured identified herein have been added to the policies as an additional insured shall be attached to each of the certificates.

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.~~

A. Contractor shall purchase and maintain property insurance upon the Work at the site in the amount of the full replacement cost thereof except for flood perils which shall have a \$1,000,000 limit (subject to such deductible amounts as may be provided in these Supplemental Conditions or required by Laws and Regulations). This insurance shall:

1. include the interests of Owner, Contractor, Subcontractors, Engineer, Engineer's Consultants and any other person or entities identified in the Supplementary Conditions, each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;
2. be written on a Builder's Risk or Installation Floater "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework and Work in transit and shall insure real and personal property against at least the following perils: fire, lightning, extended coverage, theft, vandalism and malicious mischief, explosives and blasting, wind, flood, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage, and such other perils 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, permits, loss and damage to the Work, temporary building and scaffoldings, false work, work in transit, and materials and supplies, fixtures, machinery and equipment);
4. cover materials and equipment in transit for incorporation in the Work or stored at the site or at any other location prior to being incorporated in the Work, provided that such materials and equipment have been recommended by Engineer; and be maintained in effect until final agreed to in writing by Owner, Contractor, and Engineer with thirty days written notice to each other additional insured to whom a certificate of insurance has been issued.

5. allow for partial utilization of the Work by Owner;
6. include testing and startup;
7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued; and
8. contain the following provisions: (1) coverage for property in transit and (2) coverage for building damage as required by ordinance and law including demolition, debris removal and increased cost of construction.
9. Property insurance furnished under this contract shall have deductibles no greater than \$25,000 for all perils.

B. 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 or approved by Owner. 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.

C. The policies of insurance required to be purchased and maintained by Contractor in accordance this paragraph 5.06 shall comply with the requirements of GC 5.04.B.5.

5.07 *Waiver of Rights*

A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 by Contractor 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~~ Contractor as trustee or otherwise payable under any policy so issued.

~~B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, 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 Contractor in accordance with this Article 5 on the basis of non-conformance its not complying with the Contract Documents, the objecting party shall so Owner will notify the other party Contractor in writing thereof within 10ten days after receipt of the certificates (or other evidence requested) required by of the date of delivery of such certificate to Owner in accordance with Paragraph 2.01.B. Owner

~~and Contractor shall each provide to the other such additional information in respect of insurance provided by Contractor as the other Owner 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, provide quality control, 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. Contractor shall also designate, in writing, a representative, hereinafter referred to as Project Manager, assigned to the Project on a full-time basis during execution of the Work who shall have the authority to act on behalf of Contractor, including executing the orders or directions of the Engineer without delay. This Superintendent and/or Project Manager shall have full authority to promptly supply products, tools, plant equipment, and labor as may be required to diligently prosecute the Work. All communications given to or received from the Superintendent and/or the Project Manager shall be binding on Contractor.
- C. If at any time during the Project the Superintendent or Project Manager leaves the Project site while Work is in progress, Engineer shall be notified and provided with the name of Contractor’s representative having responsible charge.

D. Contractor shall also designate the person responsible for Contractor's quality control while Work is in progress. Engineer shall be notified in writing prior to any change in quality control representative assignment.

E. Prior to the Commencement of the Contract Times, Contractor shall furnish to the Owner and Engineer the names, resumes, 24-hour contact information and other relevant information associated with the Project Manager and the Superintendent that are to be assigned to this project. The Project Manager and Superintendent must be acceptable to the Owner and Engineer.

6.02 *Labor; Working Hours [See Supplementary Conditions SC-6.02]*

A. Contractor shall provide competent, skilled, 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. Contractor shall, upon demand from the Engineer, immediately remove any manager, superintendent, foreman or workman whom the Engineer or Owner may consider incompetent or undesirable.

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.

C. Regular working hours may be Monday through Friday, excluding holidays, occurring between the hours of 7:00 AM and 7:00 PM, unless restricted otherwise. Contractor shall establish a 40-hour work week with regular scheduled work times, e.g., four 10-hour days or five 8-hour days, within the hours and days allowed above. Approval for specific work outside regular scheduled work times shall be requested no less than 48 hours prior to the requested work period. Contractor shall request approval of changes in regular scheduled work times no less than one week prior to the desired change. Occasional unscheduled overtime on weekdays may be permitted provided reasonable notice is given to Engineer.

D. Contractor shall pay all extra costs incurred by the Owner associated with work, outside of regular working hours, including additional support services, inspection services, testing services, utilities or other applicable costs. The cost associated with the Owner's inspection overtime will be the amounts as provided in the Supplementary Conditions per hour per individual, depending upon individuals assigned to the Project, the type of work being inspected, and the date of the invoice; i.e., allowing for salary escalation. Contractor will not be responsible for extra costs associated with inspection overtime for work in excess of 50 hours per week when such overtime work is explicitly required by the Contract Documents.

E. Except in the case of emergencies or other unusual circumstances, no work shall be permitted on the project on Sunday.

F. The Engineer will determine to what extent extraordinary onsite personnel work is required during Contractor's overtime work or working hours outside regular scheduled work hours.

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, quality control, 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 products (material and equipment) provided on this Project shall be new and unused and provided by the Contractor unless specified otherwise, shall be products currently manufactured by the manufacturer, i.e., products shall not be discontinued or out-of-date products nor shall they be of the last production run of the product. Contractor shall incorporate the previous sentence in any contract or agreement between Contractor and subcontractor or supplier supplying products provided on this Project. All special warranties and guarantees required by the ~~Specifications~~ Contract Documents 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.
- D. Without limiting the responsibility or liability of the Contractor pursuant to this agreement, all warranties given by manufacturers on materials or equipment incorporated in the work are hereby assigned by the Contractor to the Owner. Such assignment shall be effective upon completion of Contractor's warranty period. If requested, the Contractor shall execute formal assignments of said manufacturer's warranties to the Owner. All such warranties shall be directly enforceable by the Owner. Such assignment shall in no way affect the Contractor's responsibilities and duties during the warranty period.

6.04 *Progress Schedule*

- A. The Contractor shall proceed with the Work at a rate of progress which will ensure completion within the Contract Time. It is expressly understood and agreed by and between the Contractor and the Owner, that the Contract Times for the Work described herein are reasonable times, taking into consideration the average climatic and economic conditions, and other factors prevailing in the locality of the Work.
- BA. Contractor shall provide all resources, labor, materials, equipment, services, etc. necessary to adhere to the Progress Schedule established in accordance with Paragraph 2.07 and the General Requirements 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 and the General Requirements) an updated the Progress Schedule that will not result in changing the Contract Times and an updated Schedule of Submittals with each partial payment request, but no less than monthly.~~ Contractor's failure to provide

acceptable updated Progress Schedule and Schedule of Submittals will delay processing of the pay request until receipt of the acceptable updated Progress Schedule and/or an updated Schedule of Submittals. Such adjustments will updates and adjustments shall 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.
3. Number of anticipated days associated weather conditions, as defined in the Supplementary Conditions, shall be included on the critical path of Project Schedule.

C. If the Progress Schedule reflects a completion date prior to the completion date established by the Agreement, this shall afford no basis to claim for delay should Contractor not complete the Work prior to the projected completion date. Instead, all "float" between the completion date in Contractor's schedule and the completion date established in the Agreement shall belong to and is exclusively available to the Owner. Should a change order be executed with a revised completion date, the Progress Schedule shall be revised to reflect the new completion date.

D. Project Coordination Meetings: The Contractor shall participate in Project Coordination Meetings to be held on the site monthly, or more often if conditions warrant, to establish the current state of completion and revise the schedule as necessary. The Project Coordination Meeting will be conducted by the Owner and/or the Engineer.

E. The Contractor shall implement the detailed schedule of activities to the fullest extent possible between Project Coordination Meetings.

F. The Contractor shall prepare its daily report by 10:00 a.m. of the day following the report date. This daily report will contain, as a minimum, the weather conditions; number of workers by craft, including supervision and management personnel on site; active and inactive equipment on site; work accomplished by schedule activity item; problems; and visitors to the jobsite.

G. If a current activity or series of activities on the overall project schedule is behind schedule and if the late status is not due to an excusable delay for which a time extension would be forthcoming, the Contractor shall attempt to reschedule the activity to be consistent with the overall Project Schedule so as not to delay any of the Contract milestones. The Contractor agrees that:

1. The Contractor shall attempt to expedite the activity completion so as to have it agree with the overall progress schedule. Such measures as the Contractor may choose shall be made explicit during the Project Coordination Meeting.
2. If, within two weeks of identification of such behind-schedule activity, the Contractor is not successful in restoring the activity to an on schedule status, the Contractor shall:
 - a. Carry out the activity with the scheduled crew on an overtime basis until the activity is complete or back on schedule.
 - b. Increase the crew size or add shifts so the activity can be completed as scheduled.

c. Commit to overtime or increased crew sizes for subsequent activities, or some combination of the above as deemed suitable by the Engineer.

3. These actions shall be taken at no increase in the Contract Price.

H. The Contractor shall maintain a current copy of all construction schedules on prominent display in the Contractor's field office at the Project site.

I. The Contractor shall cooperate with the Owner and Engineer in all aspects of the Project scheduling system. Failure to implement the Project scheduling system or to provide specified schedules, diagrams and reports, or to implement actions to re-establish progress consistent with the overall progress schedule may be causes for withholding of payment.

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. Acceptance of any Subcontractor, other person or organization by Owner shall not constitute a waiver of any right of Owner to reject defective Work. 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. If more than twenty-five percent of the work (as measured by dollar value and not including specialty work that is customarily subcontracted) is to be performed by one or more subcontractors then Contractor is obligated to notify Owner in writing of this intent with the submission of the Bid and to provide such supplemental information within five days of the bid as outlined under section 11 of INSTRUCTIONS TO BIDDERS.
- 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~~ shall 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.~~

H. Owner or Engineer may furnish to any Subcontractor, Supplier or other person or organization, to the extent practicable, information about amounts paid on their behalf to Contractor in accordance with Contractor's Applications for Payment.

I. Specialty Subcontractors: Contractor shall utilize the services of Specialty Subcontractors on those parts of the Work which is declared as specialty work in Specifications and which, under normal contracting practices, is best performed by Specialty Subcontractors, as required by the Engineer in Engineer's sole discretion, at no additional cost to the Owner. If Contractor desires to self-perform specialty work, Contractor shall submit a request to the Owner, accompanied by evidence that Contractor's own organization has successfully performed the type of work in question, is presently competent to perform the type of work, and the performance of the work by Specialty Subcontractors will result in materially increased costs or inordinate delays.

J. The Contractor shall perform a minimum of 50 percent of the onsite labor with its own employees.

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.
- B. The Owner will submit Contract Drawings and Specifications to the Henry County Building and Plan Review Department.

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.
- D. The Contractor shall keep fully informed of all laws, ordinances and regulations of the federal, state, county, city and municipal governments or authorities in any manner affecting those engaged or employed in the Work or the materials used in the Work or in any way affecting the conduct of the Work and of all orders and decrees of bodies or tribunals having any jurisdiction or authority over same.
 - 1. Security and Immigration Act: Contractor and its Subcontractors shall register and comply with O.C.G.A. 13-10-90 et. seq. and Georgia Department of Labor Chapter 300-10-1.
- E. Contractor shall perform those duties as they relate to O.C.G.A. Section 36-91-92, including filing the Notice of Commencement. Contractor shall provide Owner and Engineer with proof of having performed these duties before any progress payments or final payment shall be considered due and payable to the Contractor.
- F. Where professional engineering and/or architectural services are required in connection with any of the components required by the Contract, all Bidders and component suppliers must make certain that there is full compliance with all applicable laws of the State of Georgia and any other

state governing professional engineering and/or architecture. The Owner and Engineer do not warrant that any entity listed as an acceptable manufacturer is or will be in compliance with such laws.

G. Any fines levied against the Owner for failure of Contractor to properly maintain required NPDES erosion and sediment control measures or any other related requirements will be deducted as set-offs from payments due Contractor.

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~~shall be delivered to Engineer for Owner. See General Requirements for additional requirements.

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 pollution of or 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).
- G. The property, improvements or facilities at the Site shall be replaced or restored to a condition as good as when Contractor entered upon the Site. In case of failure on the part of Contractor to restore such property, or make good such damages or injury, the Owner may, after 48 hours written notice, or sooner in the case of an emergency, proceed to repair, rebuild, or otherwise restore such property, improvements or facilities as may be deemed necessary. The cost thereof will be deducted from any monies due or which may become due Contractor under this Contract.

H. Contractor's Plan for Safety Precautions and Programs

1. Before any Work at the site is started, Contractor shall have prepared Contractor's written plan for Project-specific safety precautions and programs, complete with respect to procedures and actions that the Contractor intends Contractor and all others as provided in Paragraphs 6.13.A.1 and 13.02.A, to follow in order for Contractor and all others to comply with all applicable Laws and Regulations. Contractor's plan for safety precautions and programs shall have been approved and endorsed by Contractor's designated safety representative required in Paragraph 6.14.A.
2. Contractor shall revise Contractor's plan for safety precautions and programs at appropriate times to reflect changes in construction conditions, the Work, Contractor's means, methods, techniques, sequences and procedures of construction, and the requirements of paragraph 13.02.A. Contractor shall disseminate the original plan and revisions to all others indicated in Paragraphs 6.13.A and 13.02.A.
3. Contractor's plan for safety precautions and programs will not require more stringent safety requirements, training or other qualifications for all others, including those specified in Paragraph 13.02.A and their employees, than Contractor sets forth for comparable activity and responsibility of Contractor, Subcontractors, and Suppliers and their respective employees.

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 or adjusted 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~~ Specifications.
- b. Data shown on the Shop Drawings ~~shall~~ 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 Shop Drawing and Sample 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 return as incomplete or will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval or disapproval 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 or disapproval 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.

F. Excessive Submittal Resubmission: Engineer will record time required by Engineer for excessive submittal review occasioned by Contractor's resubmission, in excess of two resubmissions of any required submittal, caused by unverified, unchecked or unreviewed, incomplete, inaccurate or erroneous, or nonconforming submittals. Upon receipt of Engineer's accounting of time and costs, Contractor will reimburse Owner for the charges of Engineer's review for excessive resubmissions through set-offs from the recommended Owner payments to Contractor as established in Paragraph 14.02.D. of these General Conditions.

G. In the event that Contractor provided a submittal for a previously approved item, whether such is as a substitution or in addition to the previously approved item, Contractor shall reimburse Owner for Engineer's charges for such time as may be required to perform all reviews of the substitute item, unless the change is specifically requested by the Owner.

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, regardless of whether or not caused in part by any negligence or omission of a person or entity indemnified hereunder or whether liability is imposed upon such indemnified party by Laws and Regulations regardless of the negligence of any such person or entity. If through the negligent act or omission on the part of Contractor, any other contractor or any subcontractor shall suffer loss or damage on the Work, Contractor shall settle with such other Contractor or Subcontractor by agreement or arbitration if such other Contractor or Subcontractor will so settle. If such other Contractor or Subcontractor shall assert any claim against Owner and/or Engineer on account of any damage alleged to have been sustained, Owner shall notify Contractor, who shall indemnify and save harmless Owner and Engineer against any such claims.

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 negligent preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 2. negligently giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.
- D. Contractor, Subcontractors, Suppliers and others on the Project, or their sureties, shall maintain no direct action against the Engineer, their officers, employees, affiliated corporations, consultants, and subcontractors, for any claim arising out of, in connection with, or resulting from the engineering services performed. Only the Owner will be the beneficiary of any undertaking by the Engineer.

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 with other contractors.
- C. If Owner contracts with others for the performance of other work on the Site, the Contractor shall attend and participate in coordination meetings with the other on-site contractors.

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.

7.04 Claims Between Contractors

- A. Should Contractor cause damage to the work or property of any separate contractor at the Site, or should any claim arising out of Contractor's performance of the work at the Site be made by any separate contractor against Contractor, Owner, Engineer, or any other person, Contractor shall promptly attempt to settle with such other contractor by agreement, or to otherwise resolve the dispute by mediation, arbitration, or at law.
- B. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold Owner, Engineer, and the officers, directors, employees, agents, and other consultants of each and any of them harmless 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 directly, indirectly or consequentially out of or resulting from any action, legal or equitable, brought by any separate contractor against Owner, Engineer, or the officers, directors, employees, agents, and other consultants of each and any of them to the extent based on a claim arising out of Contractor's performance of the Work. Should a separate contractor cause damage to the Work or property of Contractor or should the performance of work by any separate contractor at the Site give rise to any other claim, Contractor shall not institute any action, legal or equitable, against Owner, Engineer, or the officers, directors, employees, agents, and other consultants of each and any of them or permit any action against any of them to be maintained and continued in its name or for its benefit in any court or before any mediator or arbitrator which seeks to impose liability on or to recover damages from Owner, Engineer, or the officers, directors, employees, agents, or other consultants of each and any of them on account of any such damage or claim.
- C. If Contractor is delayed at any time in performing or furnishing Work by any act or neglect of a separate contractor, and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable hereto, Contractor may make a claim for an extension

of times in accordance with Article 12. An extension of the Contract Times shall be Contractor's exclusive remedy with respect to Owner, and/or Engineer and the officers, directors, employees, agents, or other consultants of each and any of them for any delay, disruption, interference or hindrance caused by any separate contractor. This Paragraph does not prevent recovery from Owner and Engineer for activities that are their respective responsibilities.

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 [See Supplementary Conditions SC-9.03]*

- 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 have authority to determine the actual quantities and classifications of Unit Price Work performed by Contractor. If Engineer exercises such authority, 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, except that Owner shall determine whether bonds, certificates of insurance and release of liens comply 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).
 - 1. Owner may, in anticipation of possibly ordering an addition, deletion or revision to the Work, request Contractor to prepare a proposal of cost and times to perform Owner's contemplated changes in the Work. Contractor's written proposal shall be transmitted to the Engineer promptly, but not later than fourteen days after Contractor's receipt of Owner's written request and shall remain a firm offer for a period not less than sixty days after receipt by Engineer.
 - 2. Contractor is not authorized to proceed on an Owner contemplated change in the Work prior to Contractor's receipt of a Change Order (or Work Change Directive) incorporating such change into the Work.

3. Owner's request for proposal or Contractor's failure to submit such proposal within the required time period will not justify a claim for an adjustment in Contract Price or Contract Times (or Milestones).

4. The Owner shall not be liable to the Contractor for any costs associated with the preparation of proposal associated with the Owner's contemplated changes in the Work.

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.

B. In signing a Change Order, the Owner and Contractor acknowledge and agree that:

1. The stipulated compensation (Contract Price or Contract Time, or both) set forth in the Change Order includes payment for:

a. the Cost of the Work covered by the Change Order,

- b. Contractor's fee for overhead and profit.
 - c. interruption of Progress Schedules.
 - d. delay and impact, including cumulative impact, on other work under the Contract Documents, and
 - e. extended home office and jobsite overhead;
- 2. the Change Order constitutes full mutual accord and satisfaction for the change to the Work;
 - 3. No reservation of rights to pursue subsequent claims on the Change Order will be made by either party; and
 - 4. No subsequent claim or amendment of the Contract Documents will arise out of or as a result of the Change Order.

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 and Disputes*

- 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~~14 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 written supporting data shall be delivered to the Engineer and the other party to the Contract within ~~60~~21 days (and monthly thereafter for continuing events) 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.
 1. Full rental cost for rented, leased, and/or owned equipment shall not exceed the rates listed in the Rental Rate Blue Book published by Equipment Watch, a unit of Primedia, Inc., as adjusted to the regional area of the Project. The most recent published edition in effect at the commencement of the actual equipment use shall be used.

2. Rates shall apply to equipment in good working condition. Equipment not in good condition, or larger than required, may be rejected by Engineer or accepted at reduced rates.
3. Equipment in Use: Actual equipment use time documented by the Engineer shall be the basis that the equipment was on and utilized at the Project site. In addition to the leasing rate above, equipment operational costs shall be paid at the estimated operating cost, payment category (and the table below), and associated rate set forth in the Blue Book if not already included in the lease rate.

The hours of operation shall be based upon actual equipment usage to the nearest full hour, as recorded by the Engineer.

<u>Actual Usage</u>	<u>Blue Book Payment Category</u>
<u>Less than 8 hours</u>	<u>Hourly Rate</u>
<u>8 or more hours but less than 7 days</u>	<u>Daily Rate</u>
<u>7 or more days but less than 30 days</u>	<u>Weekly Rate</u>
<u>30 days or more</u>	<u>Monthly Rate</u>

4. Equipment when idle (Standby): Idle or standby equipment is equipment on-site or in transit to and from the Work site and necessary to perform the Work under the modification but not in actual use. Idle equipment time, as documented by the Engineer, shall be paid at the leasing rate determined in 11.01.A.5.c., excluding operational costs.
5. Where a breakdown occurs on any piece of equipment, payment shall cease for that equipment and any other equipment idled by the breakdown. If any part of the Work is shut down by the Owner, standby time will be paid during non-operating hours if diversion of equipment to other Work is not practicable. Engineer reserves the right to cease standby time payment when an extended shutdown is anticipated.
- 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 any of the Work that has been completed and accepted by the Owner, 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. If, however, any such loss or damage to the Work that has been accepted by Owner requires reconstruction and Contractor is placed in charge thereof, Contractor shall be paid for services, a fee proportionate to that stated in Paragraph 12.01.c.

- 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~~ value fixed by the Owner or by unit price values fixed by the Owner (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~~ where the methods under Paragraph 12.01.B.2. are not selected by the Owner, 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 based on subcontractor's actual Cost of the Work;
- 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; except the maximum total allowable cost to Owner shall be the Cost of the Work plus a maximum collective aggregate fee for Contractor and all tiered Subcontractors of 26.8 percent.
- 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 [See Supplementary Conditions SC-12.03]*

- 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, quarantine restrictions, strikes, freight embargoes, acts of war (declared or not declared), 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 is responsible for the initial and subsequent inspections of Contractor's Work to ensure that the Work conforms to the requirements of the Contract Documents. 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. Contractor shall establish an inspection program and a testing plan acceptable to the Engineer and shall maintain complete inspection and testing records available to Engineer.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all non-contractor 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.
- G. Tests required by Contract Documents to be performed by Contractor and that require test certificates to be submitted to Owner or Engineer for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and Regulations and applicable state and local statutes. In the event state license or certification is not required testing laboratories or agencies shall meet the following applicable requirements:
1. "Recommended Requirements for Independent Laboratory Qualification", published by the American Council of Independent Laboratories.
 2. Basic requirements of ASTM E329, "Standard of Recommended Practice for Inspection and Testing Agencies for Concrete and Steel as Used in Construction" as applicable.
 3. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Bureau of Standards or accepted values of natural physical constants.

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.
- B. If Owner stops Work under Paragraph 13.05.A. Contractor shall not be entitled to an extension of Contract Times or increase in Contract Price.

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.
- C. Contractor shall promptly segregate and remove rejected products from the Site.

D. If rejected products or Work is not removed within 48 hours, the Engineer will have the right and authority to stop the Work immediately and will have the right to arrange for the removal of said rejected products or Work at the cost and expense of the Contractor.

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.
- F. Repetitive malfunction of an equipment or product item shall be cause for replacement and an extension of the correction period to a date one year following acceptable replacement. A

repetitive malfunction shall be defined as the third failure of an equipment or product item following original acceptance.

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 as defined by the Engineer 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 and as modified 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~~Forty-five 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.

4. Items entitling Owner to retain set-offs from the amount recommended, include but are not limited to:

a. Owner compensation to Engineer because of the following Contractor-caused events:

(1) Delays necessitating a time extension for the performance of Engineer's services;

(2) Witnessing retesting of corrected or replaced defective Work;

(3) Return visits to manufacturing facilities to witness factory testing or retesting;

(4) Submittal reviews in excess of three reviews by Engineer for substantially the same Submittal;

(5) Evaluation of proposed substitutes and in making changes to Contract Documents occasioned thereby;

(6) Hours worked by Contractor, in excess of normal work hours as defined by Article 6.02 of the General Conditions, necessitating Engineer to work overtime;

(7) Return visits to the Project by Engineer for Commissioning Activities not performed on the initial visit;

b. Fines levied against the Owner for Contractor's performance of NPDES Erosion and Sedimentation Control Measures or other permit violations.

c. The cost of repair, rebuilding or restoration of property improvements or facilities by the Owner as outlined in Paragraph 6.13.

d. Liability for liquidated damages incurred by Contractor as set forth in the Agreement.

E. Prompt Payment Clause

1. Owner and Contractor agree that all partial payments and final payments shall be subject to the Georgia Prompt Pay Act, as originally enacted and amended, and as set forth in O.C.G.A. 13-11-1 through 13-11-11, except as provided below to the extent authorized by law.

2. Interest Rate: For purposes of computing interest on late payments, the rate of interest shall be the applicable monthly interest rate for the "Georgia Fund 1" investment pool managed by the State of Georgia Office of Treasury and Fiscal Services.

3. Payment Periods:

- a. When Contractor has performed in accordance with the provisions of these Contract Documents, the Owner shall pay Contractor within 45 days of receipt by the Owner or the Owner's representative of any properly completed Application for Payment, based upon work completed or service provided pursuant to the terms of these Contract Documents.
 - b. When a subcontractor has performed in accordance with the provisions of its subcontract and the subcontract conditions precedent to payment have been satisfied, Contractor shall pay to that subcontractor and each subcontractor shall pay to its subcontractor, within ten days of receipt by Contractor or subcontractor of each periodic or final payment, the full amount received for such subcontractors work and materials based on work completed or service provided under the subcontract, less retainage expressed as a percentage, but such retainage shall not exceed that retainage being held by the Owner, provided that the subcontractor has provided or provides such satisfactory reasonable assurances of continued performance and financial responsibility to complete its work as contractor in its reasonable discretion may require, including but not limited to a payment and performance bond.
4. Interest on Late Payment: Except otherwise provided in these Contract Documents and/or in O.C.G.A. 13-11-5, if a periodic or final payment to Contractor is delayed by more than the time allotted in Paragraph 14.02.E.3b, or if a periodic or final payment to a subcontractor is delayed more than ten days after receipt of periodic or final payment by Contractor or Subcontractor, the Owner, Contractor, or subcontractor, as the case may be, shall pay interest to its Contractor, or subcontractor beginning on the day following the due dates as provided in Paragraph 14.02.E.3b, at the rate of interest as provided herein. Interest shall be computed per month or a pro-rata fraction thereof on the unpaid balance. There shall be no compounded interest. No interest is due unless the person or entity being charged interest received "Notice" as provided in Paragraph 14.02.E.5. Acceptance or progress payments or final payment shall release all claims for interest on said payments.
 5. Notice of Late Payment and Request of Interest: Any person or entity asserting entitlement to interest on any periodic or final payment pursuant to the provisions of this Prompt Payment Clause shall provide "notice" to the person or entity being charged interest of the charging party's claim to interest on late payment. "Notice" shall be in writing, served by U.S. Certified Mail – Return Receipt Requested at the time the properly completed Application for Payment is received by the Owner or Owner's representative, and shall set forth the following:
 - a. A short and concise statement that interest is due pursuant to the provisions of the Georgia Prompt Pay Act and this Prompt Payment Clause;
 - b. The principal amount of the periodic or final payment which is allegedly due to the charging party; and
 - c. The first day and date upon which the charging party alleges that said interest will begin to accrue, pursuant to the provisions of the Georgia Prompt Pay Act and this Prompt Payment Clause.

6. These "Notice" provisions are of the essence; therefor, failure to comply with any requirement as set forth in the Prompt Payment Clause precludes the right to interest on any alleged late payment to which said "Notice" would otherwise apply.

7. Integration with the Georgia Prompt Pay Act: Unless otherwise provided in these Contract Documents, the parties hereto agree that these provisions of this Prompt Payment Clause supersede and control all provisions of the Georgia Prompt Pay Act (O.C.G.A. 13-11-1 through 13-11-11 (1994)), as originally enacted and as amended, and that any dispute arising between the parties hereto as to whether or not the provisions of this contract or the Georgia Prompt Pay Act control will be resolved in favor of these Contract Documents and its terms.

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.
- B. No materials or supplies for the Work shall be purchased by Contractor or subcontractor subject to any chattel mortgage or under a conditional sale contract or other agreement by which an interest is retained by the seller. Contractor warrants that Contractor has good title to all materials and supplies used by Contractor in the Work, free from all liens, claims or encumbrances.
- C. Contractor shall indemnify and save Owner harmless from all claims growing out of the lawful demands for payment by subcontractors, laborers, workmen, mechanics, material men, and furnishers of machinery and parts thereof, equipment, power tools, and all supplies, including commissary, incurred in the furtherance of the performance of this Contract. Contractor shall, at Owner's request, furnish satisfactory evidence that all obligations of the nature hereinabove designated have been paid, discharged, or waived. If Contractor fails to do so, then Owner may, after having served written notice on the said Contractor either pay unpaid bills, of which Owner has written notice, direct, or withhold from Contractor's unpaid compensation a sum of money deemed reasonably sufficient to pay any and all such lawful claims until satisfactory evidence is furnished that all liabilities have been fully discharged whereupon payment to Contractor shall be resumed, in accordance with the terms of this Contract, but in no event shall the provisions of this sentence be construed to impose any obligations upon Owner to either Contractor or to Contractor's Surety. In paying any unpaid bills of Contractor, Owner shall be deemed the agent of Contractor and any payment so made by Owner shall be considered as payment made under the Contract by Owner to Contractor and Owner shall not be liable to Contractor for any such payment made in good faith.

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. Specific items of Work that must be completed prior to the Engineer's issuance of a certificate of Substantial Completion include, but are not limited to, the following:

1. Correction of all deficient Work items listed by all state, local, and other regulatory agencies or departments.
 2. All submittals must be received and approved by the Engineer, including but not necessarily limited to, the following:
 - a. Record documents.
 - b. Factory test reports, where required.
 - c. Equipment and structure test reports.
 - d. Manufacturer's Certificate of Proper Installation.
 - e. Operating and maintenance information, instructions, manuals, documents, drawings, diagrams, and records.
 - f. Spare parts lists.
 3. All additional warranty or insurance coverage requirements have been provided.
 4. All manufacturer/vendor-provided operator training is complete and documented.
 5. All occupancy permits required by local building code officials.
 6. Other items of Work specified elsewhere as being prerequisite for 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. Under no circumstances will Contractor's application for final payment be accepted by the Engineer until all Work required by the Contract Documents has been completed.
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.
 - e. The Contractor's signed and sealed final change order to close the Contract; and
 - f. Any other data reasonably required by the Owner and/or Engineer, including execution of Affidavit of Contractor, establishing payment or satisfaction of all obligations, including releases, waivers of liens, and documents of satisfaction of debts.
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 all 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~~ Thereupon 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. If the Application for Payment and accompanying documentation are appropriate as to form and substance, Owner will in accordance with the applicable State or local General Law, pay Contractor the amount recommended by Engineer.

C. *Payment Becomes Due:*

1. ~~Thirty-Sixty~~ 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;
5. If Contractor abandons the Work, or sublets this Contract or any part thereof, without the previous written consent of Owner, or if the Contract or any claim thereunder shall be assigned by Contractor otherwise than as herein specified;
6. Contractor is adjudged bankrupt or insolvent;
7. Contractor makes a general assignment for the benefit of creditors;
8. A trustee or receiver is appointed for Contractor or for any of Contractor's property;
9. Contractor files a petition to take advantage of any debtor's relief act, or to reorganize under the bankruptcy or applicable laws;
10. Contractor repeatedly fails to supply sufficient skilled workmen, materials or equipment;
11. Contractor fails to make satisfactory progress toward timely completion of the work; or
12. Contractor repeatedly fails to make prompt payments to subcontractors or material suppliers for labor, materials or equipment.

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, unless Contractor otherwise cures the deficiency in accordance with Paragraph 15.02.D.:

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.
- G. Any termination by Owner pursuant to Paragraph 15.02 may result in the disqualification of Contractor for bidding on future contracts of Owner.

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 or discontinue, in whole or in part, 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. direct 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; ~~and~~
 5. ten percent overhead and profit for those costs agreed to in Paragraphs 15.03.A.1 through 15.03.A.4 above.
- B. Contractor shall submit within 30 calendar days after receipt of notice of termination a written statement setting forth its proposal for an adjustment to the Contract Price to include only the incurred costs described in this clause. Owner shall review, analyze, and verify such proposal and negotiate an equitable amount and the Contract may be modified accordingly.
- C. 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 ~~30-45~~ 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, or by facsimile transmission and followed by written confirmation, to the last business address known to the giver of the notice.
- B. All notices required of Contractor shall be performed in writing to the appropriate entity.
- C. Electronic mail and messages will not be recognized as a written notice.

D. If the Contractor does not immediately notify the Owner in writing of the belief that a field order, additional work by other contractors or the Owner, or subsurface, latent, or unusual unknown conditions entitles the Contractor to a Change Order, no consideration for time or money will be given the Contractor.

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. Each and every provision of this Agreement shall be construed in accordance with and governed by Georgia law. The parties acknowledge that this Contract is executed in Henry County, Georgia and that the Contract is to be performed in Henry County, Georgia. Each party hereby consents to the Henry County Superior Court's sole jurisdiction over any dispute which arises as a result of the execution or performance of this Agreement, and each party hereby waives any and all objections to venue in the Superior Court of Henry County, Georgia.

17.06 *Headings*

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

17.07 Addresses

A. Both the address given in the Bid form upon which this Agreement is founded, and Contractor's office at or near the site of the Work are hereby designated as places to either of which notices, letters, and other communications to Contractor shall be certified, mailed, or delivered. The delivering at the above named place, or depositing in a postpaid wrapper directed to the first-named place, in any post office box regularly maintained by the post office department, of any notice, letter or other communication to Contractor shall be deemed sufficient service thereof upon date of such delivery or mailing. The first-named address may be changed at any time by an instrument in writing, executed by Contractor, and delivered to and acknowledged by the Owner and Engineer. Nothing herein contained shall be deemed to preclude or render inoperative the service of any notice, letter, or other communication upon Contractor personally.

17.08 Forms and Record

- A. The form of all Submittals, notices, change orders and other documents permitted or required to be used or transmitted under the Contract Documents shall be determined by the Engineer.
- B. Contractor shall maintain throughout the term of the Contract, complete and accurate records of all Contractor's costs which relate to the work performed, including the extra work, under the terms of the Contract. The Owner, or its authorized representative, shall have the right at any reasonable time to examine and audit the original records.
- C. Records to be maintained and retained by Contractor shall include, but not be limited to:
1. Payroll records accounting for total time distribution of Contractor's employees working full or part time on the work;
 2. Cancelled payroll checks or signed receipts for payroll payments in cash;
 3. Invoices for purchases, receiving and issuing documents, and all other unit inventory records for Contractor's stores, stock, or capital items;
 4. Paid invoices and cancelled checks for materials purchase, subcontractors, and any other third parties' charges;
 5. Original estimate and change order estimate files and detailed worksheets;
 6. All project-related correspondence; and
 7. Subcontractor and supplier change order files (including detailed documentation covering negotiated settlements).

D. Owner shall also have the right to audit: any other supporting evidence necessary to substantiate charges related to this agreement (both direct and indirect costs, including overhead allocations as they may apply to costs associated with this agreement); and any records necessary to permit evaluation and verification of Contractor compliance with contract requirements and compliance with provisions for pricing change orders, payments, or claims submitted by Contractor or any payees thereof. Contractor shall also be required to include the right to audit provision in the contracts (including those of a lump-sum nature) of all subcontractors, insurance agents, or any other business entity providing goods and services.

17.09 Assignment

A. Contractor shall not assign the whole or any part of this Contract or any monies due or to become due hereunder without written consent of the Owner. In case Contractor assigns all or any part of any monies due or to become due under this Contract, the instrument of assignment shall contain a clause substantially to the effect that it is agreed that the right of the assignee in and to any monies due or to become due to Contractor shall be subject to prior liens of all persons, firms and corporations for services rendered or materials supplied for the performance of the Work called for under this Contract.

END OF SECTION



SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC C-700 (2007 Edition, with Modifications). All provisions which are not so amended or supplemented remain in full force and effect.

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

The address system used in these Supplementary Conditions is the same as the address system used in the General Conditions, with the prefix "SC" added thereto.

The provisions in this Section of the Specifications shall govern in the event of any conflict between this Section and the General Conditions.

SC-4.02 *Subsurface and Physical Conditions*

Add the following new paragraphs immediately after 4.02.B:

- 4.02.C In preparation of Drawings or Specifications, Engineer or Related Entities relied on the following reports of explorations and tests of subsurface conditions at the Site:
 - 4.02.C.1 Report dated May 3, 2016, prepared by Geo-Hydro Engineers, Inc., "Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Indian Creek Water Reclamation Facility Expansion, Henry County, Georgia, Geo-Hydro Project Number 160205.20."
- 4.02.D In preparation of Drawings and Specifications, Engineer or Related Entities relied upon the following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the Site:
 - 4.02.D.1 "Indian Creek Water Reclamation Facility, Phase I, Contract No. 42," record drawings by ARCADIS Geraghty & Miller.
- 4.02.E Copies of reports itemized in SC-4.02 that are not included with Bidding Documents may be examined at the office of the Engineer during regular business hours. These reports are not part of the Contract Documents, but the "technical data" contained therein are incorporated therein by reference. Contractor is not entitled to rely upon other information and data utilized by Engineer and Related Entities in the preparation of Drawings and Specifications.

SC-5.04 *Contractor's Liability Insurance*

The limits of liability for the insurance required by paragraph 5.04 of the General Conditions shall provide the following coverages for not less than the following limits or greater where required by Laws and Regulations:

5.04.A.1 and 5.04.A.2 – For coverage as required by General Conditions 5.04.A.1 and 5.04.A.2 (Worker's Compensation):

(1) State	Statutory Limit
(2) Federal	Statutory Limit
(3) Employer's Liability	\$5,000,000

5.04.A.3-A.5 – For coverage as required by General Conditions 5.04.A.3, 5.04.A.4 and 5.04.A.5 (General Liability) which shall also include broad form property damage liability, loss of use of tangible property, and loss of use of property that has not been damaged but has been rendered useless nonetheless, completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of CONTRACTOR other than Contractor's work or equipment:

(1) Aggregate	\$5,000,000
(2) Each Occurrence	\$2,000,000
(3) Products and completed operations, aggregate	\$5,000,000
(4) Personal and advertising injury	\$2,000,000
(5) Fire Damage/Legal Liability	\$500,000
(6) Medical Expense Limit any one person	\$10,000
(7) Property damage liability insurance will provide explosion, collapse and underground coverages where applicable.	
(8) Excess/Umbrella Liability:	
General Aggregate	\$5,000,000
Each Occurrence	\$5,000,000

The aggregate policy limits for general liability coverage must be designated to the Project. The excess/umbrella policy must provide additional coverage for policy limits in excess of the general liability (including products and completed operations), automobile liability, contractual liability and employer's liability. Mobile equipment coverage described in S.C. 5.03.G must be included.

5.04.A.6 – For coverage as required by General Conditions 5.04.A.6 (Automobile Liability):

- (1) Combined Single Limit (Bodily Injury and Property Damage): \$2,000,000

Coverage must be provided for all owned/leased, hired and non-owned vehicles.

5.04.B.3. *Contractual Liability Insurance:*

The Contractual Liability coverage required by paragraph 5.04.B.3 of the General Conditions shall provide coverage for not less than the following amounts:

- | | |
|---|-------------|
| (1) General Aggregate | \$2,000,000 |
| (2) Each Occurrence (Bodily Injury and Property Damage) | \$2,000,000 |

The aggregate policy limits for Contractual Liability must be designated to the Project. As indicated in S.C. 5.04.A.3-A.5, the excess/umbrella policy must provide additional coverage in excess of these amounts.

SC-6.02 *Labor; Working Hours*

Add the following subparagraph 6.02.D.1:

1. The rate of \$95.00/hour will apply for the overtime work performed on behalf of the Owner.

SC-9.03 *Project Representative*

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

B. The Resident Project Representative (RPR) will be Engineer's or Engineer's Consultant's employee or agent at the Site, will act as directed by and under the supervision of Engineer, and will confer with Engineer regarding RPR's actions. RPR's dealings in matters pertaining to the Work in general shall be with Engineer and Contractor. RPR's dealings with Subcontractors shall be only through or with the full knowledge and approval of Contractor. The RPR shall:

1. *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.
2. *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.
3. *Liaison*:
 - a. Serve as Engineer's liaison with Contractor, working principally through Contractor's authorized representative, assist in providing information regarding the 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.
4. *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.

5. *Modifications:* Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, to Engineer. Transmit to Contractor in writing decisions as issued by Engineer.
6. *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 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.
7. *Inspections, Tests, and System Startups:*
 - 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.
8. *Records:*
 - a. 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.
 - b. Maintain records for use in preparing Project documentation.
 - c. Obtain GPS locations along center line of pipe at every joint of pipe, at fittings and other important locations. Contractor shall assist RPR in holding the GPS rover unit rod on top of the pipe as needed, wait for the GPS unit to obtain an accurate reading (for a reasonable time but not to exceed 15 minutes) and return the equipment to the RPR before safety shoring is removed.
9. *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, damage to property by fire or other causes, or the discovery of any Hazardous Environmental Condition.
10. *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.
11. *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 Specifications 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.
12. *Completion:*
- a. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and the preparation of lists of items to be completed or corrected.
 - b. Participate in a final inspection in the company of Engineer, Owner, and Contractor and prepare a final 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. Contractor is hereby advised by Engineer that the RPR is not authorized to:
- 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, Suppliers, or Contractor's superintendent.
 - 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 unless such advice or directions are specifically required by the Contract Documents.

5. Advise on, issue directions regarding, or assume control over safety practices, precautions, and programs in connection with the activities or operations of Owner or Contractor.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by Engineer.
7. Authorize Owner to occupy the Project in whole or in part.

SC-12.03 *Delays*

Add the following subparagraphs to Paragraph 12.03.C:

1. Extensions of time will be granted for abnormal inclement weather conditions that delay the critical path of the progress of the work.
2. Abnormal weather is defined as days lost to weather where precipitation exceeds 0.10-inches.
3. Contract Time will not be extended for normal bad weather. The Contract Time in the Contract Documents includes due allowance for calendar days on which work cannot be performed outdoors. For the purpose of this Contract, Contractor agrees that he may expect to lose a total number of calendar days between the Notice to Proceed date and the Substantial Completion date due to weather in accordance with the following table which is the average from three local area weather stations:

Month	Days
January	7
February	7
March	7
April	6
May	6
June	7
July	8
August	7
September	5
October	4
November	5
December	7

4. If the total accumulated (not on an individual month-by-month basis) number of calendar days (pro-rated for the Notice to Proceed date month and/or Substantial Completion date per the table above as may be applicable to reflect the actual dates of these occurrences) lost to weather from the Notice to Proceed date to the Substantial Completion date exceeds the total accumulated number to be expected for the same period from the table above, time for completion will be extended by the number of calendar days needed to include the excess number of calendar days lost. The contractor shall submit with each pay request a

letter stating the number of days lost for the respective pay period so that it may be agreed upon by all parties.

5. No reduction in Contract Time shall be imposed if the total days actually lost to weather is less than the total to have been expected for that same period.

END OF SECTION



SECTION 01010
SUMMARY OF WORK

1 GENERAL

1.1 WORK COVERED BY CONTRACT DOCUMENTS

- A. The work to be performed under this Contract consists of furnishing all labor, materials, tools, equipment, and incidentals and performing all work required to construct complete in place and ready to operate the expanded Indian Creek Water Reclamation Facility.
 - 1. The Indian Creek Water Reclamation Facility (WRF) treatment capacity will be increased from 1.5 million gallons per day (MGD) to 3 MGD. The treatment plant will also be converted from a land application system to a surface water discharge type treatment plant and the treatment process will be changed from a contact-stabilization process to a membrane biological reactor (MBR) treatment process.
- B. Membranes and associated MBR equipment for this project will be supplied by GE Water & Process Technologies/Zenon Environmental Corporation.
- C. The Henry County Water Authority has an existing sludge dewatering system, 600 KW generator, and 1500 KW generator located at their Springdale Road Wastewater Treatment Plant which has been decommissioned. The sludge dewatering system and generators shall be dismantled, transported to the Indian Creek WRF, and reinstalled as complete operational systems as specified herein and as shown on the Drawings. Contractor shall provide all labor, materials, and equipment required to dismantle, load, haul, unload, and install relocated equipment. Contractor shall have all relocated equipment serviced and installations inspected by the original equipment supplier as specified herein and as specified on the Drawings.
- D. In general, the Indian Creek Water Reclamation Facility Expansion to 3 MGD project will consist of the following major work:
 - 1. Upgrade to existing Influent Pump Station
 - 2. New influent metering flume
 - 3. New influent screening structure
 - 4. Upgrade to existing headworks
 - 5. New MBR treatment process
 - 6. New ultraviolet disinfection system
 - 7. New plant water system
 - 8. New cascade aeration system
 - 9. New effluent outfall line
 - 10. Upgrade existing aerobic digesters
 - 11. Upgrade existing solids handling facilities
 - 12. Upgrade existing chlorine building
 - 13. New administration building
 - 14. Miscellaneous site work

1.2 PROJECT LOCATION

- A. The project site is located at 1601 Lester Mill Road, Locust Grove, GA 30248.

1.3 COORDINATION

- A. The Indian Creek WRF is a functioning wastewater treatment plant and must be kept in operation at all times. Shut down of any equipment, treatment process, power supply, etc. must be coordinated with the Owner. Contractor shall not turn on or off any equipment or

turn on or off power to any equipment unless specifically authorized by the Owner. Owner's personnel must be present when any equipment is turned on or off.

- B. Depending on the time of day and weather conditions, certain processes may be able to be shut down for a short period of time, one to two hours at the most. If extended shut downs are required, the Contractor will be required to provide bypass pumping per Section 02960, Temporary Bypass Pumping. Contractor will be responsible for all bypass pumping operations. If any wastewater spill occurs as a result of Contractor negligence, the Contractor shall be responsible for paying all fines levied as a result of the spills.
- C. This project will need to be constructed in phases. The existing Indian Creek WRF has four biological process trains. Two of these trains are currently in operation and two are currently not in operation. Half of the MBR system will be installed in the existing trains that are not in operation. This half of the MBR system will be placed into service and made operational. Once it is operational, the second half of the MBR system will be constructed in the existing process trains that are in use. Contractor shall allow at least 8 weeks in the schedule to start up the biological process for Phase 1 prior to being able to begin Phase 2 construction.

**** END OF SECTION ****

SECTION 01020
ALLOWANCES

1 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall include in his proposal the allowance amount(s) listed below.
- B. The allowance(s) shall cover work, manufactured equipment or services that will be provided either by the Contractor or by others who may be selected by the Owner. All work performed under allowance(s) will be eligible for payment only with the Owner's prior written approval, and under special terms described herein.
- C. Subcontract Allowances: Authorized subcontract work that is performed by subcontractors to the General Contractor and paid for under Allowances is considered to be subcontract work to the Contractor. Therefore, in accordance with the General Conditions of the Contract, actual payment to the Contractor will be actual cost of the subcontractor's charges plus a fee equal to five percent (5%) of subcontractor's charges.
- D. Cash Allowances for Purchases and Purchased Services: Where Contractor purchases equipment or materials that are authorized to be paid from Allowances and installed or incorporated into the project, the Contractor's costs for unloading, handling, installation, overhead, profit, taxes, and other expenses are to be included in Contractor's Bid Price. This same provision will apply to Purchased Services by Owner from parties who are not a subcontractor to the Contractor.
- E. The Contractor shall include in the Contract Sum all allowances stated in the Contract Documents. The Contractor's handling costs on the site, labor, installation costs, overhead, profit, taxes, and other expenses contemplated for the original allowance shall be included in the Contract Sum and not in the allowance. The Contractor shall cause work covered by these allowances to be performed for such amounts and by such persons as the Owner/Engineer may direct, but he will not be required to employ persons against whom he makes a reasonable objection. If the cost, when determined, is more than or less than the allowance, the Contract Sum shall be adjusted accordingly by Change Order.

2 SCHEDULE OF ALLOWANCES

2.1 MAJOR EQUIPMENT ALLOWANCES

- A. The Contractor's Total Base Bid Price shall include an allowance of \$2,802,249.00 to cover the purchase price of the Membrane Biological Reactor System as described in GE Water & Process Technologies "As-Sold Proposal for Henry County Water Authority, MBR Preselection Request for Proposals, Indian Creek Water Reclamation Facility, Locust Grove, Georgia," GE Proposal Number: 089928. This cost does not include federal, state, or local taxes. Taxes, if applicable, and any other associated costs shall be included in the Contractor's Lump Sum Bid price (Bid Item 1). Contractor shall execute a purchase order with GE Water & Process Technologies no later than January 15, 2017. Contractor shall be responsible for paying any additional costs incurred as a result of his failure to execute a purchase order by January 15, 2017.
- B. The Contractor's Total Base Bid Price shall include an allowance of \$23,840 to cover the purchase price of a Gorman-Rupp self-priming centrifugal pump and control panel for the relocated belt filter press as described in Templeton & Associates letter dated August 23, 2016. This cost does not include federal, state, or local taxes, unloading, or installation. Taxes, if applicable, and all other associated costs shall be included in the Contractor's Lump Sum Bid price (Bid Item 1).
- C. The Contractor's Total Base Bid Price shall include an allowance of \$45,880 to cover the purchase price of the equipment from Keystone Conveyor Corporation required to extend the existing sludge conveyor to the relocated belt filter press as described in Keystone Conveyor Corporation's quote (P17176.1) dated August 18, 2016. This cost does not

include federal, state, or local taxes, unloading, installation, controls, or motor starters. Taxes, if applicable, and all other associated costs shall be included in the Contractor's Lump Sum Bid price (Bid Item 1).

2.2 OWNER ALLOWANCES

- A. The Contractor's Total Base Bid Price shall include an allowance of \$350,000.00 to cover cash allowances and unspecified contingencies, and work that the Owner may choose to add to the Contract.

** END OF SECTION **

TEMPLETON & ASSOCIATES

ENGINEERING SALES

August 23, 2016

To: All Bidders

Re: Belt Press Sludge Feed Pump

Project: HCWSA – Indian Creek WRF

Equipment: Gorman Rupp Pump and Control Panel

Sir/Mam:

Templeton & Associates is pleased to offer the following equipment quote for the Indian Creek WRF Belt Press Sludge Feed Pump.

One (1) each: Gorman Rupp T3AS-B pump with 7.5 HP premium efficiency motor, belts, sheaves, vertical v-belt base, suction flange, discharge flange, pump drain kit and air release valve. Motor will be 460v, 3 phase, 60 Hz, 1.15 SF and equipped with 3 motor winding temperature switches. Certified Pump Test Curve required.

One (1) each: ESG simplex control panel as defined on the attached control panel scope.

Sell Price - \$23,840.00

NOTES:

- Price includes start-up.
- Price excludes taxes.
- Price includes a certified pump test curve.
- Attached terms and conditions apply.
- Anchor Bolts for anchoring bas to slab are not included.

Suite 100 , 4324 Brogdon Exchange , Suwanee, Georgia , 30024
(770) 614.8550 , fax (770) 614.5992

a division of walker & cannon inc.

TERMS AND CONDITIONS

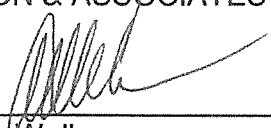
1. Price quoted is freight included FOB factory.
2. Only those items of equipment specifically mentioned above are included in this proposal.
3. No taxes are included in the quoted price.
4. Price quoted will remain firm for a period of 30 days from date of proposal.
5. Payment terms are net 30 days from receipt of equipment to approved credit accounts.
6. This proposal is subject to the Manufacturer's standard warranty clauses.

An order may be placed for the equipment covered in this proposal by signing in the space provided below and returning one signed copy, or by issuing your purchase order to:

TEMPLETON & ASSOCIATES ENGINEERING SALES
Suite 100 – 4324 Brogdon Exchange
Suwanee, GA 30024

and indicating on your order that it is an acceptance of this proposal.

Submitted By: TEMPLETON & ASSOCIATES ENGINEERING SALES



Allen Walker

Accepted By: _____
Signature

Printed Name with Title

Company

Date: _____



ENGINEERED SYSTEMS GROUP

Quotation Date: 8/18/2016 **Exp Date:** 11/16/2016
Customer: Templeton **Project:** 460V, 7.5HP Simplex VFD Controller
QUOTE #: 10756 R1.2 Indian Creek- WRF Expansion

Device	Options Selected	Qty	Description
Motor Horsepower	460v,7.5HP VFD	1	480V, 7.5HP, VFD rated 50 deg C with Input 42KAIC Circuit Breaker
Contactors	Contactors	1	Isolation and Bypass Contactors with Overload
Thermistor Circuit	Thermistor Circuit	1	Thermistor Circuit per Spec
Line Reactor	KLRUL12ATB	1	3% Line Reactor
Control Package	Standard Control	1	CPT with Fused Pri & Sec
Pilot Devices	Nema Pilot with ETM	1	30mm Run Light, HOA Selector Switch and Elapsed Time Meter
Phase Monitor	Lightning Arrestor	1	APT SPDee 50KA Lightning Arrestor
Enclosure	N4X DF-363010	1	N4X Dead Front Stainless Steel Enclosure
Ground Bus	Ground Bus	1	Enclosure Mounted Ground Bus Bar
Additional Pilot Device	Additional Lights Nema	3	30mm Pilot Light for ON, OFF, or FAIL status
Additional Pilot Device	Additional Relay	4	Remote Contacts for Pump Running, Pump in Remote Mode, VFD Fault & Motor High Temp
Input Signals		3	Inputs for Call to Run, Speed Control & Motor High Temp Switch
Additional Nema Device	Additional Nema Device	1	Start/Stop Pushbutton
Extra Terminals	Extra Terminals	1	25% Spare Terminals
Start-Up	Start-Up	1	Days Start up and Training per Spec
Fan/Filter	Fan + Filter	1	Nema 4X SS Fan and Filter

Exceptions/Clarifications/Adders:

Exception- 3.2 Factory Testing- Standard factory test procedures quoted.

Exception- 3.4 Harmonics testing. The ABB VFD's quoted are built in strict accordance with IEEE-519, however to perform harmonics testing in accordance with this section of the spec will require a full onsite test performed by a third party engineering firm that specializes in this. This will require complete system electrical information including one line diagrams and transformer information (Vin, Vout, kVA, %Z.). An estimate only for this field study can be \$6000-\$8000. Please advise if actual quote is required.

Exception- 2.2L No EMI/RFI Filters Quoted. Please add \$300 if required.

Exception-2.2M- Spare parts not included. Spec requirement would call for a new VFD. Please call for price. Analog device for speed control not included as spec calls for this to come from belt press.

Panel to be built by UL508 shop.

Shipping charges are prepaid and added to the invoice.

Terms: Net 30 Days.

If extra start-up or training is required add \$1,500/day

Typical Lead time is 6 Weeks after Submittal Approval.

Typical Submittal Drawing lead time is 2 weeks after receipt of order.

Drawing submittal includes an electronic copy of complete drawing set, including schematics and layout.

The price above includes an electronic copy of a hardware submittal if needed.

Finished panel will include two hard copies (non-laminated) of complete drawing set.

Please contact me with any questions you have. I look forward to working with you on this project.

Thanks,

Mike Bruce

PO BOX 968 • BUFORD, GEORGIA • 30515
PHONE: 770-614-7022 • FAX: 770-614-7025

KEYSTONE

CONVEYOR CORPORATION

File: P17176.1
Date: August 18, 2016

Re: Indian Creek WRF Expansion, Henry County, GA
Existing Sludge Loadout Belt Conveyor Extension

We are pleased to offer this information and pricing for the existing Keystone Conveyor sludge loadout belt conveyor extension at the Indian Creek WRF expansion project. The following is included.

(1) only – Belt Conveyor Extension, 18-inch wide x 32'-0" approximate centers, flexible sidewall design belt conveyor extension. The extended belt conveyor will be designed to convey up to ± 12 TPH of dewatered sludge, weighing 60-65 PCF, for discharge to loadout. The belt conveyor extension will include the following.

- Complete new belt for the extended $\pm 81'-0"$ centers belt conveyor. 18-inch wide, 2-ply, 220 PIW, cross-rigid, MOR belting with 3-inch high corrugated sidewalls and stainless steel hinged mechanical splice.
- CEMA-C, 5-inch diameter corrosion resistant idlers with sealed bearings.
- #12 ga. hot-dip galvanized mild steel skirting at load area from the new BFP.
- Hot-dip galvanized mild steel conveyor frame and supports. Supports on $\pm 10'-0"$ centers to the floor.
- #12 ga. hot-dip galvanized mild steel deck plate and drip pans.
- Safety stop pull cord switch cable and cable fittings for new conveyor length.

Total Price: \$45,880.00 (*Forty-five thousand eight hundred eighty dollars*)

The total price shown includes submittal data and equipment delivery to Henry County, GA and one day on site for equipment start-up. It does NOT include taxes, unloading, installation, controls or motor starters. Deliveries would be ± 4 -weeks for drawings after order with equipment following 4-6 weeks after approval.

We hope this information is useful for your immediate needs and ask that you feel free to contact me if we can offer any additional information.

Sincerely,

Dan Crohn
Keystone Conveyor Corp.

Specialists in Conveyor Systems

19992 Ferret Street N.W. • Elk River, MN 55330 • ph: 763-712-1322 • fax: 763-712-1324
www.keystoneconveyor.com

SECTION 01051
GRADES, LINES AND LEVELS

1 GENERAL

1.1 DESCRIPTION

- A. All work under this contract shall be constructed in accordance with the lines and grades on the plans or as given by the Engineer or Owner. The full responsibility for holding to alignment and grade shall rest upon the Contractor.
- B. The Contractor shall be responsible for layout and staking. The Contractor shall furnish personnel fully qualified and capable of staking centerlines and/or layouts as shown on the plans.
- C. The Contractor shall safeguard all points, stakes, grade marks, bench marks, and monuments established on the work, shall bear the cost of re-establishing same if disturbed, and shall assume the entire expense of rectifying work improperly constructed due to failure to maintain and protect such established points, stakes, and marks. Any property corners or R/W monuments damaged during construction shall be restored by a registered land surveyor at the Contractor's expense.

** END OF SECTION **



SECTION 01070

ABBREVIATIONS, SYMBOLS, TRADE NAMES AND MATERIALS

1 GENERAL

1.1 GENERAL

- A. Whenever reference is made to the furnishing of materials or testing thereof to conform to the standards of any technical society, organization, or body, it shall be construed to mean the latest standard, code, specification or tentative specification adopted and published at the time of advertisement for bids. Such standards are made a part hereof to the extent which is indicated or intended.

1.2 ABBREVIATIONS

AA	Aluminum Association
AAMA	Architectural Aluminum Manufacturer's Association
AASHTO	American Association of State Highway and Transportation Officials
ACI	American Concrete Institute
ACPA	American Concrete Pipe Association
AEIC	Association of Edison Illuminating Companies
AFBMA	Anti-Friction Bearing Manufacturer's Association
AGA	American Gas Association
AGMA	American Gear Manufacturer's Association
AIA	American Institute of Architects
AIEE	American Institute of Electrical Engineers
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AITC	American Institute of Timber Construction
ANSI	American National Standards Institute
AMCA	Air Moving and Conditioning Association
APA	American Plywood Association
APHA	American Public Health Association
API	American Petroleum Institute
APWA	American Public Works Association
AREA	American Railroad Engineering Association
ASA	American Standards Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigeration, and Air Conditioning Engineers
ASME	American Society of Mechanical Engineers
ASTM	American Society for Testing and Materials
AWS	American Welding Society
AWWA	American Water Works Association
CFR	Code of Federal Regulations
CRSI	Concrete Reinforcing Steel Institute
CTI	Cooling Tower Institute
DEMA	Diesel Engine Manufacturer's Association
DIPRA	Ductile Iron Pipe Research Association
EDA	Economic Development Administration
EIA	Electronic Industries Association
EPA	Environmental Protection Agency
FmHA	Farmers Home Administration
FS	Federal Specifications
HEI	Heat Exchange Institute
IBC	International Building Code
IEEE	Institute of Electronic and Electrical Engineers
IES	Illuminating Engineering Society
IPCEA	Insulated Power Cable Engineer's Association

IPC	Institute of Printed Circuits
ISA	Instrument Society of America
MBMA	Metal Building Manufacturer's Association
MSS	Manufacturers Standardization Society of the Valve and Fitting Industry
NAAMM	National Association of Architectural Metal Manufacturers
NACE	National Association of Corrosion Engineers
NBFU	National Board of Fire Underwriters
NBS	National Bureau of Standards
NCPI	National Clay Pipe Institute
NEC	National Electric Code
NEMA	National Electrical Manufacturer's Association
NFPA	National Fire Protection Association
NRMA	National Ready-Mix Association
OSHA	Occupational Safety and Health Administration
PCA	Portland Cement Association
PCI	Prestressed Concrete Institute
SMACNA	Sheet Metal and Air Conditioning Contractors National Association
SSPC	Steel Structures Painting Council
TCA	Tile Council of America
TEMA	Tubular Exchangers Manufacturer's Association
UBC	Uniform Building Code
UL	Underwriters Laboratories
USDC	United States Department of Commerce
WEF	Water Environment Federation

1.3 TRADE NAMES AND MATERIALS

- A. Where materials or equipment are specified by a trade or brand name, it is not the intention of the Owner to discriminate against an equal product of another manufacturer, but rather to set a definite standard of quality of performance, and to establish an equal basis for the evaluation of bids. Where the words "equivalent," "proper," or "equal to", are used, they shall be understood to mean that the item referred to shall be proper, the equivalent of, or equal to the item specified by a trade or brand name, in the opinion or judgment of the Engineer. Unless otherwise specified, all materials shall be the best of their respective kinds and shall be equal to approved samples. Notwithstanding that the words "or equal to", or other such expressions, may be used in the Specifications in connection with a material, manufactured article or process, the material, article, or process specifically designated shall be used, unless a substitute is approved in writing by the Engineer.

1.4 SYMBOLS

- A. Symbols and material legends shall be as scheduled on the Contract Drawings.

** END OF SECTION **

SECTION 01080
APPLICABLE CODES AND STANDARDS

1 GENERAL

1.1 GENERAL

A. All materials, equipment, fabrication, and installation practices shall comply with the following applicable Codes and standards, except in those cases where the Contractor's quality standards establish more stringent quality requirements, as determined by the Engineer.

1. Pressure Piping and Tubing

- a. ANSI (American National Standards Institute)
- b. API (American Petroleum Institute)
- c. ASME (American Society of Mechanical Engineers)
- d. AWWA (American Water Works Association)
- e. NSF (National Sanitation Foundation)

2. Materials

- a. AASHTO (American Association of State Highway and Transportation Officials)
- b. ANSI (American National Standards Institute)
- c. ASTM (American Society for Testing and Materials)

3. Painting and Surface Preparation

- a. NACE (National Association of Corrosion Engineers)
- b. SSPC (Steel Structures Painting Council)

4. Gear Reducers and Bearings

- a. AFBMA (Anti-friction Bearing Manufacturers Association)
- b. AGMA (American Gear Manufacturers Association)

5. Ventilating Fans

- a. AMCA (Air Moving and Conditioning Association)
- b. PFMA (Power Fan Manufacturers Association)

6. Electrical and Instrumentation

- a. EIA (Electronic Industries Association)
- b. IEEE (Institute of Electrical and Electronic Engineers)
- c. IPC (Institute of Printed Circuits)
- d. IPCEA (Insulated Power Cable Engineers Association)
- e. ISA (Instrument Society of America)
- f. NEMA (National Electrical Manufacturers Association)
- g. NFPA (National Fire Protection Association)
- h. UL (Underwriter's Laboratories)

7. Aluminum

- a. AA (Aluminum Association)
- b. AAMA (Architectural Aluminum Manufacturers Association)

8. Steel
 - a. AISC (American Institute of Steel Construction)
 9. Concrete
 - a. ACI (American Concrete Institute)
 10. Welding
 - a. ASME (American Society of Mechanical Engineers)
 - b. AWS (American Welding Society)
 11. Safety
 - a. OSHA (Occupational Safety and Health Act)
 12. General Building Construction
 - a. FM (Factory Mutual Fire Insurance Company)
 - b. IBC (International Building Code)
 - c. NFPA (National Fire Protection Association)
 13. Subgrades and Pavement
 - a. SSRBC (Standard Specifications for Road and Bridge Construction, Georgia Department of Transportation)
 14. Ductwork and Sheet Metal Work
 - a. SMACNA (Sheet Metal and Air Conditioning Contractors National Association)
 15. Plumbing
 - a. AGA (American Gas Association)
 - b. NSF (National Sanitation Foundation)
 - c. PDI (Plumbing Drainage Institute)
 - d. SPC (SBCC Standard Plumbing Code)
 16. Refrigeration, Heating, and Air Conditioning
 - a. ARI (American Refrigeration Institute)
 - b. ASHRAE (American Society of Heating, Refrigeration, and Air Conditioning Engineers)
 17. Pressure Vessels
 - a. ASME (American Society of Mechanical Engineers)
- B. In addition, all work shall comply with the applicable requirements of local codes, utilities, and other authorities having jurisdiction.
- C. All material and equipment, for which a UL Standard, an AGA approval, or an ASME requirement is established, shall be so approved and labeled or stamped. Label or stamp shall be conspicuous and not covered, painted, or otherwise obscured from visual inspection.

** END OF SECTION **

SECTION 01150
MEASUREMENT AND PAYMENT

1 GENERAL

1.1 DESCRIPTION

- A. The following subsections describe the measurement and payment for Work to be done under the items listed in the Bid Form. Each unit or lump sum price stated in the Bid Form shall constitute full compensation for each item of Work completed. The Contractor shall provide all labor, materials, tools, equipment, and services required to complete the Work, as specified and shown in the Bidding Documents.
- B. Payment for the various items in the Bid Form, as further specified herein, shall include all compensation to be received by the Contractor for furnishing all tools, equipment, supplies, and manufactured articles, and for all labor, operations, taxes, materials, commissions, transportation and handling, bonds, permit fees, insurance, overhead and profit, and incidentals appurtenant to the items of Work being described, as necessary to complete the various items of the Work all in accordance with the requirements of the Bidding Documents, including all appurtenances thereto, and including all costs of compliance with the regulations of public agencies having jurisdiction, including Safety and Health Requirements of the Occupational Safety and Health Administration of the U.S. Department of Labor (OSHA). Such compensation shall also include payment for any loss or damages arising directly or indirectly from the Work.
- C. The Contractor's attention is called to the fact that the quotations for the various items of Work are intended to establish a total price for completing the Work in its entirety. Should the Contractor feel that the cost for any item of Work has not been established by the Bid Items of the Bid Schedule or this Section, it shall include the cost for that Work in some other applicable Bid Item, so that its proposal for the Project does reflect its total price for completing the Work in its entirety.
- D. The items listed in the Bid Form constitute all of the pay items for the completion of the Work. No direct or separate payment will be made for providing rock excavation, miscellaneous temporary or accessory works, plant services, Contractor's or Engineer's field offices, layout surveys, job signs, sanitary requirements, testing, safety devices, approval and record drawings, water supplies, power, maintaining traffic, removal of waste, watchmen, bonds, insurance, and all other requirements of the General Conditions, any Supplementary Conditions, and the General Requirements. Compensation for all such services, things and materials shall be included in the prices stipulated for the lump sum pay item listed therein.
- E. The lump sum bid price will be deemed to include an amount considered by Contractor to be adequate to cover Contractor's overhead and profit for the work.
- F. Work includes furnishing all labor, equipment, tools and materials and performing all operations required to complete the work satisfactorily, in place, as specified and as indicated on the Drawings.

1.2 QUANTITIES

- A. The Owner reserves the right to alter quantities of work to be performed or to extend or shorten the improvements at any time when and as found necessary, and the Contractor shall perform the work as altered, increased or decreased. Payment for such increased or decreased quantity will be made in accordance with the General Conditions. No allowance will be made for any change in anticipated profits nor shall such change be considered as waiving or invalidating any conditions or provisions of the Contract and Bond, unless specifically called for in the Supplementary Conditions.

1.3 SUBMITTALS

- A. The Contractor shall submit a Preliminary Progress Schedule for review as specified in Section 01300, Submittals, and Section 01310, Construction Progress Schedules. The Preliminary Progress Schedule shall include a Detailed Cost Breakdown and Schedule of Values for the Work for the purpose of making periodical payments during the construction period.
- B. The Contractor shall not submit an Application for Payment until the Preliminary Progress Schedule has been approved.

1.4 APPLICATIONS FOR PAYMENT

- A. Submit Applications for Payment to Engineer at the times agreed to in the pre-construction meeting.
- B. Submit Applications for Payment to Engineer in accordance with the schedule of values established by Section 01310, Construction Progress Schedules.
- C. After the Engineer reviews the Application for Payment and determines that it is properly completed and correct, the Contractor shall submit 5 signed originals to the Engineer. Engineer will then approve the Application for Payment and forward them to the Owner.
- D. Applications for Payment shall be submitted in a form approved by the Owner and Engineer.
- E. Applications for Payment shall be submitted on 8 1/2-inch by 11-inch white paper.
- F. When Owner or Engineer requires substantiating data, Contractor shall submit suitable information with a cover letter identifying:
 - 1. Project.
 - 2. Application number and date.
 - 3. Detailed list of enclosures.
 - 4. For stored products:
 - a. Item number and identification as shown on application.
 - b. Description of specific material.
 - 5. Submit one copy of data and cover letter for each copy of application.

1.5 MEASUREMENT

- A. Measurement of an item of work will be by the unit indicated in the Bid Schedule.
- B. Measurement will include all necessary and incidental related work not specified to be included in any other item of work listed in the Bid Schedule.
- C. Unless otherwise stated in individual sections of the Specifications or in the Bid Schedule, no separate payment will be made for any item of Work, materials, parts, equipment, supplies or related items required to perform and complete the Work. The costs for all such items required shall be included in the Contract price bid for item of which it is a part.
- D. All excavation is bid unclassified and all costs associated with excavation shall be included in the lump sum bid price.

1.6 PAYMENT

- A. Payment will be made at the Contract price per unit indicated in the Bid with total price of the Contract being equal to the Total Bid, as specified and as modified, by extending unit prices multiplied by quantities as appropriate to reflect actual Work. Such price and payment shall constitute full compensation to the Contractor for furnishing all labor, equipment, tools and materials, and for performing all operations required to furnish to the Owner the entire Project, complete in place, as specified and as indicated on the Drawings.

** END OF SECTION **

SECTION 01201
PRECONSTRUCTION CONFERENCE AND PROGRESS MEETINGS

1 GENERAL

1.1 PRECONSTRUCTION MEETING

- A. A preconstruction meeting will be held after Award of Contract, but prior to starting work at the site.
- B. Attendance at preconstruction meeting will include, but not be limited to, the following.
 - 1. Owner
 - 2. Engineer
 - 3. Contractor
 - 4. Major subcontractors
 - 5. Safety representative
 - 6. Representatives of governmental or other regulatory agencies, as required.
- C. Minimum Agenda
 - 1. Tentative construction schedule
 - 2. Critical work sequencing
 - 3. Designation of responsible personnel
 - 4. Processing of Field Decisions and Change Orders
 - 5. Adequacy of distribution of Contract Documents
 - 6. Submittal of Shop Drawings and samples
 - 7. Procedures for maintaining record documents
 - 8. Use of site and Owner's requirements
 - 9. Major equipment deliveries and priorities
 - 10. Safety and first aid procedures
 - 11. Security procedures
 - 12. Housekeeping procedures
 - 13. Processing of Partial Payment Requests
 - 14. General regard for community relations

1.2 PROGRESS MEETINGS

- A. Progress meetings will be held monthly during the performance of the work of this Contract. Additional meetings may be called as progress of work dictates.
- B. Engineer will preside at meetings and record minutes of proceedings and decisions. Engineer will distribute copies of minutes to participants.
- C. Attendance at progress meetings shall include the following.
 - 1. Owner
 - 2. Engineer
 - 3. Contractor
 - 4. Subcontractors, only with Engineer's approval or request, as pertinent to the agenda
- D. Minimum Agenda
 - 1. Review and approve minutes of previous meeting.

2. Review progress of Work since last meeting.
 3. Review proposed 30-day construction schedule.
 4. Note and identify problems which impede planned progress.
 5. Develop corrective measures and procedures to regain planned schedule.
 6. Review erosion and sedimentation measures.
 7. Revise construction schedule as indicated and plan progress during next work period.
 8. Review quality and work standards.
 9. Review work environment.
 10. Complete other current business.
 11. Schedule next progress meeting.
- E. The Contractor shall bring record drawings to each progress meeting for review. Record drawings shall reflect all changes to date. Failure to keep up-to-date record drawings will result in not processing pay requests.
- F. The Contractor shall bring updated project schedules to each progress meeting for review. Updated project schedules shall reflect all changes to date. Failure to keep up-to-date project schedules will result in not processing pay requests.
- 1.3 CALLED MEETINGS
- A. The Owner or Engineer may request meetings with the Contractor at any time on matters pertaining to the progress of Work being carried out under this Contract. It will be the responsibility of the Contractor to supply whatever information is requested by the Owner or Engineer concerning the project throughout its duration.
- B. Contractor shall make manufacturer representatives and information available on request for meetings the Engineer has with the Owner.

** END OF SECTION **

SECTION 01300
SUBMITTALS

1 GENERAL

1.1 SHOP DRAWINGS AND PRODUCT DATA

- A. The Contractor shall submit to the Engineer for review and approval complete drawings and engineering data for all equipment, materials, and products to be incorporated into the work. Shop drawings and engineering data shall be provided and the Engineer's review will be conducted in accordance with requirements of the General Conditions. The review of the drawings by the Engineer shall not be construed as a complete check but only for conformance with the contract documents. Review of such submittals will not relieve the Contractor of the responsibility for any errors that may exist, as the Contractor shall be responsible for the dimension and design of adequate connections, details, and satisfactory construction of all work.
- B. The term "submittals" shall mean shop drawings, manufacturer's drawings, catalog sheets, brochures, descriptive literature, diagrams, schedules, calculations, material lists, performance charts, test reports, office and field samples, and items of similar nature which are normally submitted for the Engineer's review for conformance with the design concept and compliance with the contract documents.
- C. Shop drawings and engineering data shall be prepared by the original equipment vendors or fabricators, as applicable.
- D. Each shop drawing and each item of engineering data shall bear the Contractor's approved stamp indicating that the Contractor has reviewed the drawing or data for conformance with the Contract Documents.
- E. All design calculations and drawings for sheeting and shoring and concrete formwork shall bear the signed and dated stamp of a licensed professional engineer.
- F. No material or equipment shall be fabricated or shipped unless the applicable drawings or submittals have been reviewed and approved by the Engineer and returned to the Contractor. No payments will be made for materials or equipment that do not have approved shop drawings.

1.2 MISCELLANEOUS SUBMITTALS

- A. The Contractor shall submit to the Engineer miscellaneous information, procedures, test data, samples, etc., in the manner and at the time specified in these Specifications and Contract Documents. Miscellaneous submittals shall include, but not be limited to, the following:
 - 1. Satisfactory written evidence in the form of laboratory or mill test reports indicating that all cement, aggregate, masonry, castings, steel reinforcement, pipe, grout, grass seed, and other items incorporated into the work are in compliance with requirements of these Specifications.
 - 2. Project record documents.
 - 3. When requested, analysis and design data on concrete formwork and sheeting and shoring.
 - 4. Drawings and details of erosion and sediment control structures.

1.3 SAMPLES

- A. At the Engineer's request, the Contractor shall furnish certified samples of materials utilized in the fabrication or production of equipment, materials, and products supplied under these Contract Documents. Cost of all such samples shall be borne by the Contractor. The samples will be tested by a qualified independent testing laboratory selected by the Owner to determine if the mechanical and chemical properties of the materials supplied are in accordance with requirements of these Specifications and Contract Documents. The

Owner will pay for the laboratory testing of material samples provided by the Contractor. The Contractor shall pay for all retests made necessary by the failure of materials to conform to the requirements of these Specifications and Contract Documents.

1.4 CONCRETE CONSTRUCTION

A. Concrete Lift or Pour Sequence Drawings

1. The Contractor shall prepare and submit Drawings using joints indicated on the design drawings of all concrete pours. The sequence Drawings and the sequence of concrete pours shall be the basis of the detailing of any reinforcing steel, or other embedded items. Sequence Drawings shall be legible, and shall be ink lined on a reproducible sheet not less than 11x17 inches. A bill of material of embedded items shall be indicated, in addition to the necessary details. No concrete shall be placed until the sequence drawings of the proposed pours have been returned to the Contractor with a notice to proceed. Concrete placed in violation of this requirement may be ordered removed and replaced and such removal and replacement shall be at the expense of the Contractor.
2. Sequence drawings will indicate all dimensions and details necessary for the crafts to build forms and locate embedded items. These dimensions shall be tied to surveying stations, offsets from centerlines, and elevations.
3. Pay quantities shall be calculated and tabulated by bid item number, description, and pay quantity. The reviewed sequence drawing tabulation will be the agreed amount for payment for items involved. Reinforcing steel and embedded items, which are pay items or subsidiary to pay items, shall be included.
4. One copy of layout sheets shall be furnished indicating relative position of all sequence lifts or pours and construction joints.
5. A concrete placement schedule shall be furnished indicating intended pouring date of each sequence. This may be in the form of a bar graph indicating bid item vs. time with sequence numbers noted along each bar.

B. Concrete Reinforcing Drawings

1. Concrete reinforcing drawings will be checked for general arrangement and structural safety; however, responsibility of reinforcing the structures in compliance with design drawings rests entirely with the Contractor. Shop drawings shall have been checked by the Contractor before being submitted. Drawings submitted that have not been checked will not be accepted.
2. Reinforcing details shall consist of a bar schedule, showing the number of bars, marks, sizes, lengths, weights, bending configurations, and an erection drawing indicating location in the structure of all reinforcing bars and accessories as required to support the steel in compliance with the latest American Concrete Institute Detailing Manual 1980 SP-66 and as specified.

1.5 GENERAL SUBMITTAL REQUIREMENTS

A. Scheduling

1. Where appropriate in various required administrative submittals (listings of products, manufacturers, supplier and subcontractors, and in job progress schedule), show principal work-related submittal requirements and time schedules for coordination and integration of submittal activity with related work in each instance.

B. Coordination of Submittal Times

1. Prepare and transmit each submittal to the Engineer sufficiently in advance of performing related work or other applicable activities, so the installation will not be delayed or improperly sequenced by processing times, including non-approval and re-submittal (if required). Coordinate with other submittals, testing, purchasing, delivery and similar sequenced activities. No extension of time will be authorized because of

Contractor's failure to transmit submittals to the Engineer sufficiently in advance of the work.

C. Sequencing Requirements

1. As applicable in each instance, do not proceed with a unit of work until submittal procedures have been sequenced with related units of work, in a manner which will ensure that the action will not need to be later modified or rescinded by reason of a subsequent submittal which should have been processed earlier or concurrently for coordination.

D. Preparation of Submittals

1. Provide permanent marking on each submittal to identify project, date, Contractor, subcontractor, submittal name and similar information to distinguish it from other submittals. Show Contractor's executed review and approval marking and provide space for the Engineer's "Action" marking. Package each submittal appropriately for transmittal and handling. Submittals which are received from sources other than through the Contractor's office will be returned "without action."

E. Transmittal Identification

1. Number transmittals in sequence for each Division of the Specifications. The number before the dash indicates the Section of the Specifications, and the number after the dash is the sequence number of the transmittal (15140-1 would be the first transmittal applicable to Section 15140 of the Specifications, 15140-2 would be the second transmittal for Section 15140, etc.)
2. Identify re-submittals with a letter of the alphabet following the original number, using "A" for the first re-submittal, "B" for the second re-submittal, etc. A re-submittal affecting transmittal 15140-1 would then be numbered 15140-1A. The number 15140-1 would then be entered in the space "Previous Transmittal Number," which is left blank except on re-submittals. Re-submittals shall include all previous submittal information. No partial submittals will be accepted.

1.6 SPECIFIC CATEGORY REQUIREMENTS

A. General

1. Except as otherwise indicated in the individual work sections, comply with general requirements specified herein for each indicated category of submittal.
 - a. Submittals shall contain:
 - 1) The date of submittal and the dates of any previous submittals.
 - 2) The project title.
 - 3) The project number.
 - 4) The names of the:
 - a) Contractor
 - b) Supplier
 - c) Manufacturer
 - 5) Identification of the product, with the Specification Section number and equipment tag numbers.
 - 6) Field dimensions, clearly identified as such.
 - 7) Relation to adjacent or critical features of the work or materials.
 - 8) Applicable standards, such as ASTM or Federal Specification numbers.
 - 9) Notification to the Engineer in writing, at time of submittal, of any deviations on the submittals from requirements of the Contract Documents.
 - 10) Identification of revisions on re-submittals.

- 11) Two 4 inch x 4 inch blank spaces for Contractor and Engineer stamps.
- 12) Contractor's stamp, initialed or signed, certifying to review of submittal, verification of products, field measurements and field construction criteria, and coordination of the information within the submittal with requirements of the Work and of Contract Documents.
- 13) Submittal sheets or drawings showing more than the particular item under consideration shall have all but the pertinent description of the item for which review is requested crossed out.

1.7 ROUTING OF SUBMITTALS

- A. Submittals and routine correspondence shall be routed as follows:
 - 1. Supplier to Contractor (through representative if applicable) for preliminary check.
 - 2. Contractor to Consulting Engineer for general review or comment.
 - 3. Consulting Engineer to Contractor.
 - 4. Contractor to Supplier.

1.8 ADDRESS FOR COMMUNICATIONS

- A. Engineering Strategies, Inc.
 3855 Shallowford Road, Suite 525
 Marietta, GA 30062
 (770) 429-0001

1.9 SUBMITTAL COPIES REQUIRED

- A. Shop Drawings, Product Data, and Miscellaneous Submittals
 - 1. All submittals marked "No Exception Noted" or "Furnish as Corrected" will be distributed as follows:
 - a. For ESI 2 copy
 - b. For Contractor 2 copies
 - c. For Field Inspection Office 1 copy
 - d. For Owner 1 copy
 - e. Total 6 copies
- B. To the above number may be added additional copies as required by the Contractor.
- C. The Engineer will mark all copies of each shop drawing. One will be retained in the Engineer's office, one sent to the Field Inspection office, one will be retained for the Owner and the remaining copies sent to the Contractor for his records and distribution.
- D. For non-approval items, such as parts lists and operation or maintenance manuals, 3 copies are required, unless specified otherwise:
 - 1. For ESI File 1 copy
 - 2. For Contractor File 1 copy
 - 3. For Owner File 1 copy
 - 4. Total 3 copies
- E. Samples
 - 1. Submittal
 - a. At Contractor's option, provide preliminary submittal of a single set of samples for the Engineer's review and "action." Otherwise, initial submittal is final submittal unless returned with "action" which requires re-submittal. Submit two sets of samples in final submittal; one set will be returned.

2. Quality Control Set

- a. Maintain returned final set of samples at project site, in suitable condition and available for quality control comparisons by Engineer and by others.

1.10 REVIEW OF SUBMITTALS

A. Review Time

1. Allow 15 working days from the date the submittal is received in the Engineer's office for the Engineer to review and respond to each submittal, except allow longer periods where processing must be delayed for coordination with subsequent submittals. The Engineer will advise the Contractor promptly when it is determined that a submittal being processed must be delayed for coordination.

B. Engineer's Action

1. "No Exception Noted" - Indicates the drawings have been reviewed for conformance with the contract documents and no exceptions have been taken. Proceed with the work.
2. "Furnish as Corrected" - Indicates the drawings have been reviewed for conformance with the contract documents and work may proceed in accordance with all comments. Re-submittal will not be required.
3. "Revise and Resubmit" - Indicates the drawings have been reviewed for conformance with the contract documents, and work may not proceed. After items to which exceptions have been taken are corrected, Contractor shall again submit copies for review.
4. "Rejected" - Indicates the drawings have been reviewed for conformance with the contract documents and are too incomplete or in an unacceptable condition for review. A notation will be made on the shop drawings as to the exceptions taken. Drawings shall be revised and resubmitted for review before proceeding with the work.
5. "Submit Specific Item" - Indicates that one or more items in the submittal were missing or incomplete. Work may commence on any items to which no exceptions were taken; missing or incomplete items must be submitted as noted.

1.11 DAILY REPORTS

- A. The Contractor shall submit daily reports to the Engineer. Reports shall contain, but not be limited to, a list of all employees and subcontractors by trade that worked on the job that day, received equipment and materials, survey stake-out data, erosion control maintenance updates.

** END OF SECTION **



SECTION 01310
CONSTRUCTION PROGRESS SCHEDULES

1 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall submit to the Engineer for approval construction planning, scheduling, and cost value documentation pertaining to the project as detailed herein and shall update same throughout project as required.
- B. The following schedules, reports, and plots shall be submitted to the Engineer.
 - 1. Construction Progress Schedule
 - 2. Short Term Schedules
 - 3. Detailed Cost Breakdown/Schedule of Values
 - 4. Activity Reports
 - 5. Equipment and Material Order Schedule
 - 6. Logic Diagrams
 - 7. Resource Plots
- C. No Construction Progress Schedule review by the Engineer shall relieve the Contractor from the responsibility to comply with the Contract Times and any sequences of Work indicated in or required by the Contract Documents or to complete Work within the Contract Times. Nor will any such Construction Progress Schedule review by the Engineer lead to approval of, or consent to, any variation from the Contract Documents, except as the Engineer may otherwise approve or consent to individual variations by means of specific, separate notations in writing.

1.2 SUBMITTAL PROCEDURES

- A. Within 10 working days of Notice to Proceed, the Contractor shall submit to the Engineer for approval the products required by this section of the Specifications.
- B. Within 5 working days following receipt of same the Engineer shall arrange for a meeting with the Contractor so as to familiarize the Engineer with the Contractor's proposed construction plans and schedules.
- C. Within 5 working days following the Engineer's review the Contractor shall resubmit a corrected copy of those documents requiring revision.
- D. Within 5 working days following his receipt of the adequately revised documents the Engineer will approve same for use on the project.
- E. Once approved, the Contractor shall submit 4 copies of the construction scheduling documents to the Engineer for use on the project. The construction scheduling documents shall be marked Rev. 0.
- F. The Contractor shall not submit an Application for Payment until the Rev. 0 Construction Progress Schedule is approved.

2 PRODUCTS

2.1 GENERAL

- A. All construction scheduling documents shall be prefaced with the following summary data.
 - 1. Project Name
 - 2. Contractor
 - 3. Type of Tabulation (Initial or Updated with revision number)

4. Project Duration
5. Project Scheduled Completion Date
6. Effective or Starting Date of the Schedule
7. If an updated (revised) schedule, the new project completion date and project status

2.2 CONSTRUCTION PROGRESS SCHEDULE

- A. The Construction Progress Schedule shall be a cost-and-resource loaded critical path method (CPM) progress schedule.
- B. The Construction Progress Schedule shall detail CPM activities and logic ties to the extent required to show the Contractor's overall approach to the Work.
- C. At a minimum, the Construction Progress Schedule shall include the following.
 1. Activity Number
 2. Activity Description
 3. Estimated Activity Duration (Work Days)
 4. Activity Start Date (Calendar Dated)
 5. Activity Finish Date (Calendar Dated)
 6. Activity Cost of each of the various subdivisions of work required under the Contract Document, Specifications, and Drawings.
- D. The Construction Progress Schedule shall clearly define the prosecution of the Work from Notice-to-Proceed to Final Acceptance by using separate CPM Activities.
- E. CPM Activities shall equate to the days required to complete the associated work.
- F. CPM Activities shall be assigned consistent descriptions, codes, and sort codes.
- G. CPM Activity durations shall be depicted in the form of a bar chart.
- H. The narrative shall list the CPM Activities on each Critical Path and compare Early and Late Dates for CPM Activities designating Contract Times and Target Times. The narrative shall also recap progress and days gained or lost vs. the current Construction Progress Schedule, describe changes in resources to be used on remaining Work and identify delays, their extent and causes. The narrative shall also itemize changes in Activities, logic ties and detailed cost breakdown pay items by each change, recovery plan and Contractor-initiated revision.
- I. Construction Progress Schedules shall be submitted on 11"x17" white paper and shall be in color.
- J. Contractor shall also submit two color copies of the schedule on minimum 22"x34" sheet(s) suitable for wall mounting.
- K. Construction Progress Schedule Updates
 1. The Contractor shall update the Construction Progress Schedule at least monthly and indicate those activities whose completion dates are in jeopardy because of activities behind schedule.
 2. Updated construction scheduling documents shall be submitted to the Engineer each month at the construction progress meeting.
 3. Each monthly Construction Progress Schedule Update shall be marked Rev. 0.1, Rev. 0.2, etc.
 4. The Owner may require the Contractor to modify any portions of the work schedule that becomes infeasible because of "activities behind schedule" or for any other valid reason. Any such modification will be at the Contractor's expense unless the modification is required to accommodate schedule revisions required by the Owner.

5. If a revision is required to the Construction Progress Schedule Update submittal, it shall be marked Rev. 0.1A, Rev. 0.1B, etc.
 6. An activity that cannot be completed by its original latest completion date shall be deemed to be behind schedule.
- L. If a revision is required to the overall Construction Progress Schedule, it shall be marked Rev. 2, Rev. 3, etc.

2.3 SHORT TERM SCHEDULES

- A. Short-Term Schedules shall subdivide CPM Activities into detailed tasks and cover the prior two (2) weeks and the next four (4) weeks. Each installation task shall be cross-referenced to a CPM Activity and shall not combine the Work for more than one crew. Submittals shall segregate preparation from review and shall not combine items furnished by separate Suppliers.

2.4 DETAILED COST BREAKDOWN/SCHEDULE OF VALUES

- A. The Detailed Cost Breakdown (DCB) shall divide the Work into pay items by significant Sections of the Specifications within areas, structures, and facilities, or vice versa. If requested by the Engineer in writing, there shall be separate DCB reports for self-performed Work and the Work of each Subcontractor.
- B. The Schedule of Values (SOV) shall subdivide the DCB into CPM and Pay Activities, sequenced by Activity codes, and shall tabulate for each Activity: code, description, Values for labor, Subcontract and/or materials and equipment costs; Activity Values; percent complete; and Earned Values. Delivery and Submittal Review Activities, where appropriate, shall be cost-loaded if the Contractor intends to request payment for stored materials and for approved equipment Shop Drawings, respectively.
1. The Contractor shall establish and submit a cost value for each activity in his progress schedule and estimates so that monthly partial payments to the Contractor can be calculated on the basis of work in place.
 2. Wherever in the General Conditions it is provided that payments will be allowed for materials delivered to the site but not yet incorporated in the work, subject to the terms and conditions specified in the General Conditions, separate pay items shall be established for furnishing and installation of such items.
 3. Costs of materials delivered to the site but not yet incorporated into the work shall be included as a separate pay item and shall not be included in the cost value of the installation activity for such materials.
- C. Pay Activities or the features of the software shall be used to ensure that any total CPM Activity Value or, if appropriate, that any Activity labor, Subcontract, etc. Values roll up to only one DCB pay item. Once the Rev. 0 DCB and SOV are approved, the Contractor shall not modify any DCB pay item or Activity Value, unless otherwise authorized by the Engineer in writing.
- D. A schedule of the anticipated amount of each monthly payment that will become due the Contractor in accordance with the Construction Progress Schedule shall be included provided. This anticipated monthly payment schedule shall distribute the costs of the project more or less evenly over the scheduled project life in a manner acceptable to the Owner and compatible with the Owner's funding arrangements for the project. Re-submittal will be required until the anticipated monthly payment schedule is acceptable to Owner. For this project, substantial variation from this schedule of payments will not be permitted.

2.5 ACTIVITY REPORTS

- A. Activity Reports shall include CPM Activity code, description, duration, calendar, Early and Late Dates (calendar dates), Total Float, labor manhours, and sort codes. The Late Finish Date (or the Early Start Date) of any CPM Activity highlighting a Contract Time (or commencement of all or any part of the Work) shall equal the corresponding Contract Time (or Contract date). In addition, for precedence-based Progress Schedules, Activity Reports

shall show, for each CPM Activity, all preceding and succeeding logic ties (lead/lag and lead times) or attach a separate report combining such Activity and logic tie data.

2.6 EQUIPMENT AND MATERIAL ORDER SCHEDULE

- A. Equipment and Material Order Schedule shall include the following information for principal items of equipment and materials.
 - 1. Dates on which Shop Drawings are requested and received from the manufacturer
 - 2. Dates on which certification is received from the manufacturer and transmitted to the Engineer
 - 3. Dates on which Shop Drawings are submitted to the Engineer and returned by the Engineer for revision
 - 4. Dates on which Shop Drawings are revised by manufacturer and resubmitted to the Engineer
 - 5. Date on which Shop Drawings are returned by Engineer annotated either "Furnish as Submitted" or "Furnish as Corrected"
 - 6. Date on which accepted Shop Drawings are transmitted to manufacturer
 - 7. Date of manufacturer's scheduled shop test
 - 8. Date of manufacturer's scheduled delivery
 - 9. Date on which delivery is actually made

2.7 LOGIC DIAGRAMS

- A. Logic Diagrams shall be arrow or precedence and, once the Engineer has designated time-scales, shall be plotted on a time- scaled calendar, on minimum 22-inch x 34-inch color sheets. Logic Diagrams shall identify the Contract Times and Critical Path(s). CPM Activities shall be shown on the Early Dates, and Total Floats shall be noted beside the CPM Activities. Logic connectors whether on the same sheet or not, shall identify predecessors and successors.

2.8 RESOURCE PLOTS

- A. Resource Plots shall graph monthly (or weekly, if chosen by the Engineer) and cumulative payments and manpower, using current Early Dates and Late Dates and, when requested by the Engineer, comparing Construction Progress Schedule and current Early Dates. The specific trades shall be chosen by the Engineer.

2.9 PROPOSAL SCHEDULES

- A. If required, the Contractor shall submit Proposal Schedules, which shall support proposals or claims for changes in Contract Price or Contract Time, schedule recovery plans and other Contractor-initiated Progress Schedule adjustments.
- B. A Proposal Schedule Submittal shall include all the reports, schedules, plots, etc. specified for a Progress Schedule Submittal.

3 EXECUTION

3.1 GENERAL

- A. Contractor shall take all reasonable actions to maintain the Rev. 0 Construction Progress Schedule.

3.2 DELAY PROVISIONS

- A. The Contractor shall promptly take appropriate action to recover schedule whenever the Contractor anticipates, or any Construction Progress Schedule submittal demonstrates, that a CPM Activity will slip, due to acts or omissions within the control of the Contractor, by fifteen (15) or more days beyond any Target Time or Contract Time.

- B. If the Contractor is not responsible for such schedule slippage, the Contractor shall give prompt written notice of a delay justifying a Contract Time extension, and follow such notice by taking prompt appropriate action nonetheless, if so directed by the Engineer.
- C. If schedule recovery is required, the Contractor shall enclose with the next Construction Progress Schedule submittal a schedule recovery plan consisting of the following.
 - 1. A narrative describing the cause of schedule slippage and the actions taken to recover schedule within the shortest reasonable time
 - 2. A Proposal Schedule with the corresponding revisions in Activities and logic ties and other adjustments. Appropriate schedule recovery actions may include assignment of additional labor, subcontractors or construction equipment; Work during other than normal working hours; re-sequencing of the Work; expediting of submittals and deliveries; and any combination of any of these or other similar actions. Activity shortening and overlapping shall be explained as to their basis (and be supported by increases in resources).
- D. If the Contractor believes that an increase in Contract Time is justified, any such extension in Contract Time and associated increase in Contract Price will not be evaluated, unless the following requisites are met.
 - 1. The Contractor, using the procedures in this Section, demonstrates that conditions justifying extensions in Contract Time or increases in Contract Price, or both, have arisen.
 - 2. The Contractor's analysis is verifiable by an independent, objective evaluation by the Engineer, using the data furnished by the Contractor.
- E. The Contractor's failure, refusal, or neglect to take appropriate schedule recovery action or, in the alternative, give written notice of a delay, and, in either case, to follow up with a timely Proposal Schedule shall be reasonable evidence that the Contractor is not prosecuting the Work with due diligence. Any such Contractor failure, refusal, or neglect shall give sufficient basis to the Owner, with the Engineer's advice, to elect any of the following.
 - 1. Demand adequate, written assurance of due performance.
 - 2. Increase retainage.
 - 3. Withhold liquidated damages.
 - 4. In the Owner's sole discretion, direct alternate schedule recovery actions.
 - 5. In the event the Engineer is unable to approve any Construction Progress Schedule revision, both the Engineer and Contractor shall be required to use the Rev. 0 Construction Progress Schedule to resolve issues affecting Contract Time and Contract Price.

3.3 CHANGE ORDERS

- A. Upon approval of a Change Order by the Owner the approved change shall be reflected in the next submittal by the Contractor.

3.4 MEASUREMENT AND PAYMENT

- A. The Contractor represents to have included in the Lump Sum Contract Price all costs for Work under this Section. Payment for Work performed under this Section will be made as part of those payments made on in-progress and completed Detailed Cost Breakdown pay items, or using the Earned Values for Progress Schedule Submittal pay items, if any such pay items are established.

** END OF SECTION **



SECTION 01320
CONSTRUCTION PROGRESS REPORTING

1 GENERAL

1.1 DAILY REPORTS

- A. The Contractor shall submit daily reports to the Engineer. Reports shall contain, but not be limited to, the following information:
1. Summary of work completed that day
 2. A list of all employees and subcontractors by trade that worked on the job that day
 3. A list of all equipment and materials received
 4. Survey stake-out data collected
 5. Erosion control maintenance updates
 6. Summary of any critical events from the day, injury reports, etc.
 7. Any other information pertinent to the construction project

** END OF SECTION **



SECTION 01330
PHOTOGRAPHIC DOCUMENTATION

1 GENERAL

1.1 SCOPE

- A. Furnish all equipment, labor, and materials required to provide the Owner with digital construction photographs and audio/video recordings of the Project.
- B. Photos, electronic files, and audio/video recordings shall become the property of the Owner and none of which shall be published without express permission of the Owner.

1.2 PRE AND POST CONSTRUCTION PHOTOGRAPHS

- A. Prior to the beginning of any work, take project photographs of the work area to record existing conditions.
- B. Following completion of the work, take another set of photos showing the same areas and features as in the pre-construction photographs.
- C. Show all conditions which might later be subject to disagreement in sufficient detail to provide a basis for decisions.
- D. Submit the pre-construction photographs to the Engineer within 15 calendar days after the date of receipt by the Contractor of the Notice to Proceed. Provide post-construction photographs prior to final acceptance of the project.

1.3 PROGRESS PHOTOGRAPHS

- A. Include the date and time marking of the recording on the photographs. Electronically label all photographs to indicate date and description of work shown.
- B. Submit a minimum of 25 photographs with each request for payment. The view selection will be as agreed to with the Engineer. Submit two compact discs with copies of the electronic photograph files in jpeg format.

1.4 PRE AND POST CONSTRUCTION AUDIO/VIDEO RECORDINGS

- A. Prior to the beginning of any work, make audio/video recordings of the work area to record existing conditions.
- B. Following completion of the work, make another recording showing the same areas and features as in the pre-construction recording.
- C. Show all conditions which might later be subject to a disagreement in sufficient detail to provide a basis for decisions.
- D. Include the date and time markings on the video. Provide an audio narration, stating a description of what is shown, structure, area, approximate station of the area shown, and street address and property owner where appropriate for all videos.
- E. Use DVD minus R format for audio/video recordings. The quality and content shall be subject to the approval of the Engineer.
- F. Provide typed labels for the DVD and DVD case with the following information: Project title, date of recording, project stations shown on the recording.

1.5 SUBMITTALS

- A. Photo Quality
 - 1. 4.0 megapixels (2,240x1,680 resolution) or better with 48 Bit color depth.

B. Formats

1. Provide photo files on compact discs in jpeg format.
2. Provide audio/video recordings in DVD minus R format.

C. Submit the pre-construction photographs to the Engineer within 15 calendar days after the date of the Notice to Proceed. Submit post-construction photographs prior to final acceptance of the Project.

D. Submit progress photographs with each payment request.

E. Audio/Video Recordings

1. Submit the pre-construction recording prior to the first partial payment request.
2. Submit the post-construction recording with the final payment request.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

** END OF SECTION **

SECTION 01410
TESTING LABORATORY SERVICES

1 GENERAL

1.1 DESCRIPTION

- A. The Contractor shall use the services of the Owner-selected testing laboratory for all materials testing related to soil compaction and concrete strength outlined in these specifications.
- B. Employment of a testing laboratory shall in no way relieve the Contractor of his obligation to perform work meeting the requirements of the Contract.
- C. Payment for the testing will be paid by the Owner separate from this Contract.

1.2 LABORATORY DUTIES

- A. Cooperate with Engineer and Contractor.
- B. Provide qualified personnel promptly on notice.
- C. Perform specified inspections, sampling and testing of materials and methods of construction.
 - 1. Comply with specified standards; ASTM, other recognized authorities and as specified.
 - 2. Ascertain compliance with requirements of Contract Documents.
- D. Promptly notify Engineer and Contractor of irregularity or deficiency of Work observed during performance of services.
- E. Promptly submit three copies of report of inspections and tests in addition to those required by the Contractor including:
 - 1. Date issued.
 - 2. Project title and number.
 - 3. Testing laboratory name and address.
 - 4. Name and signature of inspector.
 - 5. Date of inspection or sampling.
 - 6. Record of temperature and weather.
 - 7. Date of test.
 - 8. Identification of product and specification section.
 - 9. Location of Project.
 - 10. Type of inspection or test.
 - 11. Results of test.
 - 12. Observations regarding compliance with Contract Documents.
- F. Perform additional services as required.
- G. Laboratory is not authorized to:
 - 1. Release, revoke, alter or enlarge on requirement of Contract Documents.
 - 2. Approve or accept any portion of work.

1.3 CONTRACTOR RESPONSIBILITIES

- A. Cooperate with laboratory personnel, provide access to Work and/or manufacturers requirements.
- B. Provide to laboratory, preliminary representative samples of materials to be tested in required quantities.

- C. Furnish copies of mill test reports.
- D. Furnish required labor and facilities.
 - 1. To provide access to work to be tested.
 - 2. To obtain and handle samples at the site.
 - 3. To facilitate inspections and tests.
- E. Notify laboratory sufficiently in advance of operation to allow for the assignment of personnel and schedules of tests.
- F. Laboratory Tests
 - 1. Where such inspection and testing are to be conducted by an independent laboratory or agency, the sample or samples shall be selected by such laboratory or agency or the Engineer and shipped to the laboratory by the Contractor at his expense.

** END OF SECTION **

SECTION 01504
MOBILIZATION

1 GENERAL

1.1 GENERAL REQUIREMENTS

A. Mobilization shall include the obtaining of all permits, moving equipment onto the site, furnishing and erecting temporary buildings and other construction facilities, and providing utility services, all as required for the proper performance and completion of the Work. Mobilization shall include the following principal items:

1. Moving onto the site all of the Contractor's equipment required for first month operations
2. Installing temporary construction power, wiring, and lighting facilities
3. Providing construction water supply
4. Providing field offices for the Contractor and the Engineer
5. Providing on-site sanitary facilities and potable water facilities
6. Arranging for and erection of Contractor's work and storage area
7. Obtaining all required permits
8. Having all OSHA required notices and establishment of safety programs
9. Having the Contractor's superintendent at the job site full time
10. Submitting initial submittals

1.2 PAYMENT FOR MOBILIZATION

- A. The Contractor's attention is directed to the condition that no payment for mobilization, or any part thereof will be approved for payment under the Contract until all mobilization items listed above have been completed as specified.
- B. As soon as practicable after receipt of the Notice to Proceed, the Contractor shall submit a breakdown to the Engineer for approval, which shall show the estimated value of each major component of mobilization.
- C. The lump sum price for mobilization will be payable with the first progress payment request except that this initial payment will be limited to 5% of the total Contract amount. Any remaining amount will be paid when the value of the completed work exceeds 50% of the total Contract amount.

** END OF SECTION **



SECTION 01505
SAFETY IN WASTEWATER WORKS

1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. The Contractor shall be responsible for conducting all work in a safe manner and shall take reasonable precautions to ensure the safety and protection of workers, property, and the general public.
- B. All construction work shall be conducted in accordance with the latest applicable requirements of Part 1926 of the Occupational Safety and Health Act, Safety and Health Regulations for Construction, Section 107 of the Contract Work Hours and Safety Standards Act, as well as any other local or state safety codes and regulations.
- C. The Contractor shall designate a trained and qualified employee who is to be responsible for ensuring that the work is performed safely and in conformance with all applicable regulations. The name and resume of the designated safety supervisor shall be submitted to the Engineer prior to commencing any construction work.
- D. The Contractor shall determine for himself the safety hazards involved in executing the work and the precautions necessary to conduct the work safely. If the Contractor is unsure as to any special hazards which may be unique to the various processes and facilities at the treatment plant, it shall be his responsibility to contact the Engineer and request such information in writing prior to beginning the work.
- E. The Contractor shall bear all risks associated with performing the work and shall fully indemnify the Owner and Engineer.

** END OF SECTION **



SECTION 01510

UTILITIES

1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. The Contractor shall provide temporary light and power, heating, water service and sanitary facilities for his operations and for the construction operations of the Contractor's subcontractors at the site. The temporary services shall be provided for use throughout the construction period.
- B. The Contractor shall coordinate and install all temporary services in accordance with the requirements of the utility companies having jurisdiction and as required by applicable codes and regulations.
- C. At the completion of the work, or when the temporary services are no longer required, the facilities shall be restored to their original conditions by the Contractor.
- D. All costs in connection with the temporary services including, but not limited to, installation, utility company service charges, maintenance, relocation, and removal shall be borne by the Contractor at no additional cost to the Owner.
- E. Some temporary facilities that may be required may be indicated on the Drawings; however, the Drawings do not necessarily show any or all of the temporary facilities that the Contractor ultimately uses to complete the work.
- F. Contractor shall not be allowed to use any of the existing facilities or utilities.

1.2 TEMPORARY UTILITIES

A. Temporary Power and Light

1. The Contractor shall provide temporary power facilities required for the proper prosecution and inspection of the work. These facilities shall be installed and maintained by the Contractor, and shall be located in such a manner as to result in the least interference with work upon the project site. Temporary power facilities shall remain in place after completion of construction until final acceptance of the work. After final acceptance of the work, the Contractor shall remove temporary power facilities.
2. The Contractor shall provide temporary lighting facilities for the proper prosecution and inspection of the work. These facilities shall be installed and maintained by the Contractor and shall be located in such a manner as to result in the least interference with work upon the project site and existing facilities.
3. The temporary general lighting and small power requirements shall be serviced by 120/240 V, 1 phase, 3 wire temporary systems furnished and installed by the Contractor. This service shall be furnished complete with main disconnect, over-current protection, meter outlet, branch circuit breakers, and wiring as required; including branch circuit breakers and wiring as required for furnishing temporary power to the various Contractor's field office service connections, all in accordance with the requirements of the servicing power company and applicable standards and codes. The meter for the temporary 120/240 V service for construction purposes shall be registered in the name of the Contractor and all energy charges for furnishing this temporary electric power shall be borne by the Contractor.
4. The Contractor shall make all necessary arrangements, and pay for all permits, inspections, and power company charges for all temporary service installations. Upon completion of the work, but prior to acceptance by the Owner, the Contractor shall remove all temporary services.

B. Temporary Heating

1. Concrete Curing

- a. When the mean daily temperature of the atmosphere is less than 40°F, the temperature of concrete shall be maintained between 50° and 70°F for two days following placement. When necessary, arrangements for heating, covering, insulating, or housing the concrete work shall be made in advance of placement and shall be adequate to maintain the required temperature and moisture conditions without injury due to concentration of heat. The Contractor shall provide temporary heat for proper execution of the work.

C. Temporary Water

1. The Contractor shall make the necessary arrangements for securing and transporting all water required in the construction, including water required for mixing of concrete, sprinkling, testing, flushing, flooding, jetting, sanitary facilities, field offices, or cleaning, and including any temporary pipeline or equipment which may be necessary to make use of such water.
2. Water service shall be protected from freezing and the service shall be extended and relocated as necessary to meet temporary water requirements.

D. Potable Water

1. The Contractor shall be responsible for furnishing a supply of potable drinking water for employees, subcontractors, inspectors, Engineers and the Owner who are associated with the work progress.

E. Temporary Telephone Service

1. Provide telephone service, for the duration of the project, at the Contractor's and the Engineer's field offices.

F. Sanitary Facilities

1. The Contractor shall provide sufficient sanitary facilities in proximity to the areas of work for his employees and those employees of his subcontractors. The Contractor will be responsible for continual maintenance and servicing of these facilities.

G. First-Aid Facilities

1. The Contractor shall maintain at a well-known place at the job site, all articles necessary for giving first-aid to the injured, and shall make standing arrangements for the immediate removal to a hospital or a doctor's care of persons (including employees) who may be injured on the job site. In no case, shall employees be permitted to work at a job site before the employer has made a standing arrangement (verified in writing to the Owner) for removal of injured persons to a hospital or a doctor's care.

1.3 PERMANENT UTILITIES

- A. The Contractor shall obtain all required permanent utilities for the facility prior to substantial completion.
- B. Permanent utilities shall be transferred to the Owner at substantial completion.

** END OF SECTION **

SECTION 01540
JOB SITE SECURITY

1 GENERAL

1.1 BARRICADES AND LIGHTS

- A. The Contractor shall furnish and erect barricades, fences, lights, and danger signals and shall provide such other precautionary measures for the protection of persons or property and of the work as necessary.
- B. Barricades shall be painted in a color that will be visible at night.
- C. From sunset to sunrise, the Contractor shall furnish and maintain at least one light at each barricade and sufficient numbers of barricades shall be erected to keep vehicles from being driven on or into any work under construction.
- D. The Contractor will be held responsible for all damage to the work due to failure of barricades, signs, and lights to protect it and whenever evidence is found of such damage, the Contractor shall immediately remove the damaged portion and replace it at his cost and expense. The Contractor's responsibility for the maintenance of barricades, signs, and lights shall not cease until the project has been accepted by the Owner.

** END OF SECTION **



SECTION 01550
SITE ACCESS

1 GENERAL

1.1 ACCESS ROADS

- A. The Contractor shall construct and maintain such temporary access roads as required to perform the work of this Contract. Access roads shall be located as shown on the Contract Drawings.
- B. Access roads shall be located within the property lines of the Owner unless the Contractor independently secures easements for his use and convenience.
- C. Existing access roads used by the Contractor shall be suitably maintained by the Contractor at his expense during construction. Contractor shall not be permitted to restrict Owner access to existing facilities. Engineer may direct Contractor to perform maintenance of existing access roads when Engineer determines that such work is required to insure all weather access by the Owner.

1.2 PARKING AREAS

- A. The Contractor shall construct and maintain suitable parking areas for his construction personnel and equipment on the project site where approved by the Engineer and the Owner.

1.3 RESTORATION

- A. At the completion of the work, the surfaces of land used for access roads and parking areas shall be restored by the Contractor to its original condition and to the satisfaction of the Engineer. At a minimum, such restoration shall include establishment of a permanent ground cover adequate to restrain erosion for all disturbed areas.
- B. All existing asphalt roadways that are damaged by construction traffic shall be removed and replaced.

** END OF SECTION **



SECTION 01562
DUST CONTROL

1 GENERAL

1.1 DESCRIPTION

- A. Limit blowing dust caused by construction operations by applying water or employing other appropriate means or methods to maintain dust control.

1.2 PROTECTION OF ADJACENT PROPERTY

- A. The bidders shall visit the site and note the buildings, landscaping, roads, parking areas and other facilities near the work site that may be damaged by their operations. The Contractor shall make adequate provision to fully protect the surrounding area and will be held fully responsible for all damages resulting from his operations.
- B. Dust, Fumes, Spray, or Spills
 - 1. Protect all existing facilities (indoors or out) from damage by the above hazards (indoors or out):
 - 2. Protect motors, bearings, electrical gear, instrumentation, and building or other surfaces from dirt, dust, welding fumes, paint spray, spills or droppings causing wear, corrosion, malfunction, failure or defacement by enclosure, sprinkling or other dust palliatives, masking and covering, exhausting or containment.
- C. The Contractor shall be responsible for dust generated both on the construction site and on unpaved roads to the site. The Contractor shall provide the necessary controls to minimize dust generation from construction traffic on the unpaved roads used to access the site.

** END OF SECTION **



SECTION 01590
FIELD OFFICES

1 GENERAL

1.1 ENGINEERS FIELD OFFICE

- A. The Contractor shall provide and equip an Engineer's office space (prefabricated building or mobile trailer), properly weatherproofed, skirted, and adequately anchored against 100-mile per hour gusts and winds. The office building shall be located on the project site and shall be in the vicinity of the Contractor's offices and buildings.
- B. The Engineer's field office shall be ready for occupancy within 10 days after notice to proceed with construction and shall not be removed until the project has been accepted for final completion.
- C. The office space shall contain a minimum of 600 (12x50) square feet of floor space. Include two separate offices with locking doors, a meeting room and a private restroom with toilet, sink, and shower. It shall be a separate facility from Contractor's facilities.
- D. Plumbing shall include hot and cold running water and shall be heat traced and insulated.
- E. Walls, ceilings, and floors shall be adequately insulated.
- F. Interior finishes shall be manufacturer's standard, subject to approval.
- G. The office building shall be adequately wired for electricity in accordance with applicable Codes to handle the total lighting, air conditioning, and other loads. Lighting fixtures, in adequate numbers, shall be installed to give illumination of 150-foot candles average and minimum glare. Fluorescent lamp fixtures with minimum 45 degrees shielding will be required.
- H. 110-volt convenience outlets, and 220-volt grounded wall outlets shall be provided.
- I. Air conditioning and heating combination unit to maintain 78 °F inside in winter with outside air temperature of 20 °F and 72 °F inside in summer with an outside temperature of 100 °F. Provide air filters and change once per month.
- J. Telephone service and wiring for two lines. DSL telephone service internet connection.
- K. Provide 5'x10' wooden stoop.
- L. Venetian blinds shall be installed on all windows.
- M. Windows and outside entrance doors shall be properly screened.
- N. Acoustical tile ceiling.
- O. Outside door(s) shall have lock(s). Contractor shall be responsible for protecting the Engineer's trailer and its contents.
- P. Furnishings
 - 1. The Contractor shall provide such furniture and furnishings of quality equal to those used in the Contractor's Field Office for the Engineer's office facilities as follows:
 - a. Two (2) six-foot double desks with 2-drawer metal file pedestals and two pencil drawers.
 - b. Two (2) executive swivel chairs on castors.
 - c. One (1) eight-foot-long conference/meeting tables.
 - d. Ten (10) side chairs.
 - e. Two (2) telephones, one (1) answering machine, and telephone service (including long distance).
 - f. One (1) plain paper printer/copier/scanner with reducing and enlarging capability. Minimum 10 copies per minute. Include operating supplies.

- g. Two (2) four-drawer locking file cabinets.
 - h. Two (2) book cases, each with twelve linear feet of shelving.
 - i. One (1) 4'x8' plan desk.
 - j. Two (2) task lights.
 - k. Two (2) five-foot folding tables.
 - l. Water cooler with service.
 - m. Two (2) 3'x5' dry erase boards with accessories.
 - n. Two (2) 3'x5' bulletin boards.
- Q. Provide rain gauge and indoor/outdoor thermometer. Install rain gauge on post near field office as directed by field representative.
- R. Provide janitorial services to clean trailer once per week. Include sweeping, mopping floors, empty wastebaskets, and clean bathroom.
- S. Provide a submittal of office layout for review. Coordinate with on-site representative and install furniture per approved layout.

** END OF SECTION **

SECTION 01610
TRANSPORTATION AND HANDLING

1 GENERAL

1.1 GENERAL

- A. The Contractor shall provide transportation of all equipment, materials, and products furnished under these Contract Documents to the site of the work. In addition, the Contractor shall provide preparation for shipment and storage, unloading, handling and re-handling, short-term storage, extended storage, storage facilities, maintenance and protection during storage, preparation for installation, and all other work and incidental items necessary or convenient to the Contractor for the satisfactory execution and completion of the work.
- B. Any and all materials and products, including spare parts, damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the Owner prior to being incorporated into the work.

1.2 TRANSPORTATION

- A. All equipment shall be suitably boxed, crated, or otherwise protected during transportation.
- B. All equipment shall be shipped and delivered in the largest assembled sections practical or permitted by carrier regulations to minimize the number of field connections.
- C. The Contractor shall be responsible for ensuring that the equipment is assembled and transported in such a manner so as to clear buildings, power lines, bridges, and similar structures encountered during shipment or delivery to the site of the work.
- D. Where equipment will be installed using existing cranes or hoisting equipment, the Contractor shall ensure that the weights of the assembled sections do not exceed the capacity of the cranes or hoisting equipment.
- E. Small items and appurtenances such as gauges, valves, switches, instruments, and probes which could be damaged during shipment shall be removed from the equipment prior to shipment and packaged and shipped separately. All openings shall be plugged or sealed to prevent the entrance of water or dirt.
- F. Temporary shipping braces and supports shall be painted orange or yellow for easy identification.

1.3 HANDLING

- A. All equipment, materials, and products shall be carefully handled to prevent damage or excessive deflections during unloading or transportation. All equipment, materials, and products damaged during transportation or handling shall be repaired or replaced by the Contractor at no additional cost to the Owner prior to being incorporated into the work.
- B. Lifting and handling drawings and instructions furnished by the manufacturer or supplier shall be strictly followed. Eyebolts or lifting lugs furnished on the equipment shall be used in handling the equipment. Shafts and operating mechanisms shall not be used as lifting points. Spreader bars or lifting beams shall be used when the distance between lifting points exceeds that permitted by standard industry practice. Slings and chains shall be padded as required to prevent damage to protective coatings and finishes.
- C. Under no circumstances shall equipment or products such as pipe, structural steel, castings, reinforcement, lumber, piles, poles, etc., be thrown or rolled off of trucks onto the ground.
- D. Items such as nonmetallic pipe, nonmetallic conduit, flagpoles, and lighting poles shall be handled using nonmetallic slings or straps. Slings and Chains shall be padded as required to prevent damage to protective coatings and finishes.

- E. All handling, moving, lifting, transporting, and storing of materials including spare parts and other products shall be done in strict accordance with the methods recommended by the respective manufacturers.

** END OF SECTION **

SECTION 01620
STORAGE AND PROTECTION

1 GENERAL

1.1 GENERAL

- A. Equipment shall be received, inspected, unloaded, handled, stored, maintained, and protected by the Contractor in a suitable location on or off site, if necessary, until such time as installation is required.
- B. Storage and protection of Contractor-furnished equipment shall be in strict conformance with the requirements of Section 11100, General Equipment Stipulations.

1.2 STORAGE

- A. The Contractor shall be responsible for providing satisfactory storage facilities which are acceptable to the Engineer. In the event that satisfactory facilities cannot be provided on site, a satisfactory warehouse, acceptable to the Engineer, shall be provided by the Contractor for such time until the equipment, materials, and products can be accommodated at the site.
- B. Equipment, materials, and products which are stored in a satisfactory warehouse acceptable to the Engineer will be eligible for progress payments as though they had been delivered to the job site.
- C. The Contractor shall be responsible for the maintenance and protection of all equipment, materials, and products placed in storage and shall bear all costs of storage, preparation for transportation, transportation, re-handling, and preparation for installation.
- D. Equipment and products stored outdoors shall be supported above the ground on suitable wooden blocks or braces arranged to prevent excessive deflection or bending between supports. Items such as pipe, structural steel, and sheet construction products shall be stored with one end elevated to facilitate drainage.
- E. Unless otherwise permitted in writing by the Engineer, building products and materials such as cement, grout, plaster, gypsum board, particleboard, resilient flooring, acoustical tile, paneling, finish lumber, insulation, wiring, etc., shall be stored indoors in a dry location. Building products such as rough lumber, plywood, concrete block, and structural tile may be stored outdoors under a properly secured waterproof covering.
- F. Tarps and other coverings shall be supported above the stored equipment or materials on wooden strips to provide ventilation under the cover and minimize condensation. Tarps and covers shall be arranged to prevent ponding of water.

1.3 EXTENDED STORAGE

- A. In the event that certain items of major equipment such as air compressors, pumps, and mechanical aerators have to be stored for an extended period of time, the Contractor shall provide satisfactory long-term storage facilities which are acceptable to the Engineer. The Contractor shall provide all special packaging, protective coverings, protective coatings, power, nitrogen purge, desiccants, lubricants, and exercising necessary or recommended by the manufacturer to properly maintain and protect the equipment during the period of extended storage. Extended storage shall be defined as any item that is placed on the stored materials list for monthly pay requests.
- B. Contractor shall submit to Engineer, manufacturer's recommended storage procedures for each piece of equipment placed in extended storage.

** END OF SECTION **



SECTION 01655
FIELD TESTING AND STARTING OF SYSTEMS

1 GENERAL

1.1 SCOPE

- A. Provide all labor, including the services of equipment manufacturer's representatives, and materials required to perform pre-operational checkout, functional testing, and commissioning of all equipment and mechanical systems installed under this contract.
- B. The physical inspection and testing requirements in this Section are in addition to those requirements defined in the technical specifications.

1.2 DESCRIPTION

- A. The exact sequence of the facility start-up will depend upon a start-up schedule proposed by the Contractor and reviewed by the Engineer. The facility start-up schedule will be based upon the schedule information generated via the Project Schedule and a priority list of the equipment and systems developed by the Engineer, which are critical and required for startup. The start-up schedule will be updated on a monthly basis, or as directed by the Engineer.
- B. It is the Contractor's responsibility to make sure that all Work is completed in time to support field and startup testing. Initial testing of the systems may begin only after the Engineer has received full documentation and certification by the manufacturer and Contractor of the complete and correct installation of equipment associated with the Work. The Contractor shall also certify to the Engineer that all auxiliary systems and components associated with testing have been correctly installed/constructed and completed.
- C. All equipment testing and operation shall be witnessed by the Engineer and shall be performed as required to confirm that the Work has been constructed and/or installed properly and will operate satisfactorily under the specified conditions of service. No power is to be turned on to any piece of equipment and no equipment is to be started or tested by the Contractor outside the presence of the manufacturer's technical representative.
- D. The Contractor must verify the integrity of the Work and make any adjustments, calibrations and/or remedial measures required to prepare the Work for acceptance and performance testing.
- E. The MBR system shall require two separate pre-operational checkout, functional testing, and commissioning periods. The first commissioning period will occur after Phase 1 the MBR system is constructed and prior to the existing treatment process being taken out of service. The second commissioning period will occur after the entire project is constructed the new facility is ready to be placed into service.

1.3 SUBMITTALS

- A. Submit name, address, telephone numbers, and resume of the proposed field services technicians at least 30 days in advance of the services.
- B. Submit test data sheets and performance requirements of each piece of equipment at least 14 days prior to starting related testing.
- C. Submit schedule of proposed dates and times for testing and startup activities at least 14 days prior to start of testing.
- D. Submit a summary of power, lighting, chemical, water, gas, and other process and utility needs necessary for conducting testing and startup at least 14 days prior to start of testing.
- E. Submit a detailed step-by-step description of testing requirements a minimum of 14 days prior to start of testing.
- F. Submit field service technicians report summarizing results of pre-operational checkout, including adjustments and pre-tests, prior to conducting functional testing.

- G. Submit Manufacturer's Certificate of Proper installation.
- H. Submit Test Reports for each piece of equipment or system tested.
- I. Submit summary log of all testing and training activities, by specific equipment item, as applicable.

1.4 UNIT RESPONSIBILITY

- A. A single manufacturer shall assume unit responsibility for all items so specified in each section. Unit responsibility shall require that all items be products of, or guaranteed by, the manufacturer. The manufacturer shall be responsible for all coordination between components and provide all submittals, installation and start-up assistance and certifications on the equipment as a unit.

1.5 QUALITY ASSURANCE

- A. Field service technician shall be competent and experienced in the proper installation, adjustment, operation, testing and startup of equipment and systems being installed. Manufacturer's sales representative and marketing personnel shall not be accepted as field service technicians.
- B. Prior to startup and testing, system components shall be flushed with water and hydraulically checked for leaks, cracks, and defects.
- C. All systems shall be cleaned and purged as required prior to the pre-operational checkouts.
- D. All instruments and controls shall be calibrated through their entire range. All other adjustments required for proper operation of all instrumentation and control equipment shall be made (check that local and SCADA monitoring and control are operational).
- E. At no time during testing, startup, and commissioning activities shall the Contractor allow the facility to be operated in a manner that subjects equipment to conditions that are more severe than the maximum allowable operating conditions for which the equipment was designed.
- F. No testing of equipment operation shall take place until it has been verified that all lubricants, tools, maintenance equipment, spare parts and O&M manuals have been furnished as specified.
- G. All valve and equipment tagging shall be completed prior to startup.

1.6 PRE-OPERATIONAL CHECKOUT

- A. During this initial inspection, each piece of equipment is to be evaluated for non-dynamic, non-operational concerns. The focus shall be to confirm the readiness of a unit or system for operation in a normal duty cycle during the functional test period. To the maximum extent practical, the full capabilities of each piece of equipment, including remote operation, instrumented control schemes, alternate modes of operation, and emergency operation, should be available prior to physical checkout in order to facilitate and expedite the transition from physical checkout to functional testing.
- B. After the pre-operational checkout is completed, each manufacturer's technical representative and the Contractor shall certify to the Owner, in writing, and on the Manufacturer's letterhead, that the equipment is fully installed in accordance with manufacturer's instructions and operating requirements, and ready to be tested in an operating mode without violation of or voiding any aspect or detail of the manufacturer's warranty.

1.7 PRE-TEST/STARTUP COORDINATION MEETING

- A. A pre-test/startup coordination meeting will be conducted by the Engineer to discuss the overall testing and startup program associated with the equipment being provided under this contract. The Engineer will notify the Contractor of the time and place of the meeting. The purpose of this meeting will be to review the testing and startup requirements, review the contractor's testing plan and readiness to begin testing, and develop a startup plan.

- B. The Contractor, Engineer, and Owner shall have the required representatives at this meeting.
- C. The Contractor shall arrange for attendance of major equipment manufacturer's technical representatives, as needed.

1.8 FUNCTIONAL TESTING

- A. After pre-operational checkout is successfully completed, functional testing shall be performed on all equipment. Functional testing shall be conducted and performed using anticipated operational strategies. All field instrumentation, automatic controls and control strategies shall be demonstrated to operate as designed. In the event of failure to demonstrate satisfactory performance of the system or facility, all necessary alterations, adjustments, repairs and replacements shall be made. Functional testing shall consist of operation of the equipment on normal duty cycles for a sufficient period of time to determine satisfactory operation. Test results shall exercise the full capabilities of all equipment including remote and automatic operation, instrumented control schemes, alternate modes of operation, and emergency operation. Functional testing shall be repeated as often as necessary to the satisfaction of the Owner and Engineer, for the specified duration.
- B. Certification of functional testing shall be performed by the manufacturer using the services of an authorized representative trained in this type service. Written certification shall be filed with the Engineer on the manufacturer's stationary. Written certification shall indicate that tests were made in accordance with the manufacturer's recommendations, that the test and start-up operation has been satisfactory and that the equipment is fully operational under design requirements.

1.9 COMMISSIONING

- A. After successful completion of functional testing period, system commissioning shall be conducted over a continuous 14-day period. The Owner will furnish all operating personnel (other than vendor's or contractor's service personnel) needed to operate equipment during the commissioning period. However, the Owner's personnel will perform their duties under the Contractor's direct supervision. The Owner will be responsible for all operational costs (other than Contractors, subcontractors, or vendor's costs) and the Contractor shall bear the costs of all repairs or replacements required to meet the satisfactory completion of the commissioning. The contractor shall provide all necessary personnel and field service personnel of the major equipment suppliers on an on-call, as-needed basis during commissioning. Until commissioning is completed and units and systems are accepted by the Owner as substantially complete, the Contractor shall be fully responsible for the operational and maintenance of all new facilities and systems. Systems and facilities shall operate satisfactorily continuously through the 14-day commissioning period. After repairs, replacements, alterations, and adjustments are made to correct unsatisfactory performance, the commissioning period will be repeated as necessary until operation has operated continuously to the satisfaction of the Owner.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 TESTING PREPARATION

- A. Prior to starting field testing the Contractor shall:
 - 1. Complete Work associated with the unit and related processes, including providing and coordinating related manufacturer's technical representative services.
 - 2. Furnish related operating and maintenance manuals, and have on hand necessary testing devices, spare parts, and special tools before testing any unit or system.

3. Provide materials and equipment required to conduct testing, and provide all labor required to aid the manufacturer's technical representatives with their inspection and in making required adjustments to all equipment installed under this contract.
4. Calibrate testing equipment for accurate results.
5. Inspect and clean equipment, devices, connected piping, and structures so they are free of foreign material.
6. Turn rotating equipment by hand and check motor-driven equipment for correct rotation.
7. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.
8. Check power supply to electric-powered equipment for correct voltage.
9. Adjust clearances and torques.
10. Balance HVAC systems, measuring airflow static pressure, and component pressure losses.

3.2 FUNCTIONAL TESTING

- A. The Contractor shall:
 1. Begin testing at a time mutually agreed upon by the Owner, Engineer, manufacturer's technical representative(s), and Contractor.
 2. Conduct test until each individual component item or system has achieved 24 continuous hours of satisfactory operation. Demonstrate that all operational features and controls function during this period while in automatic modes.
- B. Separate items of equipment demonstrated to function properly during subsystem testing may require no further acceptance test if documentation of subsystem testing is acceptable to Engineer.
- C. Startup testing shall not commence until the equipment or system meets unit functional tests requirements specified herein and as required by the manufacturer.

3.3 COMMISSIONING

- A. Commissioning follows successful functional testing, and includes the process of putting the facility in operating order, final cleaning, adjusting and balancing of equipment, initial operation of equipment, operating equipment and systems, and demonstration and verification of the completed facility as a unit. Unless otherwise specified, startup testing of the entire facility shall be considered complete when the facility has operated in the manner intended for 14 continuous days without a significant interruption. This period is in addition to any training, field, or startup test periods specified elsewhere. A significant interruption will require the commissioning then in progress to be stopped and restarted after corrections are made. Restarting commissioning restarts the 14 day test period.
- B. Test Reports: Prior to initiation of the commissioning period, the Contractor shall certify in writing that:
 1. Hydraulic structures, piping systems, and valves have been successfully tested.
 2. Equipment systems and subsystems have been checked for proper installation, started, and successfully tested to indicate that they are operational.
 3. Systems and subsystems are capable of performing their intended functions.
 4. Facilities and systems are ready for intended operation.
- C. The Contractor shall provide and coordinate manufacturer's startup testing services.
- D. Any and all adjustments, repairs, and corrections necessary to complete startup testing shall be coordinated and completed by the Contractor.

- E. After the facility is operating, the Contractor shall complete the testing of any items of equipment, systems, and subsystems which could not be or were not adequately or successfully tested prior to startup test period.
- F. Substantial completion of the contract will occur after the commissioning of all systems has been completed.

** END OF SECTION **



SECTION 01658
DISINFECTION OF POTABLE WATER FACILITIES

1 GENERAL

1.1 DESCRIPTION

- A. Provide all labor, equipment, materials, and chemicals required to disinfect portions of the new facilities in accordance with the procedures specified herein.
- B. Upon completion of the construction and installation of equipment, the Contractor shall disinfect all potable water lines and the effluent outfall line.

1.2 REFERENCES

- A. American Water Works Association (AWWA):
 - 1. C-651 - Disinfection of Water Mains.
 - 2. C-652 - Disinfection of Water-Storage Facilities.
 - 3. C-653 - Disinfection of Water Treatment Plants.

1.3 SUBMITTALS

- A. Submit the following information in accordance with Section 01300, Submittals:
 - 1. Chemical Data Sheet and manufacturer's information on disinfection agent.
 - 2. Results of bacteriological tests.

2 PRODUCTS

2.1 DISINFECTION AGENT

- A. The disinfection agent shall be liquid chlorine, sodium hypochlorite solution or calcium hypochlorite granules or tablets.

3 EXECUTION

3.1 DISINFECTION PROCEDURE

- A. Flushing. Prior to disinfection, all surfaces shall be thoroughly flushed with clear water.
- B. Piping. All piping shall be disinfected. Special care must be exercised to operate all pumps, valves and other appurtenances sufficiently to ensure they are subjected to the chlorinated water during disinfection.
- C. Use Chlorination Method 1 as outlined in AWWA C652. (Short description: fill with chlorinated solution sufficient to produce 10 ppm residual after 24 hours.)
- D. Upon completion of the disinfection procedure, piping shall be placed into operation and flushed with potable water until the chlorine residual is 1.0 part per million or less. A minimum of two samples of finished water shall be tested for coliform bacteria by an approved testing laboratory.
- E. No portion of new work shall be placed in service until disinfection has been completed. Should the initial treatment fail to result in acceptable water, the chlorination procedure shall be repeated until satisfactory results are obtained.
- F. Chlorinated water shall be dechlorinated prior to being discharged to the environment. One of the neutralizing agents listed in Appendix A of AWWA C653 shall be used for this purpose. Dosage rate of the dechlorinating agent shall be carefully controlled according to the amount of chlorine present in the water.

** END OF SECTION **



SECTION 01666
TESTING OF PIPELINES AND HYDRAULIC STRUCTURES

1 GENERAL

1.1 SCOPE

- A. Furnish all labor, materials, tools, equipment and related items required to perform exfiltration tests of gravity pipelines, perform integrity and leakage tests of pressurized pipelines and perform leakage tests of hydraulic structures.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, a description of the testing procedures to be employed for testing and report form to be employed.

2 PRODUCTS

2.1 WATER FOR TESTING

- A. Contractor shall procure the necessary water required for testing the work. The Contractor shall be responsible for furnishing all equipment, necessary piping and required labor to transport the water from its source to the test location for use in testing.

3 EXECUTION

3.1 GENERAL

- A. The entire length of all pipelines shall be field tested for tightness by a test as described hereinafter.
- B. The Contractor shall furnish all labor and equipment, including required pumps with regulated bypass meters and gauges, for conducting pipeline tests.
- C. The Contractor shall furnish all equipment, necessary piping and required labor to transport water from its source to the test location for use in testing.
- D. Timing and sequence of testing shall be scheduled by the Contractor, subject to the approval of the Engineer. The Contractor shall provide the Engineer with a minimum of 4 hours notice prior to the start of any test. All tests must be observed by the Engineer.
- E. The Contractor shall repair any leaks discovered during the initial filling of the pipeline and during the testing sequence. All known and visible leaks shall be repaired whether or not the leakage rate is within allowable limits.
- F. The Contractor shall bear complete cost of the tests, including set-up, labor, temporary piping, blocking, gauges, bulkheads, air, soap solutions, and any other materials required to conduct the tests.

3.2 NON-POROUS STRUCTURES

- A. Non-porous structures, such as steel and fiberglass, shall show no leakage during the 24-hour test period.

3.3 REINFORCED CONCRETE STRUCTURES

A. General

- 1. Hydrostatically test concrete structures in accordance with ACI 350.1-01/350.1R-01.
- 2. Do not start leak testing or cleaning of surfaces until concrete is cured and joint sealants have set and cured a minimum of 14 days.
- 3. Each cell of multi-cell tanks shall be considered a single tank and tested individually.

4. Conduct testing before backfill is placed against walls.
5. Prior to testing, clean exposed surfaces by thorough hosing, and remove surface laitance and loose matter from walls and slabs. Remove wash water and debris by means other than washing through plant piping.
6. All exterior surfaces of water retaining structures and all interior surfaces of pits below groundwater level shall be free from visible damp spots or seepage before acceptance. Repeated tests and repairs may be required by the Engineer to obtain watertight structures. All structures shall be drained at the completion of the test unless otherwise directed by the Engineer. Methods of repair shall be in accordance with Section 03740, Modifications and Repair to Concrete.

B. Test Procedure

1. Fill structure to be tested to the normal operating liquid level. Filling rate shall not exceed 4 feet of water per hour, and shall be at continuous uniform rate with continuous monitoring.
2. The exterior surface of the tank shall be monitored for flowing leaks. Repair any flowing leaks which occur before continuing filling.
3. The water shall be kept at the test level for a minimum of 72 hours prior to the actual test.
4. Measure the vertical distance to the water surface from a fixed point on the tank above the water surface. Record water levels every 24-hours.
5. There shall be no measurable water loss as defined in ACI 350.1, latest edition; otherwise, the structure will be considered to have failed the leakage test.
6. The structure will also be considered to have failed the leakage test if flowing or seeping water is observed, or if moisture can be transferred to a dry hand from the exterior surface.
7. Independently measure change in water volume due to evaporation and precipitation using a 24-inch deep white, watertight container not less than 10 square feet of surface area. Position the container to experience environmental conditions similar to the structure being tested. The volume change of the structure shall be corrected based on the water volume change in the sample container.
8. Failing tanks which exhibit no visible signs of leaking or seepage may be permitted to be immediately retested.
9. Failing tanks shall be drained, repaired, and retested until the tank has met the test requirements.

3.4 REPAIRS

- A. If leakage exceeds the specified allowable limits, the point or points of leakage shall be sought out and remedied by the Contractor at no additional cost to the Owner. Structural leaks shall be made water tight under test within the limits specified.

3.5 TEST PROCEDURES FOR AIR PIPING AND VACUUM PIPING

A. Low Pressure Air Piping

1. Low pressure air piping (working pressures 15 PSI and less) shall be subjected to a pneumatic gauge pressure test. The test pressure shall be 150 percent of the maximum expected operating pressure or 20 PSI, whichever is greater. The pressure shall be maintained for a minimum of 2 consecutive hours. No leakage will be allowed.

B. High Pressure Air Piping and Vacuum Piping

1. High pressure air piping (working pressures greater than 15 PSI) and vacuum piping shall be subjected to a pneumatic gauge pressure test. The test pressure shall be 225 PSI. The pressure shall be maintained for a minimum of 2 consecutive hours. No leakage will be allowed.

3.6 TEST PROCEDURES FOR PRESSURE PIPELINES

- A. After all piping has been placed and backfilled between the joints and concrete reaction blocking has been in place for a minimum of five days, each run of newly laid pipe, or any valved section thereof, shall be tested by the Contractor in the presence of the Engineer, and tests shall be continued until all leaks have been made tight to the satisfaction of the Engineer.
- B. The contractor shall take all precautions necessary to protect any equipment that might be damaged by pressures used in the tests. Delicate equipment shall be valved off, removed, or otherwise protected.
- C. All piping shall be securely anchored and restrained against movement prior to application of test pressures. Prior to the pressure test, pipe laid in trenches shall be partially backfilled to adequately secure the pipe during the test. All joints, fittings, and valves will be left open where possible. All exposed pipe, fittings, valves, and joints shall be carefully examined during the pressure test.
- D. Before applying the specified test pressure, all air shall be expelled from the pipe. If hydrants, blow-offs, or air release valves are not available at the high places, the Contractor shall make the necessary taps at points of highest elevation before the test is made and insert plugs after the test has been completed.
- E. All pipelines shall be segmented by capping, plugging, or closing of valves. Each section of piping shall be pumped full of water and all air shall be removed, to a pressure no less than two times the maximum anticipated operating head or 150 psi, whichever is greater. Pump shall contain adequate gauges to indicate the internal pipe pressure during the test. The above pressure shall be maintained for a minimum of two consecutive hours. Test pressure shall not vary by more than ± 5 psi for the duration of the test.
- F. After satisfactory completion of the pressure test, a leakage test shall be performed. Leakage shall be defined as the quantity of water that must be supplied to the newly laid pipe or any valved section thereof to maintain pressure within 5 psi of the specified test pressure after the pipe has been filled with water and the air has been expelled.
- G. Allowable leakage in steel pipes shall be zero, except gate valves shall be permitted a maximum leakage rate of one (1) ounce per hour per inch of nominal valve size, in conformance with AWWA C500.
- H. Allowable leakage in cast iron and ductile iron pipe shall be in conformance with AWWA C600, Section 4.2 and Table 6.
- I. Allowable leakage in concrete and PVC pipe shall be 11.65 gallons per inch of nominal diameter of pipe per mile over a 24-hour period.
- J. Any leakage developed during the test shall be corrected at the Contractor's expense by tightening, replacing packing or gaskets, or replacing defective portions of the piping system. Caulking will not be permitted. If defective portion cannot be located, the Contractor, at his expense, shall remove and reconstruct as much of the original work as necessary to obtain a facility tested without leakage.
- K. After all test on any section have been completed to the satisfaction of the Engineer, the Contractor shall carefully clean, blow out, and drain the line of all water to prevent freezing of the same. The Contractor shall also demonstrate to the satisfaction of the Engineer that any and all lines are free from obstruction and foreign material.

3.7 TEST PROCEDURES FOR GRAVITY PIPE

- A. Air Pressure Testing
 - 1. Gravity sewer piping shall be low pressure air tested in accordance with UNI-B-6.
 - 2. Low pressure air test shall be witnessed by the Engineer.
 - 3. Gravity sewer lines shall be tested from manhole to manhole. Lines shall be free of dirt and debris and no personnel shall be permitted in the manholes when the test is being conducted.

4. The gravity sewer line shall be pressurized to 4.0 PSIG greater than the average back pressure of any groundwater above the pipe, but no greater than 9.0 PSIG.
5. After temperatures have equalized and the pressure has stabilized at 4.0 PSIG (greater than the average groundwater back pressure), the air supply shall be shut off. The pressure shall then be decreased to no less than 3.5 PSIG (greater than the average groundwater back pressure).
6. The time shall then start and the pressure shall not drop more than 1.0 PSIG during the testing period. The minimum test time for various diameter pipes is presented below.

Nominal Pipe Diameter (inches)	Minimum Test Time (min:sec)	Maximum Length for Minimum Test Time (feet)	Test Time for Longer Length (L) Sections (seconds)
8	7:34	298	1.520 L
10	9:26	239	2.374 L
12	11:20	199	3.418 L
15	14:10	159	5.342 L
16	15:07	149	6.078 L
18	17:00	133	7.692 L
20	18:54	119	9.497 L
24	22:40	99	13.674 L
30	28:20	80	21.366 L
36	34:00	66	30.768 L

7. In general, lateral sewers may be ignored when computing required test time. However, if a section fails to pass the air test when lateral sewers have been ignored, the test time shall be recomputed to include all lateral sewers using the method of calculation in UNI-B-6.
 8. Test shall be considered acceptable if pressure does not drop more than 1.0 PSIG during the test period.
 9. When unsatisfactory test results are obtained, repair pipe and retest until pipe passes low pressure air test. Repair visible leaks regardless of quantity of leakage.
- B. Television Inspection
1. Gravity sewer lines shall be television inspected after the trench is backfilled and compacted.
 2. Prior to television inspection, gravity sewer lines shall be cleaned using high pressure water. Water usage for cleaning gravity sewer lines shall be metered.
 3. Television inspection shall be performed by an approved contractor using pan and tilt camera.
 4. Television inspection shall be witnessed by the Engineer.
 5. Television inspection shall be recorded.
 6. At a minimum, the television inspection shall look for the following deficiencies.
 - a. Cracks in the pipe and/or lining
 - b. Rolled gaskets
 - c. Leaking joints
 - d. Deviations from line and grade
 - e. Pipe deformations
 - f. Other deficiencies

7. A television inspection report containing the following information shall be submitted to the Engineer.
 - a. Length of pipe between manholes
 - b. Location of services
 - c. Deficiencies
 - d. No paving shall be done until gravity sewer lines are passed by the Engineer.

C. Mandrel Testing

1. If the television inspection indicates that there is excessive deflection of the sewer line or that the sewer line is egg shaped, the sewer lines shall be tested for deformation using a mandrel in accordance with ASTM D3034.
2. The sewer line shall be capable of passing a mandrel which has a diameter that is 95 percent of the diameter of the sewer line.
3. Any sewer line that fails the mandrel test shall be re-laid or replaced as required.

** END OF SECTION **



SECTION 01700
PROJECT CLOSEOUT

1 GENERAL

1.1 DESCRIPTION

- A. This section covers general project closeout requirements which the Contractor shall be required to perform both during construction and before final acceptance of the project unless otherwise shown on the Drawings or specified elsewhere in these specifications.

1.2 SUBMITTALS

- A. Submit prior to processing of application for final payment:
1. Record Documents
 2. Manufacturer's warranties assembled in a separate binder.
 3. Complete set of Approved Shop Drawings and Samples
 4. Two copies of all Special Bonds, Special Warranties, and Service Agreements.
 5. Consent of Surety to Final Payment
 6. Releases or Waivers of Liens and Claims
 7. Releases from Agreements.
 8. Certificates of Inspection and Occupancy if required by local jurisdiction.
 9. Registry of training sessions conducted and list of attendees for all manufacturer's operation and maintenance training session.
 10. Registry of final maintenance and lubrication of filter and/or oil lube protected equipment.
 11. Registry of all Spare Parts and Special Tools provided to the Owner as required by individual specification sections organized by specification section inclusive of documentation depicting receipt by Owner.
 12. Final Application for Payment: Submit in accordance with procedures and requirements stated in General Conditions.
 13. A final written tabulation, plus other documentation as may be required, of all taxes, including sales tax, paid by the Contractor to assist the Owner in obtaining sales and/or use tax refunds for eligible machinery and equipment used for the primary purpose of reducing or eliminating air or water pollution as provided for in Chapter 48-8-3 (36) and (37) of the Official Code of Georgia.

1.3 RELEASE FROM AGREEMENTS

- A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.
- B. In the event Contractor is unable to secure written releases, inform the Owner of the reasons:
1. Inform Owner of the reasons.
 2. Owner or its representatives will examine the site, and Owner will direct Contractor to complete Work that may be necessary to satisfy terms of the side agreement or special easement.
 3. Should Contractor refuse to perform this Work, Owner reserves the right to have it done by separate contract and deduct the cost of same from the Contract Price, or require the Contractor to furnish a satisfactory Bond in a sum to cover legal claims for damages.

4. When Owner is satisfied that Work has been completed in agreement with the Contract Documents and terms of side agreement or special easement, the right is reserved to waive the requirement for written release if:
 - a. Contractor's failure to obtain such statement is due to the grantor's refusal to sign, and this refusal is not based upon any legitimate claims that Contractor has failed to fulfill the terms of the side agreement or special easement, or
 - b. Contractor is unable to contact or has had undue hardship in contacting the grantor.

1.4 FINAL CLEANING

- A. At the completion of the work, the Contractor shall:
 1. Schedule cleaning operations so that dust and other contaminants resulting from the cleaning process will not fall on wet, newly painted surfaces.
 2. Vacuum clean interior building areas when ready to receive finish painting and continue vacuum cleaning on an as-needed basis until building is ready for substantial completion or occupancy.
 3. Employ experienced workmen or professional cleaners for final cleaning.
 4. In preparation for substantial completion or occupancy, conduct final inspection of sight-exposed interior and exterior surfaces and of concealed spaces.
 5. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces so designated to shine finish.
 6. Repair, patch, and touch up marred surfaces to specified finish to match adjacent surfaces.
 7. Broom clean paved surfaces; rake clean other surfaces of grounds.
 8. Clean screens on air intake vents.
 9. Upon completion of the work, Contractor shall remove all rubbish from and about the site of the work, and all temporary structures, construction signs, tools, scaffolding, materials, supplies and equipment which he or any of his Subcontractors may have used in the performance of the work and leave the site with an appearance acceptable to the Engineer.
 10. The Contractor shall thoroughly clean all equipment and materials installed by him and shall deliver over such materials and equipment in a bright, clean, polished and new-appearing condition.
 11. Contractor shall replace dirty filters and burned out lights as required; clean all glass surfaces and floors and polished so as to leave work in a clean and new appearing condition.
 12. Restoration of Landscape Damage
 - a. Any landscape feature scarred or damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. The Engineer will decide what method of restoration shall be used.
 13. Restoration of Asphalt Roadways
 - a. Any existing roadways damaged by the Contractor's equipment or operations shall be restored as nearly as possible to its original condition at the Contractor's expense. Restoration may include milling and resurfacing or complete removal

and replacement. Alligatoring of the asphalt will require complete removal and replacement of the damage areas.

14. Post-Construction Cleanup or Obliteration

- a. The Contractor shall obliterate all signs of temporary construction facilities such as haul roads, work areas, structures, foundations of temporary structures, stockpiles of excess or waste materials, or any other vestiges of construction.
- B. Contractor shall maintain cleaning until project, or portion thereof, is occupied by the Owner.

1.5 LUBRICATION SURVEY

- A. A lubrication survey, made by a lubricant supply firm, subject to the approval of the Owner shall be provided and paid for by the Contractor.
- B. The lubrication survey shall list all equipment, the equipment manufacturer's lubrication recommendations, and an interchangeable lubricants tabulation standardizing and consolidating lubricants whenever possible.
- C. The Contractor shall supply all lubricants, applicators and labor for lubricating the equipment, in accordance with manufacturer's recommendations, for field testing and prior to final acceptance. A supply of required lubricants sufficient for start-up and one year of operation shall also be supplied by the Contractor.
- D. Ten (10) copies of the approved lubrication survey shall be furnished to the Engineer prior to final acceptance.

1.6 SPARE PARTS AND SPECIAL TOOLS

- A. Provide spare parts and special tools in accordance with Section 01710, Spare Parts, and the individual equipment specifications.

1.7 EQUIPMENT START-UP SERVICES

- A. Equipment start-up period, for the training of plant personnel, shall begin after satisfactory completion and acceptance of the field tests and coincidentally with the certified date of substantial completion for the part of the work for which the equipment is included. If the equipment is not covered by a certificate of substantial completion for a part of the work, the period shall begin upon substantial completion of the project.
- B. During the equipment start-up period the Contractor shall furnish, at no additional cost to the Owner the services of factory trained representatives of the equipment manufacturers for the equipment designated in the Specifications to:
 1. Assist in the start-up and operations of the equipment.
 2. Assist in the training of plant personnel, designated by the Owner in the proper operation and maintenance of the equipment.
- C. The Owner shall provide the necessary plant personnel to be instructed in the operation and maintenance of the equipment. The Owner's personnel shall operate all equipment.
- D. The Contractor shall pay for fuel, power, and chemicals consumed up to the date of "certified substantial completion" except as otherwise specified herein.
- E. Contractor shall be available to promptly repair all work during the start-up period so as to cause minimum disruption to the total plant operation.
- F. Upon completion of a minimum of fourteen (14) consecutive and continuous days of satisfactory operation, or the number of days called for in the Technical Specifications, the Owner will assume operation and operating cost of the equipment. If the equipment malfunctions during this start-up period, the start-up period will be repeated until satisfactory operation is achieved.

- G. In the event a system, equipment or component proves defective or is unable to meet specified performance criteria, the Contractor shall replace the defective item and the minimum one (1) year guarantee period, or the guarantee period called for in the Technical Specifications for the item shall start after satisfactory replacement and testing of the item.

1.8 FINAL CLEANUP/SITE REHABILITATION

- A. Before finally leaving the site, the Contractor shall wash and clean all exposed surfaces which have become soiled or marked, and shall remove from the site of work all accumulated debris and surplus materials of any kind which result from his operation, including construction equipment, tools, sheds, sanitary enclosures, etc. The Contractor shall leave all equipment, fixtures, and work, which he has installed, in a clean condition. The completed project shall be turned over to the Owner in a neat and orderly condition.
- B. The site of the work shall be rehabilitated or developed in accordance with other sections of the Specifications and the Drawings. In the absence of any portion of these requirements, the Contractor shall completely rehabilitate the site to a condition and appearance equal or superior to that which existed just prior to construction, except for those items whose permanent removal or relocation was required in the Contract Documents or ordered by the Owner.
- C. Disposal of Surplus Materials:
 - 1. Unless otherwise shown on the drawings, specified or directed, the Contractor shall dispose of all surplus excavated materials and materials and equipment from demolition, legally, off the site, and shall provide his own suitable, off-site spoil area, or on a site designated by the Owner.
 - 2. The Owner shall have the opportunity to inspect any materials removed prior to disposal by the Contractor. If said materials are determined to be salvageable by the Owner, the Contractor shall transport said material to an area designated by the Owner.

1.9 FINAL INSPECTION

- A. Final cleaning and repairing shall be so arranged as to be finished upon completion of the construction work. The Contractor will make his final cleaning and repairing, and any portion of the work finally inspected and accepted by the Engineer shall be kept clean by the Contractor, until the final acceptance of the entire work.
- B. When the Contractor has finally cleaned and repaired the whole or any portion of the work, he shall notify the Engineer that he is ready for final inspection of the whole or a portion of the work, and the Engineer will thereupon inspect the work. If the work is not found satisfactory, the Engineer will order further cleaning, repairs, or replacement.
- C. When such further cleaning or repairing is completed, the Engineer, upon further notice, will again inspect the work. The "Final Payment" will not be processed until the Contractor has complied with the requirements set forth, and the Engineer has made his final inspection of the entire work and is satisfied that the entire work is properly and satisfactorily constructed in accordance with the requirements of the Contract Documents.

1.10 HAZARD CONTROL

- A. The Contractor shall store volatile wastes in covered metal containers and remove from premises daily.
- B. The Contractor shall prevent accumulation of wastes which create hazardous conditions.
- C. Burning or burying rubbish and waste materials on the site shall not be allowed.
- D. Disposal of volatile wastes into sanitary or storm sewers shall not be allowed.

1.11 PROJECT CLOSE OUT

- A. As construction of the project enters the final stages of completion, the Contractor shall, in concert with accomplishing the requirements set forth in the Contract Documents, attend to or have already completed the following items as they apply to his contract:

1. Scheduling equipment manufacturers' visits to site.
 2. Required testing of project components.
 3. Scheduling start-up and initial operation.
 4. Scheduling and furnishing skilled personnel during initial operation.
 5. Correcting or replacing defective work, including completion of items previously overlooked or work which remains incomplete, all as evidenced by the Engineer's "Punch" Lists.
 6. Attend to any other items listed herein or brought to the Contractor's attention by the Engineer.
- B. Just before the Engineer's Certificate of Substantial Completion is issued, the Contractor shall accomplish the cleaning and final adjustment of the various building components as specified in the Specifications and as follows:
1. Clean all glass and adjust all windows and doors for proper operation.
 2. Clean all finish hardware after adjustment for proper operation.
 3. Touch up marks or defects in painted surfaces and touch up any similar defects in factory finished surfaces.
 4. Wax all resilient flooring materials.
 5. Remove bitumen from gravel stops, fascias, and other exposed surfaces.
 6. Remove all stains, marks, fingerprints, soil, spots, and blemishes from all finished surfaces, tile, stone, brick, and similar surfaces.
- C. In addition, and before the Certificate of Substantial Completion is issued, the Contractor shall submit to the Engineer (or to the Owner if indicated) certain records, certifications, etc., which are specified elsewhere in the Contract Documents. A partial list of such items appears below, but it shall be the Contractor's responsibility to submit any other items which are required in the Contract Documents:
1. Test results of project components.
 2. Certification of equipment or materials in compliance with Contract Documents.
 3. Operation and maintenance instructions or manuals for equipment.
 4. One set of neatly marked-up record drawings showing as-built changes and additions to the work under his Contract.
 5. Any special guarantees or bonds (Submit to Owner).

** END OF SECTION **



SECTION 01710
SPARE PARTS

1 GENERAL

1.1 SCOPE

- A. The Work covered by this section includes furnishing all spare parts as identified in the individual equipment specifications.

1.2 SUBMITTALS

- A. Provide a list of all spare parts and tools to be provided as part of the Work, including manufacturer/supplier name and contact information.
- B. Provide a list of other spare parts not specified to be provided in the individual equipment specifications that are recommended by the manufacturer to assure efficient operation of the equipment for a period of 120 days for the particular installation.

1.3 SOURCE OF SUPPLY

- A. Provide spare parts manufactured by the original equipment manufacturer.
- B. Provide maintenance materials identical to those installed.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Deliver required items to the Place of the Work and store in temporary locations determined by Contractor or permanent locations designated by Owner.
- B. Deliver and store items in original factory packaging or other securely packaged form.
- C. Identify, on carton or package, manufacturer's name, name of item, and part number, as applicable. Identify equipment, system, area, room no., etc. for which each item is intended.
- D. Maintain an inventory list of all items delivered. For each item, record description of item, quantity, and location where stored.
- E. Stored items shall remain in Contractor's care, custody, and control until acceptance of the Work. Protect stored items against theft or damage.
- F. Handle items as necessary, until stored in permanent locations designated by Owner.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 GENERAL

- A. Furnish parts and materials in manufacturer's unopened cartons, boxes, crates, or other protective covering suitable for preventing corrosion or deterioration for the maximum length of storage which may be normally anticipated. Clearly mark and identify packaging as to their contents and storage instructions.
- B. Furnish special tools in painted metal tool boxes properly labeled and equipped with good grade cylinder locks and duplicate keys.
- C. Deliver parts and materials to the Owner upon completion of the Work or when the Owner assumes partial utilization in accordance with the specifications.
- D. Provide a letter of transmittal including the following:
 - 1. Date of letter and transfer of parts and materials.

2. Contract title and project number.
 3. Contractor's name and address.
 4. A complete inventory of the parts and material listing the applicable specification section for each.
 5. A place for the Owner to sign and signify receipt of the parts and materials.
- E. Maintain responsibility for loss or damage to parts and materials until they are received and accepted by the Owner.

** END OF SECTION **

SECTION 01720
PROJECT RECORD DRAWINGS

1 GENERAL

1.1 SCOPE

- A. The work under this includes, but is not necessarily limited to, the compiling, maintaining, recording and submitting of project record documents as herein specified.
- B. Record documents to be prepared and submitted by the Contractor include, but are not limited to Record Drawings, Specifications, Change orders and other modifications to the Contract, Engineer field orders or written instructions, including Requests for Information (RFI) and Clarification Memorandums, Reviewed shop drawings, product data and samples, Test records, and Record drawings.
- C. The Contractor shall maintain on the Project site an updated set of Record Drawings.

1.2 MAINTENANCE OF DOCUMENTS AND SAMPLES

- A. Store documents and samples in the Contractor's field office, apart from documents used for construction. Provide files and racks for storage of documents. Provide locked cabinet or secure storage space for storage of samples.
- B. File documents and samples in accordance with format of these Specifications.
- C. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes. Maintain at the site for the Owner one copy of all record documents.
- D. Make documents and samples available at all times for inspection by Engineer and Design Consultant.
- E. Failure to maintain the Record Documents in a satisfactory manner may be cause for withholding of a certificate for payment.

1.3 QUALITY ASSURANCE

- A. Unless noted otherwise, Record Drawings shall provide dimensions, distances and coordinates to the nearest 0.01 foot for all pertinent items constructed by the Contractor.

1.4 SPECIFICATIONS

- A. Legibly mark each section to record changes made by Requests for Information (RFI), field order, clarification memoranda, or by change order.

1.5 SUBMITTAL

- A. At contract closeout, deliver Record Documents to the Engineer.
- B. Accompany submittal with transmittal letter, in duplicate, containing Date, Project title and number, Contractor's name and address, Title and number of each record document, and Signature of Contractor or Contractor's authorized representative.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 RECORD DRAWINGS

- A. The Contractor must maintain an up-to-date field record set of drawings by marking changes and other information directly on a clean set of full-size contract drawings. The Engineer will periodically review the record drawings to confirm that the recorded information is current.
- B. Making Entries on Record Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
 - a. Color Coding:
 - 1) Green when showing information deleted from Documents.
 - 2) Red when showing information added to Documents.
 - 3) Blue and circled in blue to show notes.
2. Date all entries.
3. Legibly mark to record actual changes made during construction, including, but not limited to:
 - a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
 - b. Horizontal and vertical locations of existing and new underground facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
 - c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
 - d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
 - e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, Written Amendment, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.

** END OF SECTION **

SECTION 01730
OPERATING AND MAINTENANCE DATA

1 GENERAL

1.1 SUMMARY

- A. Manuals shall be provided for equipment and systems furnished under the Contract that require maintenance, operation, or modification, including any testing or training equipment. Provide manuals for each item of equipment and its component parts.
- B. Manuals shall be provided in printed and electronic formats.
- C. All manuals shall be in English. Any foreign language portions of off-the-shelf manuals shall be removed.
- D. Submittal of manuals as required by this section implicitly conveys the right from the manufacturer to the Owner to reproduce the document for his own use.

1.2 QUALITY ASSURANCE

- A. Off-the-Shelf equipment manuals shall be edited and annotated specifically for this Project by personnel trained and experienced in maintenance and operation of described products.
- B. The production quality of printed documents shall be equivalent to offset printing. If offset printed (or equivalent) materials are not available, photocopying from original documents using a properly adjusted plain paper copier will be accepted; however, photocopies of materials containing photographs will not be accepted. Photocopies will be de-speckled and contain less than 5% skew.

1.3 MANUAL DESCRIPTION

- A. Off-the-Shelf Equipment Manuals: These manuals are the equipment manufacturer's standard pre-printed operation and maintenance manuals, specifically edited for this project as follows:
 - 1. If material covers more than one product type, the applicable information for the equipment supplied shall be clearly indicated by bubbles or arrows. Highlighting that obliterates the information when photocopied or scanned is not acceptable.
 - 2. If material includes equipment information not relevant to the project, this information shall be crossed out or otherwise clearly redacted.
- B. System Manuals: If a major equipment item is specified as a "system" (i.e., comprised of components from several manufacturers furnished on this project by a single entity assigned "system responsibility"), the operation and maintenance material for the entire system shall be included in a single manual with appropriate cross-references and indexing.
- C. Minor Components: Any equipment items or components that are typically replaced instead of repaired or have no published operation and maintenance material shall be identified by catalog cuts. If catalog cuts are included in the submittal of an Off-the-Shelf or System Manual, the catalog name and number, and the company name, address and telephone number shall be provided on the catalog cut or typewritten on a separate sheet of paper.

1.4 CONTENT OF MANUAL

- A. General: All material shall be labeled to identify the specific function that the equipment serves in the facility. The manuals shall contain, at a minimum:
 - 1. Data required to maintain equipment during equipment service life.
 - 2. Complete preventive maintenance instructions required to assure satisfactory performance and longevity of the equipment.
 - 3. Maintenance and overhaul instructions including detailed assembly drawings with part numbers, parts list, and instructions for ordering spare parts.

4. Lubrication instructions listing points to be greased or oiled, recommending type, grade, temperature range of lubricants, and frequency of lubrication.
 5. List of electrical relay settings and control and alarm contact settings.
 6. Electrical interconnection wiring diagram for equipment furnished, including all control systems.
- B. Project Information: Neatly typewritten table of contents for each volume, arranged in systematic order.
1. Contractor, name of responsible principal, address and telephone number.
 2. A list of each product required to be included, indexed to content of the volume.
 3. List, with each product, name, address and telephone number of:
 - a. Subcontractor or installer.
 - b. Maintenance Contractor, as appropriate.
 - c. Identify area of responsibility of each.
 - d. Local source of supply for parts and replacement.
 - e. Manufacturer
 4. Identify each product by product name and other identifying symbols as set forth in Contract Documents.
 5. A Table of Contents for each equipment manual that reflects all procedure numbers, page numbers, figure numbers, and tables, as well as the volumes, chapters, and/or sections of each manual.
- C. Product Data:
1. Include only those sheets which are pertinent to the specific product.
 2. Annotate each sheet to:
 - a. Clearly identify specific product or part installed.
 - b. Clearly identify data applicable to installation.
 - c. Delete references to inapplicable information.
- D. Drawings:
1. Supplement product data with drawings as necessary to clearly illustrate:
 - a. Relations and component parts of equipment and systems.
 - b. Control and flow diagrams.
 2. Coordinate drawings with information in Project Record Documents to assure correct illustration of completed installation.
 3. Do not use Project Record Documents as maintenance drawings.
- E. Written text, as required to supplement product data for the particular installation:
1. Organize in consistent format under separate headings for different procedures.
 2. Provide logical sequence of instructions of each procedure.
- F. Copy of each warranty, bond and service contract issued.
1. Provide information sheet for Owner's personnel, give:
 - a. Proper procedures in event of failure.
 - b. Instances which might affect validity of warranties or bonds.
- G. Equipment Data (for use in Owner's Computerized Maintenance Management System)
1. Provide equipment data in Excel spreadsheet format:
 - a. Equipment ID (ISA tag number or as shown on drawings)

- b. Sub-unit
- c. Description
- d. Area (Name of Water Reclamation Facility e.g. SC –South Cobb)
- e. Equipment Type (e.g. check valve)
- f. Manufacturer
- g. Model Number
- h. Serial Number
- i. Building
- j. Building Level

1.5 FORM OF SUBMITTALS

- A. Prepare data in printed format as an instructional manual for use by Owner's personnel as required.
- B. Format for Printed and Bound Document:
 - 1. Size: 8-1/2 inches x 11 inches.
 - 2. Paper: 20 pound minimum, white, for typed pages.
 - 3. Text: Manufacturer's printed data, or neatly typewritten.
 - 4. Drawings:
 - a. Provide reinforced punched binder tap, bind in with text.
 - b. Whenever possible, material shall be 8-1/2 inches by 11 inches or 11 inches by 17 inches z-folded to 8-1/2 inches by 11 inches. If necessary, materials larger than 11 inches by 17 inches may be provided; however, they shall be folded to approximately 8-1/2 inches by 11 inches so that the title block is clearly visible without unfolding.
 - 5. Provide fly-leaf for each separate product, or each piece of operating equipment.
 - a. Provide typed description of product, and major component parts of equipment.
 - b. Provide mylar-reinforced indexed tabs, labeled on both sides. Slide-in type tabs are not acceptable.
 - 6. Cover: Identify each volume with typed or printed title "OPERATING AND MAINTENANCE INSTRUCTIONS". List:
 - a. Title of Project.
 - b. Identity of separate structure as applicable.
 - c. Identity of general subject matter covered in the manual.
 - 7. Binders:
 - a. Commercial quality three post binders with durable, cleanable covers and clear plastic slip-in pockets on cover and spine.
 - b. Maximum Post Width: 2 inches.
 - c. Color of binders to be selected by the Owner.
 - d. When multiple binders are used, collate the data into related consistent groupings.
- C. Electronic Format:
 - 1. O&M manuals are to be produced in Adobe Acrobat's Portable Document Format (PDF). Normal drawing orientation shall be maintained.
 - 2. Create one PDF document (PDF file) for each equipment O&M Manual. The entire manual shall be created as a single PDF file via scanning or other conversion method. Drawings or other graphics must be converted to PDF format and made part of the one

PDF document. Rotate pages that must be viewed in landscape to the appropriate position for easy reading.

3. Images shall be scanned at a resolution of 300 dpi or greater. Perform Optical Character Recognition (OCR) capture on all images, using capture option that ensures text is searchable and selectable. Word searches of the PDF document must operate successfully to demonstrate OCR compliance.
4. Create bookmarks in the navigation frame, for each entry in the Table of Contents. Three levels deep is usually enough (i.e., "Chapter," "Section," "Sub-section").
5. Thumbnails must be generated for each PDF file.
6. Set the opening view for PDF files as follows:
 - a. Initial View: Bookmarks and Page
 - b. Magnification: Fit In Window
 - c. Page Layout: Single Page
7. Set the file to open to the cover page of the manual, with bookmarks to the left, and the first bookmark linked to the title page.
8. Fill out the Document Properties Description as follows:
 - a. Title: Enter the Title of the O&M Manual, e.g. "Return Sludge Pump."
 - b. Subject: Enter the Subject "Operation and Maintenance Manual."
 - c. Author: Enter the name of the Equipment Vendor, e.g. "Acme."
 - d. Keywords: Enter the word "Facility", followed by the Owner's facility name. Enter the word "Specification", followed by the submittal specification section number.
9. Submit final versions of the O&M manuals on compact disks. Label the CDs and the jewel cases as follows:
 - a. Facility Name.
 - b. Manufacturer Name.
 - c. Equipment name and O&M title spelled out in complete words. (example: "Operations and Maintenance Manual" "Submersible Pumps").
 - d. Specification Section No. (example: "Section 11245").
 - e. Date and file name (example: "01-23-2016," "11245_01.PDF").

1.6 SUBMITTAL SCHEDULE

- A. Submit two hard copies of the draft Operation and Maintenance Manuals to the Owner for review prior to the shipment of the equipment. Payment for the particular item of equipment, whether stored or installed, will limited to 75% of the invoiced equipment value until submittal is made.
- B. Submit three hard copies and two electronic copies of the final Operation and Maintenance Manuals, incorporating any review comments by the Owner, no later than thirty days prior to the scheduled date for training on the equipment. Applications for Payment will not be processed by the Owner, or the amount of payment may be reduced, until the proper material is submitted.

2 PRODUCTS (NOT USED)

3 EXECUTION (NOT USED)

** END OF SECTION **

SECTION 01740
WARRANTIES AND BONDS

1 GENERAL

1.1 PROJECT MAINTENANCE AND WARRANTY

- A. Maintain and keep in good repair the improvements covered by these drawings and specifications during the life of the contract.
- B. The Contractor shall warrant for a period of one (1) year from the date of Owner's written acceptance of certain segments of the Work and/or Owner's written final acceptance of the Project, as defined in the Contract Documents, that the completed Work is free from all defects due to faulty products or workmanship and the Contractor shall promptly make such corrections as may be necessary by reason of such defects. The Owner will give notice of observed defects with reasonable promptness. In the event that the Contractor should fail to make such repairs, adjustments or other work that may be made necessary by such defects, the Owner may do so and charge the Contractor the cost thereby incurred. The Performance Bond shall remain in full force and effect throughout the warranty period.
- C. The Contractor shall not be obligated to make replacements which become necessary because of ordinary wear and tear, or as a result of improper operation or maintenance, or as a result of improper work or damage by another Contractor or the Owner, or to perform any work which is normally performed by a maintenance crew during operation.
- D. In the event of multiple failures of major consequences prior to the expiration of the one (1) year warranty described above, the affected unit shall be disassembled, inspected, and modified or replaced as necessary to prevent further occurrences. All related components which may have been damaged or rendered non-serviceable as a consequence of the failure shall be replaced. A new one (1) year warranty against defective or deficient design, workmanship, and materials shall commence on the day that the item is reassembled and placed back into operation. As used herein, multiple failures shall be interpreted to mean two or more successive failures of the same kind in the same item or failures of the same kind in two or more items. Major failures may include, but are not limited to, cracked or broken housings, piping, or vessels, excessive deflections, bent or broken shafts, broken or chipped gear teeth, premature bearing failure, excessive wear, or excessive leakage around seals. Failures which are directly and clearly traceable to operator abuse, such as operations in conflict with published operating procedures, or improper maintenance, such as substitution of unauthorized replacement parts, use of incorrect lubricants or chemicals, flagrant over- or under-lubrication, and using maintenance procedures not conforming with published maintenance instructions, shall be exempted from the scope of the one (1) year warranty. Should multiple failures occur in a given time, all products of the same size and type shall be disassembled, inspected, modified or replaced, as necessary and re-warranted for one (1) year.
- E. The Contractor shall, at his own expense, furnish all labor, materials, tools and equipment required and shall make such repairs and removals or shall perform such work or reconstruction as may be made necessary by any structural or functional defect or failure resulting from neglect, faulty workmanship or faulty materials, in any part of the Work performed by him. Such repair shall also include refilling of trenches, excavations or embankments which show settlement or erosion after backfilling or placement.
- F. Except as noted on the Drawings or as specified, all structures such as embankments and fences shall be returned to their original condition prior to the completion of the contract. Any and all damage to any facility not designated for removal, resulting from the Contractor's operations, shall be promptly repaired by the Contractor at no cost to the Owner.

- G. The Contractor shall be responsible for all road and entrance reconstruction and repairs and maintenance of same for a period of one (1) year from the date of final acceptance. In the event the repairs and maintenance are not made immediately and it becomes necessary for the Owner of the road to make such repairs, the Contractor shall reimburse the Owner of the road for the cost of such repairs.
- H. In the event the Contractor fails to proceed to remedy the defects of which he has been notified within fifteen (15) days of the date of such notice, the Owner reserves the right to cause the required materials to be procured and the work to be done, as described in the drawings and specifications, and to hold the Contractor and the sureties on his bond liable for the cost and expense thereof.
- I. Notice to Contractor for repairs and reconstruction will be made in the form of a registered letter addressed to the Contractor at his home office.
- J. After the Owner has made final acceptance of the work, the Contractor shall provide written notice to the Owner and Engineer of the agreed-upon start and end date for the one (1) year warranty period.
- K. Neither the foregoing paragraphs nor any provision in the Contract Documents, nor any special guarantee time limit implies any limitation of the Contractor's liability with the law of the place of construction.

1.2 MANUFACTURER WARRANTIES

- A. Manufacturer warranties shall be assembled and submitted as part of the informational submittals to be submitted as part of the project closeout procedures per Section 01700, Project Closeout.

** END OF SECTION **

SECTION 01790
DEMONSTRATION AND TRAINING

1 GENERAL

1.1 SCOPE

- A. The Work covered by this section includes training the Owner in the operation and maintenance of all new equipment, valves, systems, etc.

1.2 SUBMITTALS

- A. Approved Operation and Maintenance Manuals
- B. Video recordings of training classes recorded on DVD

1.3 QUALITY ASSURANCE

- A. Training classes shall be conducted by an instructor who is certified by the manufacturer and is qualified in the operation and maintenance of the particular equipment. Any instructor who is not a direct employee of the manufacturer must provide documentation from the manufacturer stating the individual, by name, has been formally trained in the installation, operation, and maintenance of the equipment and is authorized to train the Owner in the operation of the equipment.

1.4 TRAINING

- A. Manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days and during regular working hours.
- B. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for additional trips to the project site.
- C. Training classes shall not be scheduled or conducted until the manufacturer has certified that the equipment is properly installed and operational; Operation and Maintenance Manuals are finalized and approved; as-built drawings are submitted; valve, equipment and piping identification is complete; and all software programming is complete.
- D. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.
- E. Training classes shall be videotaped by the Contractor.
 - 1. Each training class shall be recorded on a separate video. Do not combine training classes on one video.
 - 2. Video shall be high quality using a video camera with minimum 720p display resolution.
 - 3. Tripod(s) shall be used so that the video image is stable.
 - 4. Microphones shall be used so that audio is clear and audible.
 - 5. Video shall be recorded on DVD minus R format discs.
 - 6. Provide clear plastic cases for DVDs.
 - 7. Provide typed labels for the DVD and DVD case with the following information.
 - a. Project title
 - b. Equipment name
 - c. Date of recording
 - 8. Two copies of each video shall be provided.

** END OF SECTION **



SECTION 02010
SUBSURFACE CONDITIONS

1 GENERAL

1.1 DESCRIPTION

- A. Soil boring logs are shown in the report titled, "Report of Subsurface Exploration and Geotechnical Engineering Evaluation, Indian Creek Water Reclamation Facility Expansion, Locust Grove, Henry County, Georgia," prepared by Geo-Hydro Engineers (Geo-Hydro Project No. 160205.20). This information can be examined at the offices of Engineering Strategies, Inc.
- B. This soil investigation information is offered as an aid in bidding only and is not a part of the Contract Documents. The logs of borings are available for Contractor's information but are not a warranty of subsurface conditions. The Owner, the Engineer, and the Soils Engineer assume no responsibility for any variation between materials encountered during construction and those indicated on the boring logs nor for any variation between location of the water table encountered and that indicated on the boring logs at the date borings were taken.

1.2 ADDITIONAL INVESTIGATION

- A. Contractor shall visit site and acquaint himself with site conditions. Prior to bidding, prospective Contractors may make their own site and subsurface investigations to satisfy themselves with site and subsurface conditions. Contractor shall be responsible for obtaining for himself rights of ingress and egress to private property for site and subsurface investigation and shall assume all responsibility for any damage to property caused as a result of his investigation.

1.3 LOCATION OF BORINGS

- A. Contractor shall be responsible for making his own determination of the location of soil borings on this project.

** END OF SECTION **



SECTION 02060
DEMOLITION OF EXISTING FACILITIES

1 GENERAL

1.1 SCOPE

- A. The work in this Section consists of furnishing all material, equipment, and labor necessary for demolishing and disposing of all materials from existing structures, piping and other designated facilities indicated on the drawings. Work includes all excavation and backfilling required for removing existing facilities.

1.2 SUBMITTALS

- A. The Contractor shall submit a detailed demolition plan for approval at least 10 days before demolition is started. The demolition plan shall include a detailed description of the methods and equipment to be used for each operation and the sequence of work. The demolition procedures shall provide for safe conduct of work, protection of the property and new work, which is to remain undisturbed and coordination with other work or operation which may be in progress.

2 PRODUCTS (NOT USED)

3 EXECUTION

3.1 DEMOLITION

- A. All material shall be removed as necessary for construction, or in any event, to a minimum depth of three feet below finished grades as shown on the Drawings.
- B. The Contractor will be responsible for any damage caused to other structures, and shall be held liable for any and all repairs, replacement of parts or renovations required to restore any structure, portion of structure, equipment or items, not intended for demolition. The Contractor shall restore any damaged facilities to their condition prior to demolition provided the damage was the result of the demolition. If the Contractor does not repair any such damage immediately, or if the repairs are not suitable to the Owner, the Owner reserves the right to have such repairs made by another party and deduct the cost of required repairs from money due Contractor.
- C. In addition to these specifications, the Contractor shall utilize the demolition details and requirements noted and detailed on the drawings.
- D. Dust-tight, weather-tight partitions shall be erected to protect existing facilities from dust and weather while wrecking is in progress and until such time as closures have been made. Partitions may be constructed of wood and shall have a covering of tarred roofing felt on the weather side.
- E. All salvageable metal materials shall remain the property of the Owner, unless otherwise noted, and shall be cleaned and stored on the Owner's property as directed by the Owner.

3.2 DISPOSAL

- A. All materials designated to be demolished and removed shall become the property of the Contractor, unless noted otherwise.
- B. The Contractor shall remove all demolished structures, piping and materials from the work site and dispose of it a legal manner.
- C. All demolished structures, equipment and materials, which are either left in place or removed to the disposal site, shall be in a non-hazardous condition.

** END OF SECTION **

SECTION 02105
CONSTRUCTION STAKING

1 GENERAL

1.1 SCOPE

- A. Construction staking shall include all of the surveying work required for construction of the Work to the lines, grades and elevations shown on the plans. The Contractor shall be responsible for constructing the Project to the horizontal and vertical alignment as shown on the Drawings, as specified, or as ordered by the Engineer. The Contractor shall bear any costs of correcting work constructed in the wrong location.
- B. Contractor shall:
 - 1. Set reference points and/or offsets, baselines, and all other layout, staking, and all other surveying required for the construction of the Project.
 - 2. Safeguard all reference points, stakes, grade marks, horizontal and vertical control points, and shall bear the cost of re-establishing same if disturbed.
 - 3. Stake easements or the limits of construction.
 - 4. Be responsible for the re-establishment of reference points, baselines, center lines and temporary bench marks that are damaged during construction.
- C. Measurement of quantities for payment purposes which are different from plan dimensions is included in the work.

1.2 QUALITY ASSURANCE

- A. The Contractor shall furnish documentation prepared by a licensed surveyor confirming that staking is being done to the lines and grades shown in the Contract Documents. This requires the Contractor to hire a licensed surveyor who is acceptable to the Owner and Engineer to provide ongoing confirmation of construction staking.
- B. At least one week prior to construction of each pipe, structure or component of the Project, Contractor shall furnish the Engineer a copy of documentation confirming that staking has been done to the horizontal and vertical alignment shown in the Contract Documents.
- C. Certification of road sub-base grades is required prior to paving installation.
- D. Certification of building base grade and building corner locations is required prior to acceptance by the Owner and transfer to the building contractor.

1.3 JOB CONDITIONS

- A. A topographic survey is included in the drawings; however, the topographic information shown is believed to be reasonably correct. It shall be the contractor's responsibility to determine any major differences which would affect the project.

2 PRODUCTS

2.1 EQUIPMENT

- A. The Contractor shall furnish and use surveying equipment and supplies maintained in good working order.

3 EXECUTION

3.1 FINAL GRADES

- A. "Blue Tops" shall be installed to control final paving sub-grade.

3.2 UTILITIES

- A. Staking of utilities shall be done in accordance with generally accepted practice for the type of utility involved.
- B. Storm drain lines and drainage structure bases shall be correctly located to yield the drainage structure top locations and orientations shown on the plan drawings.

3.3 AS-BUILT PLANS

- A. As-built plans of all construction shall be maintained by the Contractor. These plans shall be turned over to the Engineer.

** END OF SECTION **

SECTION 02110
CLEARING AND GRUBBING

1 GENERAL

1.1 SCOPE

- A. Clearing and grubbing includes, but is not limited to removal from the project lands of trees, stumps, roots, brush, structures, abandoned utilities, trash, debris, and all other materials found on or near the surface of the ground in the construction area and understood by generally accepted engineering practice not to be suitable for construction of the type contemplated. Precautionary measures to prevent damage to existing features to remain is part of the work.

1.2 QUALITY ASSURANCE

- A. The Contractor shall comply with applicable codes, ordinances, rules, regulations, and laws of local, municipal, state, and/or federal authorities having jurisdiction over the project. All required permits shall be obtained for construction operations by the Contractor.
- B. Open burning shall be pre-approved by the local authority having jurisdiction.

1.3 LOCATION OF WORK

- A. The area to be cleared and grubbed is shown schematically on the drawings. The Contractor shall minimize clearing of existing trees to maintain a natural buffer around the proposed work.

2 PRODUCTS

2.1 EQUIPMENT

- A. The Contractor shall furnish equipment with operators of the type normally used in clearing and grubbing operations including, but not limited to tractors, trucks, loaders, root rakes, and burning equipment.
- B. The Contractor shall furnish equipment capable of plowing the soil to a depth of 6 inches twice in a single pass.

3 EXECUTION

3.1 CLEARING AND GRUBBING

- A. Materials to be cleared, grubbed and removed from the construction area and lands of the Owner include, but are not limited to the following: all trees, stumps, roots, brush, trash, organic matter, paving, miscellaneous structures, debris and abandoned utilities.
- B. Surface rocks and boulders shall be grubbed from the soil, stockpiled, and/or placed in embankments in accordance with the Specifications.
- C. The entire construction area shall be grubbed by heavy tractors with root rakes. Raking shall generally proceed along the contour rather than up and down slopes so as to inhibit soil erosion.
- D. Grubbing shall consist of completely removing roots, stumps, trash, and other debris from all graded areas so that topsoil is free of roots and debris. Topsoil is to be left sufficiently clean so that further picking and raking will not be required.
- E. Burying of residual materials will not be allowed.
- F. Stumps and roots shall be grubbed and removed to a depth not less than 2 feet below grade. All holes or cavities which extend below the subgrade elevation of the proposed work shall be filled with crushed rock or other suitable material, compacted to the same density as the surrounding material.

- G. The Contractor shall exercise special precautions for the protection and preservation of trees, cultivated shrubs, sod, fences, etc. situated within the limits of the construction area but not directly within excavation and/or fill limits. The Contractor shall be held liable for any damage his operations have inflicted on such property.

3.2 TIMBER

- A. All timber within the cleared area having a marketable value shall be salvaged.
- B. The timber within the cleared area shall become the property of the Contractor and the Contractor shall be responsible for selling the timber.

3.3 DISPOSAL OF CLEARED AND GRUBBED MATERIALS

- A. Dispose of the cleared and grubbed materials by burning or chipping. Burning shall be permitted during approved burning seasons only. During non-burning season periods, chipping shall be used for debris disposal. Burying of burned and nonflammable materials shall be prohibited. At no time shall a fire be unattended, and the Contractor shall be responsible for damage occasioned by such fires. Disposal of materials in streams will not be permitted. Do not pile materials in stream channels or along the banks where it might be washed away by flood. Chipped material shall be removed from the site or disposed of in areas approved by the Owner.
- B. All fence material removed within the areas to be cleared shall become the property of the Contractor and shall be removed from the job site.

3.4 DISCING

- A. After grubbing is complete, discing of the entire area is required. Discing shall be done in two directions at approximate right angles. The second discing shall generally be done along the contour.
- B. The construction area is to be left free-draining with a finished agricultural appearance.

** END OF SECTION **

SECTION 02115
SOIL EROSION AND SEDIMENT CONTROL

1 GENERAL

1.1 SCOPE OF WORK

- A. This part of the work consists of providing and maintaining temporary and permanent erosion and sediment control measures. Temporary and permanent erosion and sediment controls include grassing or mulching of disturbed areas and installing structural barriers at certain locations to control erosion and sediment during construction.
- B. This section covers the work necessary for the installation of structures and measures for the prevention and control of soil erosion. The Contractor is responsible for implementing best management practices to prevent and minimize erosion and resultant sedimentation in all disturbed areas before, during and after construction. The Contractor is responsible for submitting the Notice of Intent (NOI) and the Notice of Termination (NOT) in accordance with the General National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity for Standalone Construction Projects (GAR 100003).
- C. Contractor shall sign certifications required in section V of the NOI and pay \$40.00 per disturbed acre to EPD, which fee shall be included in the lump sum bid price. Any other fees for environmental compliance charged by the County shall be reimbursed to the Contractor under the Allowance included in the Bid Form.
- D. The Contractor is responsible for inspecting and properly maintaining the erosion and sediment control devices installed and for monitoring and recording the daily rainfall.
- E. The Contractor shall furnish all material and labor necessary for the proper installation, maintenance, documentation, and removal (where applicable) of erosion prevention and control measures under this section.

1.2 GENERAL

- A. The requirements specified herein and shown in the Contract Documents are the minimum requirements for preventing or minimizing soil erosion and sediment transport. Additional details and requirements are shown on the plans.
 - 1. Contractor
 - a. For the purpose of this section, the term Contractor is synonymous with discharger, operator, and permittee (permit holder) as used in permits, laws, rules, regulations, ordinances and other soil erosion and sediment control references.
 - 2. Designer
 - a. For the purpose of this section, the term Designer is synonymous with consulting engineer, licensed professional, designer, and consultant used in permits, laws, rules, regulations, ordinances and other soil erosion and sediment control references. For the purposes of this item the Designer may at any time during the project provide direction. This direction shall be considered equivalent to direction from the Engineer.
 - 3. Qualified Personnel
 - a. For the purpose of this section, the terms Qualified Personnel or Qualified Person shall mean a person who has successfully completed an erosion and sediment control short course eligible for continuing education units, or an equivalent course approved by the Environmental Protection Division of the Georgia Department of Natural Resources and the State Soil and Water Conservation Commission.
 - 4. Regulatory Compliance
 - a. Contractor shall comply with requirements specified in the Contract Documents or by the Engineer. Contractor shall also comply with all other laws, rules,

regulations, ordinances and requirements concerning soil erosion and sediment control established by the United States and the State of Georgia.

- 1) NPDES Permit
 - a) The Georgia National Pollutant Discharge Elimination System (NPDES) General Permit for Storm Water Discharges Associated with Construction Activity, governs land disturbance or construction activities of one (1) acres or more. The Contractor is responsible for complying with the terms and conditions of this permit, including preparing and submitting the NOI and NOT, and performing daily inspections.
- 2) When a construction monitoring program (CMP) is provided in the contract documents, the Contractor shall follow the practices and requirements described in the CMP.
- 3) SWP3
 - a) When a Storm Water Pollution Prevention Plan (SWP3) is provided in the Contract Documents, Contractor shall follow the practices described in the SWP3.
- 4) Manual for Erosion and Sediment Control
 - a) Contractor shall follow practices and standards of the Georgia Soil and Water Conservation Commission *Manual for Erosion and Sediment Control in Georgia, 2016 edition*.
- 5) Permitting
 - a) Land disturbance activities are not authorized to begin until after all required erosion and sediment control permits are obtained from the United States and the State of Georgia.
 - b) The Contractor is required to complete the Notice of Intent and submit to the Georgia EPD at least fourteen (14) days prior to beginning any construction activity.
 - c) The Contractor is required to submit the Notice of Termination(s) to the Georgia EPD in accordance with the NPDES storm water permit once proper permanent vegetation has been established as approved by the Engineer and Owner.

1.3 REFERENCE TO OTHER ITEMS

- A. All requirements established in other sections of these specifications, including, but not limited to, Excavation, Seeding, and Stone Rip Rap, which may apply to actions taken pursuant to this section, are hereby made a part of these specifications for Soil Erosion and Sediment Control.

1.4 SUBMITTALS

- A. The Contractor will prepare and submit the Notice of Intent (NOI) for the project to Georgia Environmental Protection Division. The Contractor will coordinate with the Engineer to acquire the engineering data needed to complete the NOI and the Owner to get the required signature. The NOI must be submitted to GA EPD at least fourteen (14) days prior to beginning any construction activity. It will be the Contractor's responsibility to coordinate a timely submittal. No time extension or cost increase will be allowed for the Contractor's failure to coordinate a timely submittal.
- B. Contractor shall submit to the Engineer the proposed schedule for installation, maintenance and removal of all temporary and permanent erosion and sediment control measures. The schedule shall reflect the requirements of Section 3.1 below (Sequence of Construction of Temporary Sediment Control Measures) and must show the anticipated starting and completion date for all land development activities including:
 1. Installation of temporary and permanent sediment control structures,

2. Storm water management activities,
3. Timber salvage operations,
4. Clearing operations,
5. Grubbing operations,
6. Mass excavation and/or fill operations,
7. Rough and finished grading,
8. Building construction,
9. Landscaping, including all seeding and sodding, and
10. Removal of temporary sediment control structures.

2 PRODUCTS

2.1 GENERAL

- A. Any products not listed herein but required for proper installation and operation of soil erosion and sediment control measures shall be in accordance with the Georgia Soil and Water Conservation Commission *Manual for Erosion and Sediment Control in Georgia*, 2016 edition.

2.2 RAIN GAUGE

- A. A rain gauge shall be a standard pre-manufactured container with dimensions at least 1½ inches in diameter, 5-inches tall, with straight sides and graduations clearly marked to indicate rainfall measured in a minimum of 1/8-inch amounts. The rain gauge will include a funnel-type opening with the area of the container equal to 0.1 times the area of the funnel. The contractor may provide an automatic rainfall gauge at no additional cost to the Owner.

2.3 MULCH

- A. Mulching materials may consist of the following:
 1. Dry straw or hay.
 2. Wood waste (chips, sawdust, or bark).
 3. Polyethylene film.

2.4 TEMPORARY SEEDING

- A. Type of seed and broadcast rate shall be as specified in Table 6-4.1 – Temporary Cover of Companion Cover Crops in the Georgia Soil and Water Conservation Commission *Manual for Erosion and Sediment Control in Georgia*, 2016 edition for the Southern Piedmont region.

2.5 PERMANENT VEGETATION

- A. Fertilizer
 1. Type of fertilizer and application rate shall be as specified in Table 6-5.1 – Fertilizer Requirements in the Georgia Soil and Water Conservation Commission *Manual for Erosion and Sediment Control in Georgia*, 2016 edition for the type of species being planted.
- B. Seed
 1. Type of seed and broadcast rate shall be as specified in Table 6-5.2 – Permanent Cover Crops in the Georgia Soil and Water Conservation Commission *Manual for Erosion and Sediment Control in Georgia*, 2016 edition for the Southern Piedmont region.

2.6 TACKIFIERS

- A. Anionic poly acrylamide monomer (PAM) with no more than 0.05% acrylamide monomer by weight.

2.7 CHECK DAMS

A. Hay Bales

1. Hay bales shall be clean, seed-free cereal hay, wire or nylon bound and of a rectangular shape with five cubic feet or more of material.

B. Stone

1. Stone for stone check dams shall be graded size 2-inch to 10-inch stone.

2.8 CONSTRUCTION EXIT

A. Aggregate

1. Aggregate size shall conform to the National Stone Associations R-2 classification (1.5-inch to 3.5-inch stone) or approved equivalent.

B. Filter Fabric

1. For subgrades with a CBR greater than or equal to 3 or shear strength greater than 90 kPa, geotextile shall meet the requirements of AASHTO M288-06, Section 7.3. For subgrades with a CBR between 1 and 3 or shear strength between 30 and 90 kPa, geotextile shall meet the requirements of AASHTO M288-06, Section 8.

2.9 CONSTRUCTION ROAD STABILIZATION

A. Filter Fabric

1. For subgrades with a CBR greater than or equal to 3 or shear strength greater than 90 kPa, geotextile shall meet the requirements of AASHTO M288-06, Section 7.3. For subgrades with a CBR between 1 and 3 or shear strength between 30 and 90 kPa, geotextile shall meet the requirements of AASHTO M288-06, Section 8.

B. Base Material

1. Graded aggregate base in accordance with Section 815 of the Georgia Department of Transportation Standard Specifications.

2.10 FILTER RING

A. Stone

1. For filter rings with diameters less than 12 inches, stone shall be no smaller than 3 to 5-inches (15 – 30 lbs.).
2. For filter rings with diameters 12 inches and greater, stone shall be no smaller than 10 to 15-inches (50 – 100 lbs.).

2.11 SILT FENCE

A. Fabric

1. Type "A" Filter Fabric for Non-Sensitive Areas
 - a. Woven or non-woven filter fabric that meets the requirements of Georgia Department of Transportation Standard Specification 881 and is listed in the Georgia Department of Transportation Qualified Products List #36.
 - b. Physical and Dimensional Requirements:
 - 1) Minimum Tensile Strength (ASTM D4632)
 - a) Warp: 120 lbs.
 - b) Fill: 100 lbs.
 - 2) Maximum Percent Elongation (ASTM D4632): 40
 - 3) Apparent Opening Size (Maximum Sieve Size) (ASTM D4751): #30
 - 4) Flow Rate (GDT 87): 25 gpm/ft²
 - 5) UV Stability (after 300 hours) (ASTM D4355): 80
 - 6) Minimum Bursting Strength (ASTM D3786): 175 PSI

- 7) Minimum Fabric Width: 36-inches
2. Type "C" Filter Fabric for Sensitive Areas
 - a. Non- woven filter fabric that meets the requirements of Georgia Department of Transportation Standard Specification 881 and is listed in the Georgia Department of Transportation Qualified Products List #36.
 - b. Physical and Dimensional Requirements:
 - 1) Minimum Tensile Strength (ASTM D4632)
 - a) Warp: 260 lbs.
 - b) Fill: 180 lbs.
 - 2) Maximum Percent Elongation (ASTM D4632): 40
 - 3) Apparent Opening Size (Maximum Sieve Size) (ASTM D4751): #30
 - 4) Flow Rate (GDT 87): 70 gpm/ft²
 - 5) UV Stability (after 300 hours) (ASTM D4355): 80
 - 6) Minimum Bursting Strength (ASTM D3786): 175 PSI
 - 7) Minimum Fabric Width: 36-inches

B. Fence Posts

1. Posts for Non-Sensitive Areas
 - a. Soft wood: 3" diameter or nominal 2"x4" by minimum 4-feet long.
 - b. Hardwood (ash, hickory, or oak): 1½"x1½" by minimum 4-feet long.
 - c. Steel: Minimum 4-feet long with a minimum weight of 1.15 lbs./ft.
2. Posts for Sensitive Areas
 - a. Hardwood (ash, hickory, or oak): 2"x2" by minimum 4-feet long.
 - b. Steel: Minimum 4-feet long with a minimum weight of 1.15 to 1.25 lbs./ft.

C. Woven Wire Fabric

1. Fabric shall be at least 32-inches high with minimum 6 horizontal wires.
2. Vertical wires shall have a maximum spacing of 12-inches.
3. Top and bottom wires shall be at least 10 gauge.
4. All other wires shall be at least 12.5 gauge.

D. Fasteners for Wooden Posts

1. Wire Staples: Use staples that are at least 17 gauge, legs at least ½-inch long, and a crown at least ¾-inch wide.
2. Nails: Use nails that are at least 14 gauge, 1-inch long, with button heads of at least ¾-inch diameter.

2.12 INLET SEDIMENT TRAP

A. Filter Fabric

1. Type C fabric for sensitive areas.

B. Posts

1. Steel: Minimum 3-feet long with a minimum weight of 1.15 to 1.25 lbs./ft.

C. Woven Wire Fabric

1. Fabric shall be at least 18-inches high with minimum 4 horizontal wires.
2. Vertical wires shall have a maximum spacing of 12-inches.
3. Top and bottom wires shall be at least 10 gauge.

4. All other wires shall be at least 12.5 gauge.

3 EXECUTION

3.1 SEQUENCE OF CONSTRUCTION OF TEMPORARY SEDIMENT CONTROL MEASURES

- A. Install all erosion and sediment control structures specified herein and shown in the Contract Documents, or as directed by the Engineer, as the first item of work within a given drainage area. Construction and installation of all sediment control structures shall begin downgradient of the area to be disturbed and proceed upgradient. Contractor shall at all times maintain all soil erosion and sediment control structures and practices throughout construction and until permanent grass cover is established.

3.2 SPECIFIC REQUIREMENTS

- A. Contractor shall install and maintain soil erosion and sediment control measures in accordance with the Georgia Soil and Water Conservation Commission *Manual for Erosion and Sediment Control in Georgia*, 2016 edition.

3.3 INSPECTIONS AND MAINTENANCE

- A. Contractor shall designate a qualified person who is knowledgeable and understanding of erosion and sediment control practices and has completed a certified training course approved by GA EPD to perform inspections required by this Section. The following areas are to be inspected daily and within 24 hours of a rainfall event that has precipitation of 0.5 inches or greater. Maintenance shall be performed, if needed, within 24 hours of inspection:
 1. Disturbed areas of the construction site that have not undergone permanent stabilization.
 2. Erosion and sediment control structures.
 3. All locations where vehicles enter or exit the site.
 4. Material storage and construction laydown areas that are exposed to precipitation and have not been finally stabilized.
- B. In areas that have been finally stabilized, inspections and, if necessary, maintenance by Contractor will occur at least once per month for duration of contract or project, whichever is longer.
- C. During inspections, the following will be observed and appropriate maintenance procedures taken:
 1. The conformance to specifications and current condition of all erosion and sediment control structures.
 2. The effectiveness and operational success of all erosion and sediment control measures.
 3. The presence of sediments or other pollutants in storm water runoff at all runoff discharge points.
 4. If reasonably accessible, the presence of sediments or other pollutants in receiving waters.
 5. Evidence of off-site sediment tracking at all locations where vehicles enter or exit the site.
 6. Inspection checklists are included at the end of this section. The checklists must be completed during each inspection, dated and signed by the Contractor's qualified person conducting the inspection. Completed inspection checklists shall be kept on-site with the Contract Documents. The Contractor shall repair deficiencies within 24 hours of inspection. The contractor acknowledges that failure to inspect, document, and maintain the erosion and sedimentation control measures will constitute a violation of the Georgia NPDES Storm Water Permit.

3.4 REMOVAL OF TEMPORARY SEDIMENT CONTROL STRUCTURES

- A. At such time that temporary erosion and sediment control structures are no longer required under this Section, the Contractor shall notify the Engineer of its intent and schedule for the removal of the temporary structures. Contractor shall remove as approved the temporary structures and all sediments accumulated at the removed structure shall be returned up-gradient. In areas where temporary control structures are removed, the site shall be left in a condition that will restore original drainage. Such areas shall be evenly graded and seeded with permanent vegetation.
- B. The Contractor is required to coordinate, complete, and submit the Notice of Termination to Georgia EPD once the project has reached final stabilization. Final stabilization means that all soil disturbing activities at the site have been completed, and that for unpaved areas and areas not covered by permanent structures, at least 80% of the soil surface is uniformly covered in permanent vegetation or equivalent permanent stabilization measures (such as the use of rip rap, gabions, permanent mulches or geotextiles) have been employed. Permanent vegetation shall consist of: planted trees, shrubs, perennial vines; a crop of perennial vegetation appropriate for the time of year and region; or a crop of annual vegetation and a seeding of target crop perennials appropriate for the region, such that within the growing season an 80% coverage by perennial vegetation shall be achieved. Final stabilization applies to each phase of construction. For linear construction projects on land used for agricultural or silvicultural purposes, final stabilization may be accomplished by stabilizing the disturbed land for its agricultural or silvicultural use. The Contractor may submit NOTs for basins if allowed by the NPDES storm water permit requirements, the Owner, and the Engineer.

3.5 MONITORING AND REPORTING

A. Monitoring

1. The Contractor shall be responsible for the implementation of the Comprehensive Monitoring Program (CMP) as written by the Designer. The implementation must comply with EPD guidelines as set forth in Part V. MONITORING, REPORTING, AND RETENTION OF RECORDS, NPDES Permit No. GAR 100003 or most recent version.

B. Reporting

1. The Contractor shall prepare and submit a summary of the monitoring results to the Engineer, the Designer and the EPD as required in the NPDES permit. The Owner reserves the right to use its own resources to duplicate monitoring and verify the work required by the Contractor in this section.

3.6 PAYMENT

- A. Costs for all erosion control work shall be included in the Lump Sum Bid Price. The costs for all erosion control work covered under this section shall include:
 1. Furnishing
 2. Placement
 3. Maintenance, including replacement of damaged measures
 4. Sampling
 5. Documentation
 6. Removal of the silt fence, hay bales, construction exits, all temporary vegetative and non-vegetative ground cover and other erosion and sedimentation control measures shown on the drawings, including all earthwork, labor, materials, and equipment necessary to complete the work as specified or directed by the Engineer.

** END OF SECTION **



SECTION 02200
EXCAVATION AND FILL

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required for all excavation and fill operations including, but not limited to, clearing and grubbing the construction site; dewatering; excavating all classes of material encountered on the construction site; handling, storage, transportation, and disposal of all excavated and unsuitable material; handling, storage, and transportation of all off-site borrow excavation; construction of fills and embankments; backfilling around structures and pipe; backfilling all trenches and pits; compacting; sheeting, shoring and bracing; preparation of subgrades; surfacing and grading, and all other appurtenant earthwork operations which may be necessary to complete the work as specified herein and as shown on the drawings.

1.2 GENERAL

- A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.
- B. The elevations shown on the Drawings as existing are intended to give reasonable, accurate information about the relative elevations. They are not precise, and the Contractor should satisfy himself as to the exact quantities of excavation and fill required.
- C. Earthwork operations shall be performed in a safe and proper manner with appropriate precautions being taken against all hazards.
- D. All excavated and filled areas shall be maintained by the Contractor in good condition at all times until final acceptance by the Owner. All damage caused by erosion or other construction operations shall be repaired by the Contractor using material of the same type as the damaged material.
- E. Earthwork within the right-of-way of the State Department of Transportation, the County Department of Transportation, and the respective cities shall be done in accordance with requirements and provisions of the permits issued by those agencies for the construction within their respective rights-of-way. Such requirements and provisions, where applicable, shall take precedence and supersede the provisions of these specifications.
- F. The Contractor shall control grading in a manner to prevent water running into excavations. Obstruction of surface drainage shall be avoided and means shall be provided whereby storm water can be uninterrupted in existing gutters, other surface drains, or temporary drains. Free access must be provided to all fire hydrants, water valves, and meters.
- G. The Owner may decide to conduct tests for compaction and density via an independent testing laboratory. The costs of compaction tests performed by an independent testing laboratory will be paid by the Owner. The Contractor shall make all necessary excavations and shall supply any samples of materials necessary for conducting compaction and density tests. The cost of all retests made necessary by the failure of materials to conform to the requirements of these Contract Documents shall be paid by the Contractor.
- H. All earthwork operations shall comply with the requirements of OSHA Construction Standards, Part 1926, Subpart P, Excavations, Trenching, and Shoring, and Subpart O, Motor Vehicles, Mechanized Equipment, and Marine Operations.
- I. It is understood and agreed that the Contractor has made a thorough investigation of the surface and subsurface conditions of the site and any special construction problems which might arise as a result of nearby watercourses and flood plains, particularly in areas where construction activities may encounter water-bearing sands and gravels or limestone solution channels. The Contractor shall be responsible for providing all services, labor,

equipment, and materials necessary or convenient to him for completing the work within the time specified in these Contract Documents.

2 PRODUCTS

2.1 STABILIZATION STONE

- A. No. 57 angular graded crushed stone, 1-inch to 3/16-inches (No. 4) in size with no more than 5 percent passing a No. 8 standard sieve in accordance with ASTM D448.
- B. Free from dirt, clay balls and organic material

2.2 SELECT EARTH BACKFILL

- A. Excavated SM and ML material that is free from rocks larger than 1-inch in diameter, ashes, cinders, refuse, organic material, frozen soil, and other deleterious material.
- B. Material containing more than 10 percent gravel, stones, or shale particles is not acceptable.
- C. Backfill material shall be within ± 3 percent of its optimum moisture content.
- D. Provide imported material as required to accomplish work.

2.3 COMMON EARTH BACKFILL

- A. Excavated SM and ML material that is free from rocks larger than 3-inches in diameter, ashes, cinders, refuse, organic material, frozen soil, and other deleterious material.
- B. Material containing more than 10 percent gravel, stones, or shale particles is not acceptable.
- C. Backfill material shall be within ± 3 percent of its optimum moisture content.
- D. Provide imported material as required to accomplish work.

2.4 TOP SOIL

- A. The top 6-inches of soil that is suitable for use in seeding and planting.
- B. Free from roots, refuse and any material toxic to plant growth.

2.5 CONCRETE

- A. Class "A" concrete in accordance with GDOT Specification Section 500.
- B. Compressive Strength: 3,000 PSI at 28 days

2.6 BITUMINOUS TACK COAT

- A. Asphalt cement per GDOT Specification Section 413.

2.7 ASPHALT PAVEMENT

- A. 9.5-mm superpave per GDOT Specification Section 828.
- B. 12.5-mm superpave per GDOT Specification Section 828.

3 EXECUTION

3.1 GENERAL

- A. Protect all existing utilities (pipes, structures, cables, etc.). Repair all utilities that are damaged by the Contractor, or utilities damaged as a result of Contractor negligence, at no additional cost to the Owner.

3.2 INITIAL ACTIVITIES

- A. Notify Utility Protection Center a minimum of 3 days prior to beginning any land disturbing activities.
- B. Install all erosion and sediment control devices prior to beginning any land disturbing activities.

3.3 CLEARING AND GRUBBING

- A. Protect all trees, ornamental plantings, and structures within or adjacent to the clearing limits that are shown or specified to not be removed with tree protection fence.
- B. Remove all vegetation, brush, stumps, roots, debris, and any other objectionable matter.
- C. Properly dispose of all materials cleared and grubbed from the project offsite.

3.4 PAVEMENT REMOVAL

- A. When approved, remove pavement and road surfaces as required in order to excavate soil.
- B. Saw cut pavement with a rotary saw, making straight cuts along the outside edges of the excavation.
- C. Width of pavement removal for pipe trenches shall be 12-inches greater than the width of the trench on each side.
- D. Remove full width of driveways and sidewalks from control joint to control joint.
- E. Remove curb and gutter from control joint to control joint.
- F. Properly dispose of all materials offsite.

3.5 SHEETING, SHORING AND BRACING

- A. Contractor is responsible for trench safety and is responsible for assessing and analyzing the need for sheeting, shoring and bracing.
- B. Install sheeting, shoring and bracing in all open excavation in accordance with the requirements of Title 29 Code of Federal Regulations, Part 1926.650-652, Subpart P, OSHA's Rules and Regulations for Construction Employment.
- C. All excavations more than 5 feet deep must have a protective system in place while workers are present in the excavation.
- D. All excavations more than 4 feet deep must have a way to get in and out of the excavation, usually a ladder, for every 25 feet of horizontal travel.

3.6 DEWATERING

- A. Provide all labor, materials, and equipment required to remove and control water as required to accomplish work.
- B. Where running or standing water occurs in an excavation or where the soil in the bottom of an excavation displays a "quick" tendency, the water shall be removed by pumping.
- C. Excavation shall be kept free from water during installation operations by suitable means, such as well points, until materials have been installed and backfill placed and compacted to a sufficient height to prevent flotation.
- D. Properly dispose of water in a manner that will not cause erosion or flooding, or otherwise damage existing facilities, completed work, or adjacent property. Contractor is responsible for any damage caused by the dewatering operation.
- E. Contractor is responsible for obtaining any required permits, required by regulatory agencies, for discharging water from dewatering operations.

3.7 SOIL EXCAVATION

- A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish work. Excavate to tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular

base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

- B. Do not over excavate without written authorization of Engineer.
- C. Stockpile top soil separately from other excavated material.
- D. Stockpile excavated soil in a manner that will not obstruct the work or endanger the workers or the public, obstruct sidewalks, driveways, roadways, or other structures.
- E. Do not place excavated soil against tree trunks.
- F. Remove and properly dispose of excavated soil that is unsuitable for backfill or exceeds the quantity required for fill or backfill offsite.

3.8 TRENCH EXCAVATION

- A. Excavate trenches to the required alignment, depth, and width required to install the pipe or structure.
- B. Conform to all federal, state, and local regulations for the protection of workers; Contractor is responsible for trench safety.
- C. Width of the trench shall be of sufficient width to install the pipe, accommodate compaction equipment, and make necessary inspections. When required, trenches shall be made wider to permit the placing of shoring.
- D. Trench bottom shall be constructed to provide a firm, stable, and uniform support for the full length of the pipe. Blocking shall not be used to change pipe grade or to intermittently support pipe across excavated sections.
- E. If unsuitable soil exists, the trench shall be over-excavated to remove the unsuitable soil and backfilled with stabilization stone. Engineer shall determine the depth of over excavation.
- F. Open trenches shall be limited to 300 feet in length and shall be backfilled at the end of each work day.
- G. Open trenches shall be barricaded or covered until they are completely backfilled.
- H. Excavated soil that is unsuitable or exceeds the quantity required for backfill shall be disposed of offsite.

3.9 PIPE INSTALLATION AND BACKFILL

- A. General
 - 1. Install pipe to the lines and grades shown on the drawings.
 - 2. Install fittings, valves, hydrants, manholes, valve vaults, and other structures in the locations shown on the drawings.
 - 3. Prior to installation, clean all dirt and debris from the interior of pipes, fittings, valves, and other appurtenances.
 - 4. Install materials in accordance the manufacturer's recommendations.
- B. Install ductile iron pipe and steel pipe in accordance with AWWA C600, Type 4 Bedding.
 - 1. Pipe shall be bedded to centerline of pipe with No. 57 stabilization stone. There shall be a minimum of 4-inches of No. 57 stabilization stone under the pipe. Make sure that material fills the voids under the haunches of the pipe and is properly compacted. Stabilization stone shall be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698.
 - 2. Backfill from centerline of pipe to 12-inches above top of pipe with select earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.
 - 3. For cuts out of pavement, backfill from 12-inches above top of pipe to finished grade with common earth backfill. Backfill shall be placed in 6-inch lifts and mechanically

compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.

4. For cuts in pavement, backfill from 12-inches above top of pipe to 20" below finished grade with common earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts. Backfill from 20" below finished grade to 8" below finished grade with common earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 100 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.

C. Install PVC pipe in accordance with AWWA C605, Type 5 Bedding.

1. PVC pipe shall be bedded to crown of pipe with No. 57 stabilization stone. There shall be a minimum of 4-inches of No. 57 stabilization stone under the pipe. Make sure that material fills the voids under the haunches of the pipe and is properly compacted. Stabilization stone shall be compacted to a minimum of 95 percent of the maximum dry density as determined by ASTM D698.
2. Backfill from top of pipe to 12-inches above top of pipe with select earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 95 percent (98 percent in pavement) of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.
3. For cuts out of pavement, backfill from 12-inches above top of pipe to finished grade with common earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.
4. For cuts in pavement, backfill from 12-inches above top of pipe to 20" below finished grade with common earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts. Backfill from 20" below finished grade to 8" below finished grade with common earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 100 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.

3.10 TRENCH REPAIR

A. Paved Areas

1. For cuts in pavement, stop backfill 8" below the finished grade.
2. Verify pavement cuts are straight and vertical without jagged edges. If damaged edges or jagged edges exist, cut new edges.
3. Install asphalt in accordance with standard pavement detail.
4. Apply bituminous tack coat at a rate of 0.07 gallons per square yard to the top surface of first course and edges of existing asphalt.

B. Non-Paved Areas

1. Terminate backfill a sufficient depth below finished grade to allow the installation of 4-inches of top soil plus the final cover (seed, sod, etc.)
2. Install 4-inches of top soil and compact to a minimum of 90 percent of the maximum dry density, as determined by ASTM D698.
3. Install grass in accordance with Section 32 92 00 Turf and Grasses.

3.11 DISPOSAL OF WASTE AND UNSUITABLE MATERIALS

- A. All materials removed by excavation, which are suitable for the purpose, shall be used to the extent possible for backfilling pipe trenches, foundations, and footings and for making embankment fills or for such other purposes as may be shown on the Drawings. All materials not used for such purposes shall be considered as waste materials and the

disposal thereof shall be made by the Contractor in a lawful manner and at a location where such materials can be lawfully disposed.

- B. Waste materials shall be spread in uniform layers and neatly leveled and shaped. Spoil banks shall be provided with sufficient and adequate openings to permit surface drainage of adjacent lands.
- C. Unsuitable materials, consisting of wood, shot rock, vegetable matter, debris, soft or spongy clay, peat, and other objectionable material shall be removed from the work site and disposed of by the Contractor in a lawful manner.
- D. No unsuitable or waste material shall be dumped on private property unless written permission is furnished by the owner of the property and unless a dumping permit is issued from the local jurisdiction.

3.12 FINAL GRADING

- A. After other earthwork operations have been completed, the sites of all structures, roads, and embankments shall be graded within the limits and to the elevations shown on the Drawings. Grading operations shall be so conducted that materials shall not be removed or loosened beyond the required limits. The finished surfaces shall be left in smooth and uniform planes such as are normally obtainable from the use of hand tools. If the Contractor is able to obtain the required degree of evenness by means of mechanical equipment he will not be required to use hand labor methods. Slopes and ditches shall be neatly trimmed and finished to slopes shown on the Drawings.
- B. Unless otherwise specified or shown on the Drawings, all finished ground surfaces shall be graded and dressed to present a surface varying not more than plus or minus 0.10 foot as regards local humps or depressions.

3.13 TOPSOIL

- A. All areas to be sprigged or planted with grass shall be prepared by grading to a smooth, even surface to a level 4 inches below the elevation of the finished grade shown on the Drawings. It shall then be brought to a neat and finished grade by the addition of 4 inches of approved topsoil.
- B. Topsoil removed from the construction area may be stockpiled and reused or topsoil may be obtained from approved borrow areas. If obtained from borrow areas, the Contractor shall make suitable arrangements with the property owner and shall pay all costs incident to the borrowed material including royalties.

3.14 SETTLEMENT

- A. The Contractor shall be responsible for all settlement of backfill, fills, and embankments which may occur within one year after final acceptance of the work by the Owner.
- B. The Contractor shall make, or cause to be made, all repairs or replacements made necessary by settlement within 30 days after receipt of written notice from the Engineer or Owner.

** END OF SECTION **

SECTION 02211
ROCK BLASTING AND REMOVAL

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to drill, blast, loosen, excavate, crush, haul, and dispose of "Blast Rock" and or "Trench Rock" as necessary for the construction of the work on this project. Excavation is unclassified and cost for any blasting shall be considered to be included in the Lump Sum bid price.
- B. Work shall include, but not be limited to the following.
 - 1. Blast round design.
 - 2. Planning and execution of appropriate site-specific safety measures to be employed during all blasting operations, and the safe handling and storage of high explosives and blasting agents.
 - 3. Drilling blast holes, loading blast holes with explosives, and wiring and safe detonation of blast rounds.
 - 4. Removal from the site of all excess excavated soil, debris, and rock as indicated in the contract Documents, or as directed by the Engineer, and disposal of excess materials at a permitted disposal site.
 - 5. Dewatering and maintenance of groundwater and surface water in all excavations.
 - 6. Performance of all surveys necessary to establish and verify the lines and grades, and to determine the amount of material removed.
 - 7. Implementation of monitoring program to monitor condition of existing structures and utilities in vicinity of proposed blasting operations to insure existing features remain undamaged by blasting procedures.
- C. "Blast Rock" is defined as any material which cannot be excavated with a single-tooth ripper mounted on a crawler tractor having a minimum draw bar pull rated at not less than 56,000 pounds (Caterpillar D-8K or equivalent) or by a Caterpillar 977 front-end loader or equivalent, and occupying an original volume of at least one cubic yard.
- D. "Trench Rock" is defined as any material which cannot be excavated with a backhoe having a bucket curling force rated at not less than 25,700 pounds (Caterpillar Model 225 or equivalent), and occupying an original volume of at least one-half cubic yard.

1.2 SUBMITTALS

- A. Contractor shall submit the following at least 30 working days prior to beginning any blasting operations.
 - 1. Names, addresses, telephone numbers, and qualifications of the blasting subcontractor(s) and explosives supplier(s) that will be used.
 - 2. Copies of Training Certificates for the designated Blaster-In-Charge, blasting foreman and any other key personnel that will be responsible for the work, showing that they have received specialized training in the proper handling of explosives.
 - 3. A Blasting Plan, indicating the methods, materials and equipment to be used. The Blasting Plan should indicate the types of explosives to be used, drilling patterns, and a general layout and schedule for executing the work in accordance with state regulations.
 - 4. A ground vibration and air blast monitoring plan, indicating structures that will be monitored, monitoring equipment that will be used, and personnel that will perform the monitoring.

- B. At least 24 hours before each blast round, Contractor shall submit a detailed blast round design plan to the Engineer's on-site representative. The blasting plan submitted is for quality control and record keeping purposes. Review by the Engineer shall not relieve the Contractor of his responsibilities as provided herein. The blast round design submittals shall include:
 - 1. Location (state, grid coordinates) and limits of the shot.
 - 2. Number, diameter, and depth of blast holes to be detonated in the round, and a plan showing the drill hole pattern, spacing and distance to the free face.
 - 3. Depth of overburden.
 - 4. Total weight of explosives in the round and the types of explosives to be used.
 - 5. Loading diagram showing the location of explosives, primers, and initiators; and location, depth, and type of stemming to be used in each hole.
 - 6. Initiation sequence, including delay timer and delay system, total weight of explosive to be detonated on each delay, and a list of the timing of the delays.
 - 7. Manufacturer's data sheet for all explosives, primers, and initiators to be used.
 - 8. Planned seismic monitoring positions, distances from the blast round, and seismograph types to be used to monitor vibrations and air blast overpressures.
 - 9. Type and amount of blasting mats and/or depth of soil cover to be used over the top surface of the shot.
 - 10. Any other information required by applicable state and federal regulations.
- C. Within 24 hours after each blast round, Contractor shall submit a blasting report to the Engineer. The blasting report shall include:
 - 1. Date and time of shot.
 - 2. Foreman's name.
 - 3. Number and depth of holes detonated.
 - 4. Weather conditions at the time of detonation.
 - 5. Type of explosives and detonators used.
 - 6. Peak particle velocity of ground motion and primary frequency for all ground vibration monitoring stations.
 - 7. Peak air blast overpressure measured.
 - 8. Distance from the blast round to each monitoring station for vibrations and air blast.
 - 9. Amount of explosive used in each hole, and maximum weight of explosive detonated on any single delay in the blast round.

1.3 SAFETY REQUIREMENTS

- A. All blasting operations shall be conducted in accordance with the Georgia Blasting Standards Act of 1978 (O.C.G.A. 25-8-1).
- B. Keep explosives on the site only in such quantity as needed for work under way and only during time as being used. Notify Engineer at least 24 hours in advance of intention to store and use explosives. Store explosives in a secure manner and separate from all tools. Caps and/or detonators shall be stored a minimum of 100 feet distant from the explosives. Promptly remove from premises remaining material when need for explosives has ended.
- C. Conform to State, Federal, and County laws, ordinances, and regulations relating to transportation, storage, handling, and use of explosives. If any of above mentioned laws, ordinances, or regulations require a licensed blaster to perform or supervise the work of blasting, employ a licensed blaster. Require him to have his license on site and permit examination by Engineer or other officials having jurisdiction.

- D. Conduct operations involving explosives with all possible care to avoid injury to persons and property. Do blasting only with such quantities and strengths of explosives and in such manner as will break rock approximately to intended lines and grades, leaving rock not to be excavated in an unshattered condition. Avoid excessive cracking of rock upon or against which any structure will be built. Prevent injury to existing pipes, structures and property above or below ground. Cover rock with logs or mats, or both. Give sufficient warning to persons in vicinity of work before a charge is exploded.
- E. Complete blasting within a distance of 50 feet before any portion of a masonry structure is placed or any pipe is laid.
- F. Determine presence of two-way-radios, stray electrical currents and other conditions adversely affecting blasting operations and implement necessary precautions to prevent accidents and premature blasts.
- G. Contractor shall notify all public utility companies having facilities in close proximity to the site of the work of his intention to use explosives. The notice shall be given sufficiently in advance to enable the utility companies to take whatever steps they may consider necessary to protect their property. The contractor shall also give the engineer, all occupants of adjacent property, and all other contractors working in or near the project, notice of his intention to use explosives.

1.4 QUALITY ASSURANCE

- A. Employ an approved, independent, vibration/blasting consultant to conduct test blasting prior to production blasting, to devise suitable blasting procedures for production blasting, and to monitor production blasting. Prior to starting the work, submit the name of the vibration/blasting consultant to the Engineer.
- B. Test blast to develop control procedures for production blasting so that no disturbance or damage shall be done to utilities, equipment, buildings, or structures.
- C. Based on the results of test blasting, develop a suitable Blasting Plan. Submit the Blasting Plan to the Engineer 30 days prior to commencement of production blasting.
- D. Conduct production blasting operations in accordance with the Blasting Plan.
- E. Monitor blasting with 3-component seismometers that record the entire particle velocity wave train and not just peak velocities. Obtain accurate, legible seismometer records of monitored blasts.
- F. If evidence of disturbance or damage to utilities, equipment, buildings, or structures is observed or reported, immediately notify the Engineer and discontinue blasting operations and require vibration/blasting consultant to recommend revised blasting procedures.
- G. Initiate the revised procedures before blasting is continued.
- H. As determined by the Engineer, restore or replace utilities, equipment, buildings, or structures damaged by blasting operations at no additional cost to the Owner.

2 PRODUCTS

2.1 INITIATORS

- A. Only non-electric type initiators may be used.

3 EXECUTION

3.1 BLASTING OPERATIONS

- A. Explosives shall be of such quantity and power and shall be used in such locations as will neither open seams nor otherwise disturb the material outside the prescribed limits of excavation. As the excavation approaches its final limits, the depth of holes for blasting and the amount of explosives used for each hole shall be reduced so that the underlying or adjacent rock will not be disturbed or shattered.

- B. Blasting shall not be performed within 100 feet of newly placed concrete that has cured less than 7 days.
- C. No blasting shall be permitted within 50 feet of any existing structure or any new structure in progress.

3.2 BLAST MONITORING

- A. A pre-construction condition inspection and documentation of adjacent structures on-site and off-site shall be performed by the Contractor. The Contractor shall exercise the utmost care not to damage property on-site and off-site. The Contractor shall notify each adjoining property owner within 5000 feet of the site of the anticipated ground vibrations and noise which will occur due to his blasting operations. This notice shall be given 30 days in advance to enable the adjacent property owners to take whatever precautions they may consider necessary. The Contractor shall limit his operations to minimize any disturbance to the adjacent property owners. Motorists on adjacent roadways shall be notified in accordance with state regulations. The Contractor shall be responsible for any damage to any structure or utility line, pipes, etc., on-site and off-site as a result of his operations.
- B. For each blast round, Contractor shall monitor and record noise and air blast overpressures at the site perimeter nearest the blast location and at the on-site or off-site structure located nearest to the round. Peak air blast overpressure shall not exceed 0.018 psi, measured at the site perimeter.
- C. The site of every blast round shall be sufficiently covered with blasting mats or other devices to prevent any flying debris. The number and type of blasting mats must be satisfactory to the Engineer. The Contractor will be fully responsible for any damage caused by flying debris, both to on-site and off-site properties.
- D. Whenever blasting is to be performed within 2500 feet of any structure, the Contractor shall measure the peak particle velocities of ground vibration resulting from each blast at the structure. Vibrations shall be monitored utilizing a seismograph capable of providing a record of particle velocity and frequency along three mutually perpendicular axes utilizing internal calibration. The measured peak particle velocity of ground motion at the monitored structure shall not exceed 2-inches per second.

** END OF SECTION **

SECTION 02215
SUBGRADE CONSTRUCTION AND PREPARATION

1 GENERAL

1.1 SCOPE

- A. Work described in this section includes furnishing all labor and equipment necessary for the construction and preparation of part of or all of the roadbed to receive the immediate construction of a base or pavement thereon.

2 PRODUCTS (NOT APPLICABLE)

3 EXECUTION

3.1 EQUIPMENT

- A. All equipment necessary and required for construction of the subgrade must be on the project, proven to be in first-class working order before construction will be permitted to begin. This shall consist of at least 1 motor grader with scarifier and 1 pneumatic tired roller meeting requirements of the Georgia Department of Transportation Standard Specifications for Road and Bridge Construction.

3.2 SUBGRADE PREPARATION

- A. Road and drainage excavation and embankment construction shall be performed in accordance with the provisions set out in Section 02200, Excavation and Fill.
- B. Subgrade shall be prepared to the lines and grades corresponding to the cross section of the bottom of the pavement as indicated on the drawings.
- C. Where excavation is necessary to prepare the subgrade, the material removed shall be carefully stored or placed for use in completing the roadbed. Unsuitable material shall be disposed of in a lawful manner or may be used for seedbed preparation where applicable.
- D. All rock shall be removed to a depth of not less than 6 inches below the surface of the subgrade and all holes or depressions, caused by the removal of rock, or otherwise, shall be backfilled with satisfactory material and thoroughly compacted.
- E. Where the roadbed is below grade the Contractor shall prepare the subgrade by hauling and spreading satisfactory material excavated in channeling, or otherwise. The material shall be spread in layers not to exceed 6 inches in thickness and thoroughly compacted by rolling, using water if directed. Each layer shall have been completed before the succeeding layer is started.
- F. Where it is intended or required to use steel forms in construction of the base of pavement, the subgrade shall be constructed at least 12 inches wider, on each side, than the neat width of the base of pavement. For bases or pavements using wooden forms, the subgrade shall be constructed at least 6 inches wider, on each side, than the width of the base or pavement, as indicated on the drawings.
- G. Where subbases are to be constructed on the subgrade, limits of the subgrade preparation shall extend across the entire section upon which any subbase course is to be applied, including the shoulders.
- H. When the subgrade is being prepared for construction of a portland cement concrete base or portland cement concrete pavement, it shall be formed to the approximate grade and cross section. Preparation of the subgrade shall be performed in conformity with requirements set out in the section covering the particular type of construction.

3.3 SUBGRADE COMPACTION

- A. After the subgrade has been approximately prepared and shaped, it shall be loosened in its entirety by discing, harrowing or other approved methods to a depth of not less than 6

inches prior to its being compacted to the approved density. The subgrade shall then be thoroughly compacted with the 10-ton roller or pneumatic tired roller. The density shall be 100 percent of the maximum density as determined by ASTM D698. The limits of the subgrade compaction shall extend across the entire section upon which any base or subbase course is to be applied, including the shoulders. Prior to reworking and compacting the subgrade, all vegetation within the limits as set out above shall be removed and properly disposed of.

- B. All soft, yielding material, which will not compact readily under the roller, shall be removed. All holes or depressions caused by the removal of material, as described above, shall be backfilled with satisfactory material and the entire surface thoroughly compacted with the roller.
- C. The subgrade shall be checked after the rolling and adjusted so as to conform to the grade and cross section.
- D. The final rolling of the subgrade, preparatory to construction of the portland cement concrete base or pavement thereon, shall be performed between the forms after they are finally set to line and grade.

3.4 SCOPE OF SUBGRADE

- A. The subgrade shall be true to lines, grades, and cross sections; must be free from dust or other loose material; must have a uniform bearing power; and shall be prepared and maintained at least 500 feet in advance of the placing of any materials thereon, except between November 1 and April 1 the distance may be reduced to 200 feet.

3.5 DRAINAGE

- A. Grading of the subgrade shall be performed in such a manner that there will not remain on the roadbed, at any time, berms of earth or other material which will interfere with the immediate drainage of water from the subgrade of the side ditches. All side ditches and drains shall be maintained to provide for proper drainage during the construction.
- B. All ditches and drains shall be completed so as to drain the roadbed effectively before the placing of any construction materials will be permitted.

3.6 PROTECTION OF SUBGRADE

- A. In handling materials, equipment, tools, etc., the Contractor shall take all precaution necessary to protect the subgrade from damage. Only hauling necessary for the purpose of construction will be permitted on the subgrade after it has been completed.
- B. If ruts of 2 inches or more in depth are formed in the subgrade, all construction materials, whether stored or in place, within the range of such ruts, shall be removed and the subgrade shall be reshaped and rolled. All ruts or rough places developing in a completed subgrade shall be smoothed and the subgrade rerolled.

3.7 SUBGRADE CHECKING

- A. Subgrade must conform to the lines, grades, and cross sections indicated before it will be permitted to construct base or pavement thereon, and shall be subject to test just prior to construction.
- B. All excess material shall be removed until the subgrade is at true elevation. Low subgrade shall be built up to the proper form and elevation when practical to roll, or if not practical to roll, it shall be filled as an integral part of the base or pavement at the Contractor's expense.

** END OF SECTION **

SECTION 02228
GRADED AGGREGATE BASE

1 GENERAL

1.1 SCOPE

- A. This work includes constructing a base course composed of mineral aggregates according to these Specifications and to the lines, grades, thickness, and typical cross-sections shown on the Plans or established by the Engineer.

2 PRODUCTS

2.1 MATERIALS

- A. Use materials from a central plant meeting the requirements for Graded Aggregate Base as contained in Section 815 of the Georgia Department of Transportation Standard Specification.

3 EXECUTION

3.1 EQUIPMENT

- A. All equipment necessary or required in connection with this type of construction must be on hand, proven to be in satisfactory working condition, and approved by the Engineer before this construction will be permitted to begin.
- B. Vibrating, tamping, or other type rollers which will produce the specified density and desired results as to finished surface may be used.

3.2 BASE CONSTRUCTION

- A. Check Subgrade before placing Graded Aggregate Base as follows:
 - 1. Proof roll the subgrade with a loaded dump truck. The subgrade must support construction equipment without excessive movement regardless of compaction.
 - 2. Rework unstable areas of subgrade to a moisture content that will provide stability and compaction. Ensure that the subgrade can firmly support construction equipment before placing subsequent layers of base and paving materials.
 - 3. Blade the surface of the completed subgrade to a smooth and uniform texture.
- B. Spread base material to obtain the required compacted thickness, using a mechanical mixture spreader. Do not use materials containing frost or frozen materials. Lay one course to the proposed compacted thickness shown on plans. No graded aggregate shall be placed if the moisture content of the material exceeds two percent of the optimum moisture content.
- C. Use the following steps to compact and finish the base:
 - 1. Ensure that the moisture content of materials is uniformly distributed and allows compaction to the specified density.
 - 2. After shaping the material to line, grade, and cross-section, roll to uniformly compact the course to at least 100 percent of the maximum dry density.
 - 3. Regardless of compaction, ensure that the compacted base is sufficiently stable to support construction equipment without pumping. If the base material is unstable from too much moisture, dry and rework the base material. Dry and rework the underlying subgrade, if necessary.
 - 4. After compaction, re-shape to the required grade, line, and cross-section.
 - 5. Add water as necessary to develop the proper moisture content and roll until the surface is smooth, closely knit, and free of cracks.

6. Correct all defects according to Subsection 300.3.06.B, "Repairing Defects" in Georgia Department of Transportation Standard Specification
7. In places inaccessible to the roller, obtain the required compaction with mechanical tampers approved by the Engineer.
8. Apply bituminous prime coat after quality control checks are completed and the base is approved for acceptance.

3.3 QUALITY CONTROL

- A. Determine the maximum dry density from representative samples of compacted material, according to AASHTO T180, Method D.
- B. Determine the in-place density of finished courses according to GDT 21 or GDT 59, where applicable.
- C. Check the finished surface of the base, subbase, or shoulder course as follows:
 1. Check the longitudinal surface using a 15 ft straightedge parallel to the centerline.
 2. Check the transverse surface by using one of the following tools:
 - a. A template, cut true to the required cross-section and set with a spirit level on non-superelevated sections.
 - b. A system of ordinates, measured from a stringline.
 - c. A surveyor's level.
 3. Check finished base surface to ensure that ordinates measured from the bottom of the template, stringline, or straightedge, to the surface do not exceed $\frac{1}{4}$ inch at any point.
 4. Correct any variations from these requirements immediately according to Georgia Department of Transportation Standard Specification subsection 300.3.06.B, "Repairing Defects." Section 310—Graded Aggregate Construction.
- D. Check finished thickness for the following tolerances.
 1. If any measurement is deficient in thickness more than $\frac{1}{2}$ inch take additional measurements to determine the deficient area.
 2. Correct any area deficient between $\frac{1}{2}$ inch and 1 inch to the design thickness by using one of the following methods according to these Specifications: (a) Add additional quantities of the same materials and reconstruct to the required thickness. (b) Leave in place and accept payment for the materials and area at $\frac{1}{2}$ the Contract Unit Price for the deficient area.
 3. Correct any area deficient in thickness by more than 1 inch by adding additional quantities of the same material and reconstructing to the required thickness in accordance with these Specifications.

3.4 MAINTENANCE AND PROTECTION

- A. After the roadway has been satisfactorily completed, it shall be maintained, under travel, smooth and uniform until the base has been completed and accepted.
- B. The maximum speed of trucks when hauling or traveling over any part of the project under construction shall be 20 miles per hour.

** END OF SECTION **

SECTION 02271

RIPRAP

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to furnish, place, and set rock riprap as shown on the drawings and/or specified herein.
- B. Riprap shall be placed on slopes of embankments or other surfaces or around structures as protection against the erosive action of water.
- C. Where shown on the drawings, a filter blanket course of crushed rock, or sand and gravel, or an approved filter fabric shall be placed under the riprap.

1.2 SUBMITTALS

- A. The Contractor shall provide the Engineer with written evidence in the form of mill test reports or test reports from a qualified testing laboratory that all sands, cements, and filter blanket materials used conform to the applicable requirements of this specification section.
- B. When requested by the Engineer, the Contractor shall furnish representative samples of rock riprap material for classification, gradation, or other tests as the Engineer may direct.

2 PRODUCTS

2.1 ROCK RIPRAP

- A. Rock riprap shall be constructed using sound, dense, durable stones, or rock fragments, free from cracks, pyrite intrusions and other structural defects. Stones which will be used with mortar shall be free from dirt, oil, or other material that might prevent good adhesion with the mortar. Stones with a laminated structure shall be avoided.
- B. When the crushed aggregate is subjected to five alternations of the sodium sulfate soundness test, the weighted percentage of loss shall be not more than 12 percent.
- C. Shape of the stones shall be generally rectangular or cubic. Flat or elongated stones having a small dimension less than 1/3 of the large dimension shall not be used.
- D. At least 35 percent of the stones or rock fragments for plain rock riprap shall weigh 75 pounds or more. The sizes of the stones shall be well graded from the smaller to the larger, with the largest stones being a maximum of two cubic feet in size. Stone shall be Type I as per section 805.01 of Georgia Department of Transportation Standard Specifications, latest edition.
- E. At least 90 percent of the stones or rock fragments for hand placed rock riprap shall weigh 50 pounds or more and shall be not less than 12 inches long, 12 inches deep, and 8 inches wide.

2.2 FILTER BLANKET MATERIAL

- A. Filter blanket material shall consist of fragments of sound, durable stone or crushed rock, free from disintegrated stone, alkali, salt, vegetable matter, or adherent coating. Aggregate shall be reasonably free from thin or elongated pieces. The percentage of wear of the aggregate as outlined in AASHTO Test No. T-96 shall not exceed 7 percent.
- B. Aggregate shall have the following gradation:

Sieve Size	Total Percent Passing by Weight
1 1/4	100
1	95-100
3/4"	70-100
3/8"	50-85
No. 4	33-65
No. 10	20-45
No. 40	8-25
No. 200	0-10

- C. The material finer than the No. 10 sieve shall be of such characteristics and gradation that will prevent the mass from setting up or becoming cemented together.

3 EXECUTION

3.1 EQUIPMENT

- A. All equipment necessary for the satisfactory performance of the work shall be on hand before construction will be permitted to begin.
- B. The equipment shall include wooden or metal tamps of sufficient weight and number to properly compact the slopes on which the riprap or slope pavement is to be placed.
- C. Equipment for mixing cement grout shall include a mechanical mixer or, if the Engineer approves hand mixing for cement grout, a watertight mixing platform or mixing box of adequate size.

3.2 PREPARATION OF FOUNDATION

- A. Immediately prior to the construction of riprap, the slopes or ground surface shall be trimmed within reasonably close conformity to the lines and grades indicated on the drawings, and shall be thoroughly compacted by the use of hand or mechanical tamps.
- B. On slopes, the bottom of the riprap shall be placed at least 2 feet below the natural ground surface, unless otherwise shown or directed.
- C. No material shall be placed on a frozen or otherwise unsuitable slope.

3.3 PLACEMENT OF FILTER BLANKET

- A. Where shown on the drawings, a filter blanket course shall be placed under the riprap on the prepared subgrade.
- B. Filter blanket shall be placed immediately prior to placement of riprap. Compaction of the filter blanket is not required except where called for by the Engineer.
- C. Where specifically permitted by a Soils Engineer, a synthetic filter fabric may be substituted for the filter blanket course. Filter fabric shall be especially designed for use as slope stabilization under riprap and shall be acceptable to the Soils Engineer. Placement of filter fabric shall be in strict conformance with the manufacturer's written instructions and recommendations.

3.4 CONSTRUCTION OF PLAIN ROCK RIPRAP

- A. Unless otherwise shown or specified, plain rock riprap shall be constructed using a crane and clam-shell. The rock shall be placed as nearly as practicable in final position using powered equipment. If necessary, larger rocks shall be worked up to the surface when the material on the surface does not meet the weight specification or when the voids next to the foundation material are too large.

- B. The quantity of small stones shall be kept as low as possible, sufficient only to fill the voids between the larger stones. Care shall be taken that this small material is well distributed throughout the mass and not allowed to segregate or form pockets of small stone. All bridging shall be broken down. Large interstices, or open channels, or voids shall be filled by chinking or otherwise manipulating the stones.
- C. When riprap is to be built on existing riprap, special care shall be taken to provide positive anchorage of the new riprap to the existing riprap.
- D. The finished riprap surface shall in general conform to the slope lines shown on the drawings. No objectionable, hazardous, or unsightly projections above the general plane surface will be permitted.
- E. The main stones shall be thoroughly chinked and filled with the smaller stones by throwing them over the surface in any manner that is practicable for the smaller stones to fill the voids. This work shall continue with the progress of the construction. Tamping of the stones will not be required if the stones have been placed in a reasonable and satisfactory manner.
- F. Knapping of the stones will not be required except stone protruding more than 4 inches above what is considered the normal surface of the stones, in which case these stones shall be broken down to come within 4 inches of the normal surface.

3.5 CONSTRUCTION OF HAND PLACED, PLAIN ROCK RIPRAP

- A. Hand placed plain rock riprap shall be constructed upon the prepared foundation by hand placing so that the stones shall be as close together as is practicable in order to reduce the voids to a minimum. Construction of riprap on sloped surfaces shall begin at the bottom and shall progress upward in approximately horizontal layers.
- B. When rock riprap is constructed in more than one layer, it shall be so placed that it will be thoroughly tied together with the larger stones protruding from one layer into the other.
- C. The standard depth of rock riprap shall be 12 inches unless otherwise indicated or directed and in no instance shall be less than 10 inches in depth. Rock riprap shall have an average depth for each 25 square feet of surface of not less than 12 inches.
- D. Each stone shall be so placed that the depth will be perpendicular to the surface upon which it is set. The length shall be placed so that it will be against the adjoining stones. The stones shall be placed in such a manner as to stagger all joints as far as it is possible and practicable.
- E. The main stones shall be thoroughly chinked and filled with the smaller stones by throwing them over the surface in any manner that is practicable for the smaller stones to fill the voids. This work shall continue with the progress of the construction. Tamping of the stones will not be required if the stones have been placed in a reasonable and satisfactory manner.
- F. Knapping of the stones will not be required except stone protruding more than 4 inches above what is considered the normal surface of the stones, in which case these stones shall be broken down to come within 4 inches of the normal surface.

3.6 PROTECTION OF STRUCTURES

- A. All structures shall be carefully protected from damage by equipment or impact of stones or blocks. All damage shall be corrected by the Contractor at his own expense.

** END OF SECTION **



SECTION 02290
FILTER FABRIC

1 GENERAL

1.1 DESCRIPTION

- A. Provide installation of filter fabric as specified or shown to separate soil from aggregate courses or to contain or stabilize aggregate placed at foundation or subbase levels.

1.2 SUBMITTALS

- A. Submit manufacturer's certification that requirements for materials, manufacture and tolerance are in compliance as specified.
- B. Submit a manufacturer's certificate prior to shipment, which includes:
 - 1. Name of manufacturer
 - 2. Chemical composition
 - 3. Product description
 - 4. Statement of compliance to specification requirements
 - 5. Signature of legally authorized official attesting to the information required.

1.3 QUALITY ASSURANCE

- A. Producer of geotextile to maintain competent laboratory at point of manufacture to insure quality control in accordance with ASTM testing procedures. Laboratory shall test and certify results according to ASTM testing procedures and shall maintain records of quality control results.
- B. The manufacturer shall file with the purchaser a certificate stating the name of the manufacturer, the chemical composition of the filaments, and other pertinent information so as to fully describe the geotextile. A copy of the certificate shall be provided to the Engineer. Each roll of fabric in the shipment shall be labeled with a number or symbol to identify that production run and to tie the roll to the manufacturer certificate.
- C. Take all necessary precautions to protect geotextile from damage resulting from any cause. Either repair or replace geotextile to Engineer's satisfaction at no additional expense to the Owner.
- D. The filter fabric shall be provided in rolls, wrapped with protective covering to protect from mud, dust, dirt, debris, and light. During periods of shipment and storage, the filter fabric will be kept wrapped until ready for installation. Rolls shall be labeled so as not to allow damage due to lifting devices or other equipment.
- E. The filter fabric shall be free of defects or flaws that affect its physical or chemical properties.
- F. Filter fabric shall not be stored directly on the ground. Rolls of the filter fabric shall be stored under cover, outside on racks supporting the roll at least 6 inches off the ground.
- G. Partial rolls shall be labeled as such; any rolls partially used shall not remain uncovered or unwrapped for over 48 hours.

2 EXECUTION

2.1 MANUFACTURERS

- A. Filter fabric shall be non-biodegradable, non-woven needle punched felt as with properties equal to Amoco 4553, Linq 180EX, Mirafi 180N or other approved equivalent fabric having a minimum average roll weight of 7.5 oz./sq. yard.

3 EXECUTION

3.1 PREPARATION OF FOUNDATION

- A. Prior to the installation of riprap, the slopes or ground surface shall be trimmed within reasonably close conformity to the lines and grades indicated on the Drawings.
- B. Subgrade shall be thoroughly compacted by the use of hand or mechanical tamps.
- C. Subgrade shall be approved by the Engineer prior to placement of riprap.

3.2 PLACEMENT OF FABRIC AND STONE

- A. No material shall be placed on a frozen or otherwise unsuitable slope.
- B. Place filter fabric over approved subgrade, lap edges and ends, a minimum of 24 inches.
- C. Place stone filter over filter fabric to the thickness indicated on the drawings.
- D. Stone filter shall be dumped on top of previously placed stone, unless the size of the area prohibits, and spread to a uniform thickness. Dumping of the stone directly on the filter fabric should be avoided.
- E. No construction vehicles or equipment will be allowed directly on the fabric.
- F. Place stone evenly and carefully in one consistent operation to preclude disturbance or displacement of substrate.

** END OF SECTION **

SECTION 02491

DEWATERING

1 GENERAL

1.1 DESCRIPTION

- A. Construct all permanent work in areas free from water. Design, construct and maintain all dikes, levees, cofferdams and diversion and drainage channels as necessary to maintain the areas free from water and to protect the areas to be occupied by permanent work from water damage. Remove temporary works after they have served their purpose.
- B. The Contractor shall be responsible for the stability of all temporary and permanent slopes, grades, foundations, materials and structures during the course of the Contract. Repair and replace all slopes, grades, foundations, materials and structures damaged by water, both surface and subsurface, to the lines, grades and conditions existing prior to the damage at no additional cost to the Owner.

2 EXECUTION

2.1 CARE OF WATER

- A. Except where the excavated materials are designated as materials for permanent work, material from required excavation may be used for dikes, levees, cofferdams and other temporary backfill.
- B. Furnish, install, maintain and operate necessary pumping and other equipment for dewatering the various parts of the Work and for maintaining the foundation and other parts free from water as required for constructing each part of the work.
- C. Install all drainage ditches, sumps and pumps to control excessive seepage on excavated slopes, to drain isolated zones with perched water tables, and to drain impervious surfaces at final excavation elevation.
- D. After they have served their purpose, remove all temporary protective work at a satisfactory time and in a satisfactory manner. All diversion channels and other temporary excavations in areas where the compacted fill or other structures will be constructed shall be cleaned out, backfilled and processed under the same specifications as those governing the compacted fill.
- E. When the temporary works will not adversely affect any item of permanent work or the planned usage of the Project, the Contractor may be permitted to leave such temporary works in place. In such instances, breaching of dikes, levees and cofferdams may be required.

** END OF SECTION **



SECTION 02510
PAVEMENT

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install asphaltic concrete pavement complete and repairing any existing asphaltic concrete pavement that is damaged by the contractor during the construction project.

1.2 QUALITY ASSURANCE

- A. Use only materials which are furnished by a bulk asphalt concrete producer regularly engaged in production of hot-mix, hot-laid asphalt concrete and approved by the Georgia DOT.
- B. Comply with the requirements of the Georgia DOT Standard Specifications, latest edition.
- C. Testing of pavements shall be done by a soil testing laboratory as required by the specifications. The Contractor shall correct any deficiencies in material makeup, strength or quantities revealed by testing.

1.3 CONDITIONS

- A. Weather Limitations
 - 1. Apply bituminous tack coats only when the ambient temperature in the shade is greater than or equal to 40°F.
 - 2. Do not conduct paving operations when surface is wet, frozen or contains excess of moisture which would prevent uniform distribution and required penetration.
 - 3. Construct asphaltic courses only when atmospheric temperature in the shade is greater than or equal to 35°F and the temperature is rising, when the underlying base is dry, and when the weather is dry.
- B. Grade Control: Establish and maintain the required lines and grades for each course during construction operations.

2 PRODUCTS

2.1 MATERIALS

- A. All materials used shall meet the appropriate physical test requirements of the latest edition of Georgia Department of Transportation Standard Specifications for Construction of Roads and Bridges.
- B. Base material shall be Group II, graded aggregate as specified in Section 815 of the Georgia DOT Standard Specifications.
- C. Asphaltic concrete binder course material shall be 19-mm superpave as specified in Section 828 of the Georgia DOT Standard Specifications.
- D. Asphaltic surface course material shall be 9.5-mm superpave as specified in Section 828 of the Georgia DOT Standard Specifications.
- E. Bituminous material for tack coat shall be as specified in Section 413 of the Georgia DOT Standard Specifications. Tack coat shall be applied at a rate of 0.07 gallons per square yard.
- F. Stabilizer aggregate shall be Type III as specified in Section 803 of the Georgia DOT Standard Specifications.

3 EXECUTION

3.1 EXISTING PAVEMENT

- A. Where new pavement will intersect existing pavement, the existing pavement shall be saw cut in a straight line along the entire length of the intersecting surface to produce a uniform and clean surface at the joint.

3.2 SUBGRADE PREPARATION

- A. Before paving, the entire surface of the subgrade shall be plowed, harrowed, and mixed to a depth of 6 inches minimum. If stabilizer aggregate is required by the Engineer, it shall be mixed into the subgrade at this time at the specified rate. After the material has been thoroughly mixed, the subgrade shall be brought to line and grade and compacted to 100 percent of the maximum dry density as determined by the ASTM D698. Surface of the finished subgrade shall have a smooth and uniform texture.
- B. The contractor shall protect subgrade from damage and maintain it in a smooth, compact, and rut-free condition until the base course has been placed.

3.3 PAVING BASE COURSE

- A. Paving base course shall be constructed of GAB and construction shall be done in accordance with Section 310 of the Georgia DOT Standard Specifications.

3.4 BITUMINOUS PAVING

- A. Bituminous paving shall be hot mix asphaltic concrete construction conforming to Section 400 of the Georgia DOT Standard Specifications.
- B. The job mix formula shall be submitted by the Contractor to the Engineer for his approval, and such approval does not relieve the Contractor of his responsibilities for adequacy and warranty of the paving.
- C. Bituminous concrete pavement shall be applied with suitable mechanical spreaders so that the whole roadway or paved area shall have a true and uniform surface, and the pavement shall conform to the proper grade and cross section. Finish pavement shall have no depressions that detain runoff.
- D. Set frames of drainage structures and miscellaneous castings to final grade in an approved manner.
- E. All joints between new and existing asphalt or new asphalt and new or existing concrete surfaces shall be sealed with a bituminous joint sealer.

3.5 PROTECTION

- A. Immediately after placement, protect pavement from damage until surface is sufficiently hardened for traffic.

3.6 SURFACE MAINTENANCE

- A. Until the expiration of the guarantee period, the Contractor shall maintain surfacing placed under this Contract and shall promptly correct all defects such as cracks, depressions, and holes that occur. At all times, the surfacing shall be kept in a safe and satisfactory condition for traffic. If defects occur in surfacing constructed by the contractor, the Contractor shall remove all bituminous concrete and base course as is necessary to properly correct the defect. The Contractor shall replace the base course and bituminous concrete in accordance with the requirements of these specifications.

** END OF SECTION **

SECTION 02601
MANHOLES

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test pre-cast concrete manholes as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. Prior to delivery all basic materials specified herein shall be tested and inspected by an approved independent commercial testing laboratory or certified copies of test reports prepared by the manufacturer's testing laboratory will be acceptable. All materials which fail to conform to these specifications shall be rejected.
- B. After delivery to the site, any materials which have been damaged in transit or are otherwise unsuitable for use in the work shall be rejected and removed from the site.

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Shop Drawings, Product Data, and Samples.

1.4 STORAGE AND PROTECTION

- A. All manhole materials shall be stored and protected in accordance with the requirements of the manufacturers, this section, and Section 01620, Product Storage and Handling Requirements.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, Warranties.

2 PRODUCTS

2.1 MATERIALS

A. Precast Manholes

- 1. Precast concrete manholes in accordance with ASTM C478.
- 2. Concrete Compressive Strength: 4,000 PSI @ 28 days.
- 3. Tongue and groove joints with preformed butyl joint seals.

B. Preformed Butyl Joint Seal

- 1. Preformed butyl joint seals shall be in accordance with ASTM C990.
- 2. Preformed butyl joint seals shall be provided in rope form.
- 3. Acceptable Manufacturers:
 - a. Hamilton Kent, Inc. (Kent Seal No. 2)
 - b. Henry Company (Ram-Nek Joint Sealant)
 - c. Press-Seal Gasket Corporation (EZ-STIK)
 - d. Engineer Approved Equal

C. Joint Wrap

- 1. Extruded Butyl exterior joint wrap in accordance with ASTM C877.
- 2. Width: 9-inches

3. Acceptable Manufacturers:
 - a. Press Seal Corporation
 - b. Sealing Systems, Inc.
 - c. Engineer Approved Equal
- D. Pipe-to-Manhole Connectors
 1. Pipe-to-manhole connectors shall be resilient connectors with stainless steel clamps in accordance with ASTM C923.
 2. Acceptable Manufacturers:
 - a. A-Lok Products, Inc.
 - b. Trelleborg Pipe Seals Milford, Inc. (Kor-N-Seal)
 - c. Engineer Approved Equal
- E. Manhole Steps
 1. Manhole steps shall be copolymer polypropylene type with ½" Grade 60 steel reinforcing rod conforming to ASTM C478.
 2. Acceptable Manufacturers:
 - a. American Step Company, Inc.
 - b. M. A. Industries, Inc.
 - c. Engineer Approved Equal
- F. Frames and Covers
 1. Frames and covers shall be heavy duty ductile iron castings.
 2. Acceptable Manufacturers:
 - a. Standard Manhole Frame and Covers for sanitary sewer manholes:
 - 1) U.S. Foundry, Model 362-CK
 - 2) East Jordan Iron Works, Model 1480-1
 - 3) Engineer Approved Equal
 - b. Bolt-down Manhole Frame and Covers for sanitary sewer manholes:
 - 1) U.S. Foundry, Model 362-CK-BWT
 - 2) East Jordan Iron Works, Model V-2480-1
 - 3) Engineer Approved Equal
 3. Manhole frames shall be cast into manhole cones.
 4. All sanitary sewer manhole covers shall have the words "SANITARY SEWER" cast on the top in 2-inch letters.
 5. All storm water manhole covers shall have the words "STORM WATER" cast on the top in 2-inch letters.

3 EXECUTION

3.1 INSTALLATION

- A. Manholes shall be set plumb in the locations shown on the plans.
- B. Manholes shall be placed on top of a minimum of twelve (12) inches of No. 57 stabilization stone. No. 57 stabilization stone shall extend a minimum of twelve (12) inches beyond the outside of the structure in all directions. Unsuitable ground conditions may require additional and/or larger stabilization stone.

- C. Manholes shall be positioned such that the influent and effluent pipes enter the center of their respective openings and do not pinch the resilient seal. Pipe shall not rest on the invert of the opening.
- D. Prior to joining sections, tongue and groove joints shall be cleaned free of dirt and debris.
- E. Manhole sections shall be aligned such that the interior manhole steps are vertically aligned.
- F. Resilient pipe seal clamps shall be tightened in accordance with the manufacturer's instructions.
- G. Manhole lifting holes shall be sealed using non-shrink grout throughout the entire depth of the hole.
- H. Manhole joints shall be sealed with non-shrink grout and wrapped with a Butyl joint seal.
- I. Manholes shall be backfilled with select earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 95 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.
- J. An invert shall be built in each manhole to transition flow from the influent pipe to the effluent pipe. The invert shall have a "U" shape.

** END OF SECTION **



SECTION 02960
TEMPORARY BYPASS PUMPING

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory temporary bypass pumping operations for the purpose of diverting the existing wastewater flows around the work area for the duration of the project.
- B. The design, installation and operation of the temporary pumping system shall be the Contractor's responsibility. The Contractor shall employ the services of a vendor who specializes in the design and operation of temporary bypass pumping systems.

1.2 QUALITY ASSURANCE

- A. Temporary bypass pumping system shall be a complete turnkey system consisting of pumps, piping, controls, and all appurtenances required for a complete system.
- B. Temporary bypass pumping system shall meet the requirements of all codes and regulatory agencies having jurisdiction.
- C. Perform leakage and pressure test on discharge piping using clean water prior to placing system into service. Engineer shall witness test.
- D. Maintain and inspect temporary pumping system a minimum of every two (2) hours while the system is in operation.
- E. A responsible operator shall be on hand at all times when pumps are operating.
- F. Keep and maintain spare parts for pumps and piping on site as required.
- G. Maintain adequate hoisting equipment and accessories on-site for each pump.

1.3 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, the following:
 - a. Plan showing staging area(s) for pumps.
 - b. Descriptions of sewer plugging/channel blocking methods.
 - c. Number, size, material, location and method of installation of suction piping.
 - d. Number, size, material, location and method of installation of discharge piping.
 - e. Bypass pump sizes, capacity, and number of each size to be onsite.
 - f. Power requirements.
 - g. A complete description of the control system that will be utilized to control the temporary bypass pumping operation.
 - h. Calculations of static lift, friction losses, and flow velocity (pump curves showing pump operating range shall be submitted).
 - i. Standby power generator size and location.
 - j. Downstream discharge plan.
 - k. Thrust and restraint block sizes and locations.

- l. Sections showing suction and discharge pipe depth, embedment, select fill and special backfill.
- m. Method of noise control for each pump and/or generator.
- n. Any temporary pipe supports and anchoring required.
- o. Calculations for selection of bypass pumping pipe size(s).
- p. Schedule for installation of and maintenance of bypass pumping system.
- q. Emergency plan detailing procedures to be followed in the event of pump failures, sewer overflows, service backups, and sewage spills. Maintain copy of emergency plan on-site for duration of project.

2 PRODUCTS

2.1 PIPE

- A. Abrasion resistant flexible hoses suitable for intended service.

2.2 PUMPS

A. General

- 1. Pumps shall be fully automatic, self-priming units that do not require the use of foot-valves or vacuum pumps in priming system.
- 2. Pumps shall be electric or diesel fuel powered.
- 3. Pumps shall be capable of running dry for long periods of time to accommodate cyclical nature of sanitary sewer flows.

B. Design Requirements

- 1. Provide a minimum of three (3) pumps, two (2) duty and one (1) standby, to meet the following design conditions:
 - a. Peak flow rate with two (2) pumps operating = 2,400 GPM @110 feet TDH.
 - b. Minimum flow rate with one (1) pump operating = 1,200 GPM @ 97 feet TDH.
- 2. Temporary bypass pumping system shall be designed to operate 24-hours per day.

2.3 CONTROLS

- A. Provide a control panel for the temporary bypass pumping system. Control panel shall have all controls required to operate the temporary bypass pumping system and shall have a light and horn for alarms.
- B. Provide alarms for the temporary bypass pumping system to monitor high water level and low water level, pump failure, and any other critical alarms.
- C. Provide an auto dialer with cellular phone service to notify the contractor and vendor of an alarm condition.

3 EXECUTION

3.1 INSTALLATION

- A. Install temporary bypass pumping system in accordance with the approved plan.
- B. Support piping and provide ramps and barriers as necessary to prevent trip hazards and damage to pipe. Do not block access to existing facilities.
- C. Contractor shall provide all plugs, cofferdams, etc. required for the work.
- D. Temporary bypass pumping system shall operate for a minimum of 24-hours without failure prior to taking the existing facilities out of service.

3.2 OPERATION

- A. Contractor shall be responsible for maintaining the temporary bypass pumping system including providing fuel for the operation of the system.
- B. Contractor shall keep the area around the temporary bypass pumping system clean at all times and shall be responsible for cleaning all spills. If any wastewater spill occurs as a result of Contractor negligence, the Contractor shall be responsible for paying all fines levied as a result of the spills.

3.3 REMOVAL

- A. After temporary bypass pumping operation is complete, remove all temporary bypass pumping facilities and restore all areas to preexisting conditions.

3.4 MEASUREMENT AND PAYMENT

- A. All costs for temporary bypass pumping operations shall be included in the Lump Sum bid cost.

** END OF SECTION **



SECTION 03200
CONCRETE REINFORCEMENT

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all concrete reinforcement complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Cast-in-place Concrete is included in Section 03300.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Reinforcing steel. Placement drawings shall conform to the recommendations of ACI 315. All reinforcement in a concrete placement shall be included on a single placement drawing or cross referenced to the pertinent main placement drawing. The main drawing shall include the additional reinforcement (around openings, at corners, etc) shown on the standard detail sheets. Bars to have special coatings and/or to be of special steel or special yield strength are to be clearly identified. For all cast-in-place concrete tanks, retaining walls, building stem walls, wall sections shall be included in the drawings.
 - 2. Bar bending details. The bars shall be referenced to the same identification marks shown on the placement drawings.
 - 3. Schedule of all placements to contain synthetic reinforcing fibers. The amount of fibers per cubic yard to be used for each of the placements shall be noted on the schedule. The name of the manufacturer of the fibers and the product data shall be included with the submittal.
- B. Submit Test Reports, in accordance with Section 01300, of each of the following items.
 - 1. Certified copy of mill test on each steel proposed for use showing the physical properties of the steel and the chemical analysis.
 - 2. Welder's certification. The certification shall be in accordance with AWS D1.4 when welding of reinforcement required.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
 - 2. ASTM A184 - Standard Specification for Fabricated Deformed Steel Bar Mats for Concrete Reinforcement.
 - 3. ASTM A185 - Standard Specification for Steel Welded Wire Fabric, Plain, for Concrete Reinforcement
 - 4. ASTM A496 - Standard Specification for Steel Wire, Deformed, for Concrete Reinforcement
 - 5. ASTM A497 - Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement
 - 6. ASTM A615 - Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement
 - 7. ASTM A616 - Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement

8. ASTM A617 - Standard Specification for Axle-Steel Deformed and Plain Bars for Concrete Reinforcement
9. ASTM A706 - Standard Specification for Low-Alloy Steel Deformed and Plain Bars for Concrete Reinforcement.
10. ASTM A767 - Standard Specification for Zinc-Coated (Galvanized) Steel Bars for Concrete Reinforcement
11. ASTM A775 - Standard Specification for Epoxy-Coated Reinforcing Steel Bars.
12. ASTM A884 - Standard Specification for Epoxy-Coated Steel Wire and Welded Wire Fabric for Reinforcement.
13. ASTM A934 - Standard Specification for Epoxy-Coated Prefabricated Steel Reinforcing Bars.

B. American Concrete Institute (ACI)

1. ACI 301 - Standard Specification for Structural Concrete
2. ACI 315 - Details and Detailing of Concrete Reinforcement.
3. ACI 318 - Building Code Requirements for Structural Concrete
4. ACI SP-66 - ACI Detailing Manual

C. Concrete Reinforcing Steel Institute (CRSI)

1. Manual of Standard Practice

D. American Welding Society (AWS)

1. AWS D1.4 - Structural Welding Code Reinforcing Steel

- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Provide services of a manufacturer's representative, with at least 2 years experience in the use of the reinforcing fibers for a preconstruction meeting and assistance during the first placement of the material.

1.6 DELIVERY, HANDLING AND STORAGE

- A. Reinforcing steel shall be substantially free from mill scale, rust, dirt, grease, or other foreign matter.
- B. Reinforcing steel shall be shipped and stored with bars of the same size and shape fastened in bundles with durable tags, marked in a legible manner with waterproof markings showing the same "mark" designations as those shown on the submitted Placing Drawings.
- C. Reinforcing steel shall be stored off the ground and kept free from dirt, oil, or other injurious contaminants.

2 PRODUCTS

2.1 MATERIALS

- A. Materials shall be new, of domestic manufacture and shall comply with the following material specifications.
- B. Deformed Concrete Reinforcing Bars: ASTM A615, Grade 60 deformed bars.
- C. Concrete Reinforcing Bars required on the Drawings to be Welded: ASTM A706.
- D. Welded Steel Wire Fabric: ASTM A185. Provide in flat sheets.
- E. Welded Deformed Steel Wire Fabric: ASTM A497.
- F. Welded Plain Bar Mats: ASTM A704 and ASTM A615 Grade 60 plain bars.

- G. Fabricated Deformed Steel Bar Mats: ASTM A184 and ASTM A615 Grade 60 deformed bars.
- H. The following alternate materials are allowed:
 - 1. ASTM A615 Grade 60 may be used for ASTM A706 provided the following requirements are satisfied:
 - a. The actual yield strength of the reinforcing steel based on mill tests shall not exceed the specified yield strength by more than 18,000 psi. Retests shall not exceed this value by more than an additional 3000 psi.
 - b. The ratio of the actual ultimate tensile strength to the actual tensile yield strength of the reinforcement shall not be less than 1.25.
 - c. The carbon equivalency (CE) of bars shall be 0.55 or less.
- I. Reinforcing Steel Accessories
 - 1. Plastic Protected Bar Supports: CRSI Bar Support Specifications, Class 1 - Maximum Protection.
 - 2. Stainless Steel Protected Bar Supports: CRSI Bar Support Specifications, Class 2 - Moderate Protection.
 - 3. Precast Concrete Block Bar Supports: CRSI Bar Support Specifications, Precast Blocks. Blocks shall have equal or greater strength than the surrounding concrete.
 - 4. Steel Protected Bar Supports: #4 Steel Chairs with plastic or rubber tips.
- J. Tie Wire
 - 1. Tie Wires for Reinforcement shall be 16-gauge or heavier, black annealed wire or stranded wire.
- K. Mechanical reinforcing steel butt splices shall be positive connecting taper threaded type employing a hexagonal coupler such as Lenton rebar splices as manufactured by Erico Products Inc., Solon, OH or equal. They shall meet all ACI 318 Building Code requirements. Bar ends must be taper threaded with coupler manufacturer's bar threader to ensure proper taper and thread engagement. Bar couplers shall be torqued to manufacturer's recommended value.
 - 1. Unless otherwise noted on the Drawings, mechanical tension splices shall be designed to produce a splice strength in tension or compression of not less than 125 percent of the ASTM specified minimum yield strength of the rebar.
 - 2. Compression type mechanical splices shall provide concentric bearing from one bar to the other bar and shall be capable of developing the ultimate strength of the rebar in compression.
- L. Fiber Reinforcement
 - 1. Synthetic reinforcing fiber for concrete shall be 100 percent polypropylene collated, fibrillated fibers as manufactured by Propex Concrete Systems Chattanooga, TN - Propex or equal. Fiber length and quantity for the concrete mix shall be in strict compliance with the manufacturer's recommendations as approved by the Engineer.

2.2 FABRICATION

- A. Fabrication of reinforcement shall be in compliance with the CRSI Manual of Standard Practice.
- B. Bars shall be cold bent. Bars shall not be straightened or rebent.
- C. Bars shall be bent around a revolving collar having a diameter of not less than that recommended by the ACI 318.
- D. Bar ends that are to be butt spliced, placed through limited diameter holes in metal, or threaded, shall have the applicable end(s) saw-cut. Such ends shall terminate in flat surfaces within 1-1/2 degrees of a right angle to the axis of the bar.

3 EXECUTION

3.1 INSTALLATION

- A. Surface condition, bending, spacing and tolerances of placement of reinforcement shall comply with the CRSI Manual of Standard Practice. The Contractor shall be solely responsible for providing an adequate number of bars and maintaining the spacing and clearances shown on the Drawings.
- B. Except as otherwise indicated on the Drawings, the minimum concrete cover of reinforcement shall be as follows:
 - 1. Concrete cast against and permanently exposed to earth: 3-in
 - 2. Concrete exposed to soil, water, sewage, sludge and/or weather: 2-in (Including bottom cover of slabs over water or sewage)
 - 3. Concrete not exposed to soil, water, sewage, sludge and/or weather:
 - a. Slabs (top and bottom cover), walls, joists, shells and folded plate members – 3/4-in
 - b. Beams and columns (principal reinforcement, ties, spirals and stirrups) - 1-1/2-in
- C. Reinforcement which will be exposed for a considerable length of time after being placed shall be coated with a heavy coat of neat cement slurry.
- D. No reinforcing steel bars shall be welded either during fabrication or erection unless specifically shown on the Drawings or specified herein, or unless prior written approval has been obtained from the Engineer. All bars that have been welded, including tack welds, without such approval shall be immediately removed from the work. When welding of reinforcement is approved or called for, it shall comply with AWS D1.4.
- E. Reinforcing steel interfering with the location of other reinforcing steel, conduits or embedded items, may be moved within the specified tolerances or one bar diameter, whichever is greater. Greater displacement of bars to avoid interference shall only be made with the approval of the Engineer. Do not cut reinforcement to install inserts, conduits, mechanical openings or other items without the prior approval of the Engineer.
- F. Securely support and tie reinforcing steel to prevent movement during concrete placement. Secure dowels in place before placing concrete.
- G. Reinforcing steel bars shall not be field bent except where shown on the Drawings or specifically authorized in writing by the Engineer. If authorized, bars shall be cold-bent around the standard diameter spool specified in the CRSI. Do not heat bars. Closely inspect the reinforcing steel for breaks. If the reinforcing steel is damaged, replace, Cadweld or otherwise repair as directed by the Engineer. Do not bend reinforcement after it is embedded in concrete unless specifically shown otherwise on the Drawings.

3.2 REINFORCEMENT AROUND OPENINGS

- A. Unless specific additional reinforcement around openings is shown on the Drawings, provide additional reinforcing steel on each side of the opening equivalent to one half of the cross-sectional area of the reinforcing steel interrupted by an opening. The bars shall have sufficient length to develop bond at each end beyond the opening or penetration.

3.3 SPLICING OF REINFORCEMENT

- A. Splices designated as compression splices on the Drawings, unless otherwise noted, shall be 30 bar diameters, but not less than 12-in. The lap splice length for column vertical bars shall be based on the bar size in the column above.
- B. Tension lap splices shall be provided at all laps in compliance with ACI 318. Splices in adjacent bars shall be staggered. Class A splices may be used when 50 percent or less of the bars are spliced within the required lap length. Class B splices shall be used at all other locations.

- C. Splicing of reinforcing steel in concrete elements noted to be "tension members" on the Drawings shall be avoided whenever possible. However, if required for constructability, splices in the reinforcement subject to direct tension shall be welded to develop, in tension, at least 125 percent of the specified yield strength of the bar. Splices in adjacent bars shall be offset the distance of a Class B splice.
- D. Install wire fabric in as long lengths as practicable. Wire fabric from rolls shall be rolled flat and firmly held in place. Splices in welded wire fabric shall be lapped in accordance with the requirements of ACI-318 but not less than 12-in. The spliced fabrics shall be tied together with wire ties spaced not more than 24-in on center and laced with wire of the same diameter as the welded wire fabric. Do not position laps midway between supporting beams, or directly over beams of continuous structures. Offset splices in adjacent widths to prevent continuous splices.
- E. Mechanical reinforcing steel splicers shall be used only where shown on the Drawings. Splices in adjacent bars shall be offset by at least 30 bar diameters. Mechanical reinforcing splices are only to be used for special splice and dowel conditions approved by the Engineer.

3.4 ACCESSORIES

- A. Determine, provide and install accessories such as chairs, chair bars and the like in sufficient quantities and strength to adequately support the reinforcement and prevent its displacement during the erection of the reinforcement and the placement of concrete.
- B. Use precast concrete blocks where the reinforcing steel is to be supported over soil.
- C. Stainless steel bar supports or steel chairs with stainless steel tips shall be used where the chairs are set on forms for a concrete surface that will be exposed to weather, high humidity, or liquid (including bottom of slabs over liquid containing areas). Use of galvanized or plastic tipped metal chairs is permissible in all other locations unless otherwise noted on the Drawings or specified herein.
- D. Alternate methods of supporting top steel in slabs, such as steel channels supported on the bottom steel or vertical reinforcing steel fastened to the bottom and top mats, may be used if approved by the Engineer.

3.5 INSPECTION

- A. In no case shall any reinforcing steel be covered with concrete until the installation of the reinforcement, including the size, spacing and position of the reinforcement has been observed by the Engineer and the Engineer's release to proceed with the concreting has been obtained. The Engineer shall be given ample prior notice of the readiness of placed reinforcement for observation. The forms shall be kept open until the Engineer has finished his/her observations of the reinforcing steel.

** END OF SECTION **



SECTION 03250
CONCRETE JOINS AND JOINT ACCESSORIES

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install accessories for concrete joints as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Cast-In-Place Concrete is included in Section 03300.
- D. Concrete Finishes are included in Section 03350.
- E. Grout is included in Section 03600.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data. Submittals shall include at least the following:
 - 1. Standard Waterstops: Product data including catalogue cut, technical data, storage requirements, splicing methods and conformity to ASTM standards.
 - 2. Special Waterstops: Product data including catalogue cut, technical data, location of use, storage requirements, splicing methods, installation instructions and conformity to ASTM standards.
 - 3. Premolded joint fillers: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
 - 4. Bond breaker: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
 - 5. Expansion joint dowels: Product data on the complete assembly including dowels, coatings, lubricants, spacers, sleeves, expansion caps, installation requirements and conformity to ASTM standards.
 - 6. Compressible joint filler: Product data including catalogue cut, technical data, storage requirements, installation requirements, location of use and conformity to ASTM standards.
 - 7. Bonding agents: Product data including catalogue cut, technical data, storage requirements, product life, application requirements and conformity to ASTM standards.
- B. Certifications
 - 1. Certification that all materials used within the joint system is compatible with each other.
 - 2. Certifications that materials used in the construction of joints are suitable for use in contact with potable water 30 days after installation.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM A675 - Standard Specification for Steel Bars, Carbon, Hot-Wrought, Special Quality, Mechanical Properties.
 - 2. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.

3. ASTM C1059 - Standard Specification for Latex Agents for Bonding Fresh to Hardened Concrete.
 4. ASTM D1751 - Standard Specification for Preformed Expansion Joint Fillers for Concrete Paving and Structural Construction. (Nonextruding and Resilient Bituminous Types).
 5. ASTM D1752 - Standard Specification for Preformed Sponge Rubber and Cork Expansion Joint Fillers for Concrete Paving and Structural Construction.
- B. U.S. Army Corps of Engineers (CRD).
 1. CRD C572 - Specification for Polyvinylchloride Waterstops.
 - C. Federal Specifications
 1. FS SS-S-210A - Sealing Compound for Expansion Joints.
 - D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

2 PRODUCTS

2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. All materials used together in a given joint (bond breakers, backer rods, joint fillers, sealants, etc) shall be compatible with one another. Coordinate selection of suppliers and products to ensure compatibility. Under no circumstances shall asphaltic bond breakers or joint fillers be used in joints receiving sealant.
- C. All chemical sealant type waterstops shall be products specifically manufactured for the purpose for which they will be used and the products shall have been successfully used on similar structures for more than five years.

2.2 MATERIALS

- A. Standard Waterstops
 1. PVC Waterstops - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. The waterstop shall be Greenstreak Group, Inc. model No. 679 or approved equal for construction joints. The waterstop shall be Greenstreak Group Inc. model No.732 or approved equal for control joints and Greenstreak Group Inc. Model No. 738 for expansion joints. Provide grommets or pre-punched holes spaced at 12 inches on center along length of waterstop.
 2. Factory Fabrications: Provide factory made waterstop fabrications for all changes of direction, transitions, and intersections, leaving only straight butt joints of sufficient length for splicing in the field.
- B. Special Waterstops
 1. Base Seal PVC Waterstop - The waterstop shall be made by extruding elastomeric plastic compound with virgin polyvinylchloride as the basic resins. The compound shall contain no reprocessed materials. Minimum tensile strength of waterstop shall be 1750 psi. The waterstop shall conform to CRD-C572. Waterstops shall be style 925 for expansion joints, style 928 for control joints, and style 927 for construction joints by Greenstreak Plastic Products, St. Louis, MO or equal.
 2. Preformed adhesive waterstops - The waterstop shall be a rope type preformed plastic waterstop meeting the requirements of Federal Specification SS-S-210A. The rope shall have a cross-section of approximately one square inch unless otherwise specified or shown on the Drawings. The waterstop shall be Synko-Flex waterstop as

manufactured by Synko-Flex Products of Houston, TX, Lockstop by Greenstreak Group Inc., or equal. Primer for the material shall be as recommended by the waterstop manufacturer.

C. Premolded Joint Filler

1. Premolded joint filler - Structures. Self-expanding cork, premolded joint filler shall conform to ASTM D1752, Type III. The thickness shall be 3/4-in unless shown otherwise on the Drawings.
2. Premolded joint filler - sidewalk and roadway concrete pavements or where fiber joint filler is specifically noted on the Drawings. The joint filler shall be asphalt-impregnated fiber board conforming to ASTM D1751. Thickness shall be 3/4-in unless otherwise shown on the Drawings.

D. Bond Breaker

1. Bond breaker tape shall be an adhesive-backed glazed butyl or polyethylene tape which will satisfactorily adhere to the premolded joint filler or concrete surface as required. The tape shall be the same width as the joint.
2. Except where tape is specifically called for on the drawings, bond breaker for concrete shall be either bond breaker tape or a nonstaining type bond prevention coating such as Williams Tilt-up Compound by Williams Distributors Inc.; Silcoseal 77, by SCA Construction Supply Division, Superior Concrete Accessories or equal.

E. Expansion Joint Dowels

1. Dowels shall be smooth steel conforming to ASTM A675, Grade 70. Dowels must be straight and clean, free of loose flaky rust and loose scale. Dowels may be sheared to length provided deformation from true shape caused by shearing does not exceed 0.04-in on the diameter of the dowel and extends no more than 0.04-in from the end. Bars shall be coated with a bond breaker on the expansion end of the dowel. Expansion caps shall be provided on the expansion end. Caps shall allow for at least 1-1/2-in of expansion.
2. Dowel Bar Sleeves: Provide Greenstreak two component Speed Dowel System, to accept 1" diameter x 12" long slip dowels. The Greenstreak Group, Inc. Speed Dowel System is comprised of a reusable base and a plastic sleeve. Both pieces shall be manufactured from polypropylene plastic.

F. Bonding Agent

1. Epoxy bonding agent shall be a two-component, solvent-free, moisture insensitive, epoxy resin material conforming to ASTM C881, Type II. The bonding agent shall be Sikadur 32 Hi-Mod by Sika Corporation of Lyndhurst, N.J.; Concrecive Liquid (LPL) by Master Builders of Cleveland, OH or equal. Acrylic may be used if approved by the Engineer.

G. Compressible Joint Filler

1. The joint filler shall be a non-extruded watertight strip material use to fill expansion joints between structures. The material shall be capable of being compressed at least 40 percent for 70 hours at 68 degrees F and subsequently recovering at least 20 percent of its original thickness in the first 1/2 hour after unloading. Compressible Joint filler shall be Evasote 380 E.S.P, by E-Poxy Industries, Inc., Ravena, NY , Sikaflex 1a by Sika or equal.

3 EXECUTION

3.1 INSTALLATION

A. Standard Waterstops

1. Install waterstops for all joints where indicated on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided.

Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.

2. Horizontal waterstops in slabs shall be clamped in position by the bulkhead (unless previously set in concrete).
3. Waterstops shall be installed so that half of the width will be embedded on each side of the joint. Care shall be exercised to ensure that the waterstop is completely embedded in void-free concrete.
4. Waterstops shall be terminated 3-in below the exposed top of walls. Expansion joint waterstop center bulbs shall be plugged with foam rubber, 1-in deep, at point of termination.

B. Special Waterstops

1. Install special waterstops at joints where specifically noted on the Drawings. Waterstops shall be continuous around all corners and intersections so that a continuous seal is provided. Provide factory made waterstop fabrications for all changes in direction, intersections and transitions leaving only straight butt joints splices for the field.
2. Each piece of the waterstop shall be of maximum practicable length to provide a minimum number of connections or splices. Connections and splices shall conform to the manufacturer's recommendations and as specified herein.
3. Waterstops shall be terminated 3-in below the exposed top of walls.

C. Construction Joints

1. Make construction joints only at locations shown on the Drawings or as approved by the Engineer. Any additional or relocation of construction joints proposed by the Contractor, must be submitted to the Engineer for written approval.
2. Additional or relocated joints should be located where they least impair strength of the member. In general, locate joints within the middle third of spans of slabs, beams and girders. However, if a beam intersects a girder at the joint, offset the joint a distance equal to twice the width of the member being connected. Locate joints in walls and columns at the underside of floors, slabs, beams or girders and at tops of footings or floor slabs. Do not locate joints between beams, girders, column capitals, or drop panels and the slabs above them. Do not locate joints between brackets or haunches and walls or columns supporting them.
3. All joints shall be perpendicular to main reinforcement. Continue reinforcing steel through the joint as indicated on the Drawings. When joints in beams are allowed, provide a shear key and inclined dowels as approved by the Engineer.
4. Provide sealant grooves for joint sealant where indicated on the Drawings.
5. At all construction joints and at concrete joints designated on the Drawings to be "roughened", uniformly roughen the surface of the concrete to a full amplitude (distance between high and low points or side to side) of approximately 1/4-in to expose a fresh face. Thoroughly clean joint surfaces of loose or weakened materials by water-blasting or sandblasting and prepare for bonding.
6. Provide waterstops in all wall and slab construction joints in liquid containment structures and at other locations shown on the Drawings.
7. Keyways shall not be used in construction joints unless specifically shown on the Drawings or approved by the Engineer.

D. Expansion Joints

1. Do not extend through expansion joints, reinforcement or other embedded metal items that are continuously bonded to concrete on each side of joint.
2. Position premolded joint filler material accurately. Secure the joint filler against displacement during concrete placement and compaction. Place joint filler over the

face of the joint, allowing for sealant grooves as detailed on the Drawings. Tape all joint filler splices to prevent intrusion of mortar. Seal expansion joints as shown on the Drawings.

3. Expansion joints shall be 3/4-in in width unless otherwise noted on the Drawings.
 4. Where indicated on Drawings, install smooth dowels at right angles to expansion joints. Align dowels accurately with finished surface. Rigidly hold in place and support during concrete placement. Unless otherwise shown on the Drawings, apply oil or grease to one end of all dowels through expansion joints. Provide plastic expansion caps on the lubricated ends of expansion dowels.
 5. Provide center bulb type waterstops in all wall and slab expansion joints in liquid containment structures and at other locations shown on the Drawings.
- E. Control Joints
1. Provide sealant grooves, sealants and waterstops at control joints in slabs on grade or walls as detailed. Provide waterstops at all wall and slab control joints in water containment structures and at other locations shown on the Drawings.
 2. Control joints may be sawed if specifically approved by the Engineer. If control joint grooves are sawed, properly time the saw cutting with the time of the concrete set. Start cutting as soon as concrete has hardened sufficiently to prevent aggregates from being dislodged by the saw. Complete cutting before shrinkage stresses have developed sufficiently to induce cracking. No reinforcing shall be cut during saw cutting.
 3. Extend every other bar of reinforcing steel through control joints or as indicated on the Drawings. Where specifically noted on the Drawings, coat the concrete surface with a bond breaker prior to placing new concrete against it. Avoid coating reinforcement or waterstops with bond breaker at these locations.

** END OF SECTION **



SECTION 03300
CAST-IN-PLACE CONCRETE

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor and materials required and install cast-in-place concrete complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Joint Accessories are included in Section 03250.
- D. Concrete Finishes are included in Section 03350.
- E. Grout is included in Section 03600.
- F. Modifications and Repair to Concrete are included in section 03740.

1.3 SUBMITTALS

- A. The contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Sources of cement, pozzolan and aggregates.
 - 2. Material Safety Data Sheets (MSDS) for all concrete components and admixtures.
 - 3. Air-entraining admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
 - 4. Water-reducing admixture. Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations and conformity to ASTM standards.
 - 5. High-range water-reducing admixture (plasticizer). Product data including catalogue cut, technical data, storage requirements, product life, recommended dosage, temperature considerations, retarding effect, slump range and conformity to ASTM standards. Identify proposed locations of use.
 - 6. Concrete mix for each formulation of concrete proposed for use including constituent quantities per cubic yard, water-cementitious materials ratio, concrete slump, type and manufacturer of cement. Provide either a. or b. below for each mix proposed.
 - a. Standard deviation data for each proposed concrete mix based on statistical records.
 - b. The curve of water-cementitious materials ratio versus concrete cylinder strength for each formulation of concrete proposed based on laboratory tests. The cylinder strength shall be the average of the 28-day cylinder strength test results for each mix. Provide results of 7 and 14 day tests if available.
 - 7. Sheet curing material. Product data including catalogue cut, technical data and conformity to ASTM standard.
 - 8. Liquid curing compound. Product data including catalogue cut, technical data, storage requirements, product life, application rate and conformity to ASTM standards. Identify proposed locations of use.

- C. Samples
 - 1. Fine and coarse aggregates if requested by the Engineer.
- D. Test Reports
 - 1. Fine aggregates - sieve analysis, physical properties, and deleterious substance.
 - 2. Coarse aggregates - sieve analysis, physical properties, and deleterious substances.
 - 3. Cements - chemical analysis and physical properties for each type.
 - 4. Pozzolans - chemical analysis and physical properties.
 - 5. Proposed concrete mixes - compressive strength, slump and air content.
- E. Certifications
 - 1. Certify admixtures used in the same concrete mix are compatible with each other and the aggregates.
 - 2. Certify admixtures are suitable for use in contact with potable water after 30 days of concrete curing.
 - 3. Certify curing compound is suitable for use in contact with potable water after 30 days (non-toxic and free of taste or odor).

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C31 - Standard Practice for Making and Curing Concrete Test Specimens in the Field.
 - 2. ASTM C33 - Standard Specification for Concrete Aggregates.
 - 3. ASTM C39 - Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
 - 4. ASTM C42 - Standard Test Method for Obtaining and Testing Drilled Cores and Sawed Beams of Concrete.
 - 5. ASTM C94 - Standard Specification for Ready-Mixed Concrete.
 - 6. ASTM C143 - Standard Test Method for Slump of Hydraulic Cement Concrete
 - 7. ASTM C150 - Standard Specification for Portland Cement
 - 8. ASTM C171 - Standard Specification for Sheet Materials for Curing Concrete
 - 9. ASTM C173 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Volumetric Method.
 - 10. ASTM C231 - Standard Test Method for Air Content of Freshly Mixed Concrete by the Pressure Method.
 - 11. ASTM C260 - Standard Specification for Air-Entraining Admixtures for Concrete.
 - 12. ASTM C309 - Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
 - 13. ASTM C494 - Standard Specification for Chemical Admixtures for Concrete.
 - 14. ASTM C618 - Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
 - 15. ASTM C1017 - Standard Specification for Chemical Admixtures for use in Producing Flowing Concrete.
- B. American Concrete Institute (ACI).
 - 1. ACI 304 - Guide for Measuring, Mixing, Transporting and Placing Concrete.
 - 2. ACI 305 - Hot Weather Concreting.

3. ACI 306.1 - Standard Specification for Cold Weather Concreting.
4. ACI 318 - Building Code Requirements for Structural Concrete.
5. ACI 350 - Environmental Engineering Concrete Structures.
6. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Reinforced concrete shall comply with ACI 318, the recommendations of ACI 350R and other stated requirements, codes and standards. The most stringent requirement of the codes, standards and this Section shall apply when conflicts exist.
- B. Only one source of cement and aggregates shall be used on any one structure. Concrete shall be uniform in color and appearance.
- C. Well in advance of placing concrete, discuss with the Engineer the sources of individual materials and batched concrete proposed for use. Discuss placement methods, waterstops and curing. Propose methods of hot and cold weather concreting as required. Prior to the placement of any concrete containing a high-range water-reducing admixture (plasticizer), the Contractor, accompanied by the plasticizer manufacturer, shall discuss the properties and techniques of batching and placing plasticized concrete.
- D. If, during the progress of the work, it is impossible to secure concrete of the required workability and strength with the materials being furnished, the Engineer may order such changes in proportions or materials, or both, as may be necessary to secure the desired properties. All changes so ordered shall be made at the Contractor's expense.
- E. If, during the progress of the work, the materials from the sources originally accepted change in characteristics, the Contractor shall, at his/her expense, make new acceptance tests of aggregates and establish new design mixes.
- F. Testing of the following materials shall be furnished by Contractor to verify conformity with this Specification Section and the stated ASTM Standards.
 1. Fine aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.
 2. Coarse aggregates for conformity with ASTM C33 - sieve analysis, physical properties, and deleterious substances.
 3. Cements for conformity with ASTM C150 - chemical analysis and physical properties.
 4. Pozzolans for conformity with ASTM C618 - chemical analysis and physical properties.
 5. Proposed concrete mix designs - compressive strength, slump and air content.
- G. Field testing and inspection services will be provided by the Owner. The cost of such work, except as specifically stated otherwise, shall be paid by the Owner. Testing of the following items shall be by the Owner to verify conformity with this Specification Section.
 1. Concrete placements - compressive strength (cylinders), compressive strength (cores), slump, and air content.
 2. Other materials or products that may come under question.
- H. All materials incorporated in the work shall conform to accepted samples.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Cement: Store in weather-tight buildings, bins or silos to provide protection from dampness and contamination and to minimize warehouse set.
- B. Aggregate: Arrange and use stockpiles to avoid excessive segregation or contamination with other materials or with other sizes of like aggregates. Build stockpiles in successive horizontal layers not exceeding 3-ft in thickness. Complete each layer before the next is started. Do not use frozen or partially frozen aggregate.

- C. Sand: Arrange and use stockpiles to avoid contamination. Allow sand to drain to uniform moisture content before using. Do not use frozen or partially frozen aggregates.
- D. Admixtures: Store in closed containers to avoid contamination, evaporation or damage. Provide suitable agitating equipment to assure uniform dispersion of ingredients in admixture solutions which tend to separate. Protect liquid admixtures from freezing and other temperature changes which could adversely affect their characteristics.
- E. Pozzolan: Store in weather-tight buildings, bins or silos to provide protection from dampness and contamination.
- F. Sheet Curing Materials: Store in weather-tight buildings or off the ground and under cover.
- G. Liquid Curing Compounds: Store in closed containers.

2 PRODUCTS

2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.

2.2 CEMENT

- A. U.S. made portland cement complying with ASTM C150.
- B. Air entraining cements shall not be used.
- C. Cement brand shall be subject to approval by the Engineer and one brand shall be used throughout the Work.

2.3 MATERIALS

- A. Materials shall comply with this Section and any applicable State or local requirements.
- B. Cement: The following cement type(s) shall be used:
 - 1. All Classes - Type I/II or Type II
- C. Fine Aggregate: Washed inert natural sand conforming to the requirements of ASTM C33.
- D. Coarse Aggregate: Well-graded crushed stone or washed gravel conforming to the requirements of ASTM C33. Grading requirements shall be as listed in ASTM C33 Table 2 for the specified coarse aggregate size number. Limits of Deleterious Substances and Physical Property Requirements shall be as listed in ASTM C33 Table 3 for severe weathering regions. Size numbers for the concrete mixes shall be as shown in Table 1 herein.
- E. Water: Potable water free from injurious amounts of oils, acids, alkalis, salts, organic matter, or other deleterious substances.
- F. Admixtures: Admixtures shall be free of chlorides and alkalis (except for those attributable to water). When it is required to use more than one admixture in a concrete mix, the admixtures shall be from the same manufacturer. Admixtures shall be compatible with the concrete mix including other admixtures and shall be suitable for use in contact with potable water after 30 days of concrete curing.
 - 1. Air-Entraining Admixture: The admixture shall comply with ASTM C260. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 - 2. Water-Reducing Agent: The admixture shall comply with ASTM C494, Type A. Proportioning and mixing shall be in accordance with manufacturer's recommendations.
 - 3. High-Range Water-Reducer (Plasticizer): The admixture shall comply with ASTM C494, Type F and shall result in non-segregating plasticized concrete with little bleeding and with the physical properties of low water/cement ratio concrete. The treated concrete shall be capable of maintaining its plastic state in excess of 2 hours.

Proportioning and mixing shall be in accordance with manufacturer's recommendations. Where walls are 14" thick or less and the wall height exceeds 12 ft a mix including a plasticizer must be used.

4. Admixtures causing retarded or accelerated setting of concrete shall not be used without written approval from the Engineer. When allowed, the admixtures shall be retarding or accelerating water reducing or high range water reducing admixtures.
- G. Pozzolan (Fly Ash): Pozzolan shall be Class C or Class F fly ash complying with ASTM C618 except the Loss on Ignition (LOI) shall be limited to 3 percent maximum.
- H. Sheet Curing Materials. Waterproof paper, polyethylene film or white burlap-polyethylene sheeting all complying with ASTM C171.
- I. Liquid Curing Compound. Liquid membrane-forming curing compound shall comply with the requirements of ASTM C309, Type 1-D (clear or translucent with fugitive dye) and shall contain no wax, paraffin, or oil. Curing compound shall be approved for use in contact with potable water after 30 days (non-toxic and free of taste or odor). Curing compound shall comply with Federal, State and local VOC limits.

2.4 MIXES

- A. Development of mix designs and testing shall be by an independent testing laboratory acceptable to the Engineer engaged by and at the expense of the Contractor.
- B. Select proportions of ingredients to meet the design strength and materials limits specified in Table 1 and to produce concrete having proper placability, durability, strength, appearance and other required properties. Proportion ingredients to produce a homogenous mixture which will readily work into corners and angles of forms and around reinforcement without permitting materials to segregate or allowing excessive free water to collect on the surface.
- C. The design mix shall be based on standard deviation data of prior mixes with essentially the same proportions of the same constituents or, if such data is not available, be developed by a testing laboratory, acceptable to the Engineer, engaged by and at the expense of the Contractor. Acceptance of mixes based on standard deviation shall be based on the modification factors for standard deviation tests contained in ACI 318. The water content of the concrete mix, determined by laboratory testing, shall be based on a curve showing the relation between water cementitious ratio and 7 and 28 day compressive strengths of concrete made using the proposed materials. The curves shall be determined by four or more points, each representing an average value of at least three test specimens at each age. The curves shall have a range of values sufficient to yield the desired data, including the specified design strengths as modified below, without extrapolation. The water content of the concrete mixes to be used, as determined from the curve, shall correspond to strengths 16 percent greater than the specified design strengths. The resulting mix shall not conflict with the limiting values for maximum water cementitious ratio and net minimum cementitious content as specified in Table 1.
- D. Compression Tests: Provide testing of the proposed concrete mix or mixes to demonstrate compliance with the specified design strength requirements in conformity with the above paragraph.
- E. Entrained air, as measured by ASTM C231, shall be as shown in Table 1.
 1. If the air-entraining agent proposed for use in the mix requires testing methods other than ASTM C231 to accurately determine air content, make special note of this requirement in the admixture submittal.
- F. Slump of the concrete as measured by ASTM C143, shall be as shown in Table 1. If a high-range water-reducer (plasticizer) is used, the slump indicated shall be that measured before plasticizer is added. Plasticized concrete shall have a slump ranging from 5 to 8-in.
- G. Proportion admixtures according to the manufacturer's recommendations. Two or more admixtures specified may be used in the same mix provided that the admixtures in

combination retain full efficiency and have no deleterious effect on the concrete or on the properties of each other.

TABLE 1					
CONCRETE MIX REQUIREMENTS					
Class	Design Strength (1)	Cement (2)	Fine Aggregate (2)	Coarse Aggregate (3)	Cementitious Content (4)
A	2500	C150 Type II	C33	57	440 min.
B	3000	C150 Type II	C33	57	480 min.
C	4000	C150 Type II	C33	57	560 min.
D	5000	C150 Type II	C33	57	600 min.

Class	W/CM Ratio (5)	Fly Ash	AE Range (6)	WR (7)	HRWR (8)	Slump Range Inches
A	0.62 max.	--	3.5 to 5	Yes	*	1-4
B	0.54 max.	--	3.5 to 5	Yes	*	1-3
C	0.44 max.	25% max	3.5 to 5	Yes	*	3-5
D	0.40 max.	--	3.5 to 5	Yes	*	3-5

NOTES:

- (1) Minimum compressive strength in psi at 28 days
- (2) ASTM designation
- (3) Size Number in ASTM C33
- (4) Cementitious content in lbs/cu yd
- (5) W/Cm is Water-Cementitious ratio by weight
- (6) AE is percent air-entrainment
- (7) WR is water-reducer admixture
- (8) HRWR is high-range water-reducer admixture
- * HRWR used at contractor's option except where walls are 14" thick or less and the wall height exceeds 12 ft a mix including a plasticizer must be used.

3 EXECUTION

3.1 MEASURING MATERIALS

- A. Concrete shall be composed of portland cement, fine aggregate, coarse aggregate, water and admixtures as specified and shall be produced by a plant acceptable to the Engineer. All constituents, including admixtures, shall be batched at the plant except a high-range water-reducer may also be added in the field.

- B. Measure materials for batching concrete by weighing in conformity with and within the tolerances given in ASTM C94 except as otherwise specified. Scales shall have been certified by the local Sealer of Weights and Measures within 1 year of use.
- C. Measure the amount of free water in fine aggregates within 0.3 percent with a moisture meter. Compensate for varying moisture contents of fine aggregates. Record the number of gallons of water as-batched on printed batching tickets.
- D. Admixtures shall be dispensed either manually using calibrated containers or measuring tanks, or by means of an automatic dispenser approved by the manufacturer of the specific admixture.
 - 1. Charge air-entraining and chemical admixtures into the mixer as a solution using an automatic dispenser or similar metering device.
 - 2. Inject multiple admixtures separately during the batching sequence.

3.2 MIXING AND TRANSPORTING

- A. Batch plants shall have a current NRMCA Certification or equal.
- B. Concrete shall be ready-mixed concrete produced by equipment acceptable to the Engineer. No hand-mixing will be permitted. Clean each transit mix truck drum and reverse drum rotation before the truck proceeds under the batching plant. Equip each transit-mix truck with a continuous, nonreversible, revolution counter showing the number of revolutions at mixing speeds.
- C. Ready-mix concrete shall be transported to the site in watertight agitator or mixer trucks loaded not in excess of their rated capacities as stated on the name plate.
- D. Keep the water tank valve on each transit truck locked at all times. Any addition of water above the appropriate W/Cm ratio must be directed by the Engineer. Added water shall be incorporated by additional mixing of at least 35 revolutions. All added water shall be metered and the amount of water added shall be shown on each delivery ticket.
- E. All central plant and rolling stock equipment and methods shall comply with ACI 318 and ASTM C94.
- F. Select equipment of size and design to ensure continuous flow of concrete at the delivery end. Metal or metal-lined non-aluminum discharge chutes shall be used and shall have slopes not exceeding 1 vertical to 2 horizontal and not less than 1 vertical to 3 horizontal. Chutes more than 20-ft long and chutes not meeting slope requirements may be used if concrete is discharged into a hopper before distribution.
- G. Retempering (mixing with or without additional cement, aggregate, or water) of concrete or mortar which has reached initial set will not be permitted.
- H. Handle concrete from mixer to placement as quickly as practicable while providing concrete of required quality in the placement area. Dispatch trucks from the batching plant so they arrive at the work site just before the concrete is required, thus avoiding excessive mixing of concrete while waiting or delays in placing successive layers of concrete in the forms.
- I. Furnish a delivery ticket for ready mixed concrete to the Engineer as each truck arrives. Each ticket shall provide a printed record of the weight of cement and each aggregate as batched individually. Use the type of indicator that returns for zero punch or returns to zero after a batch is discharged. Clearly indicate the weight of fine and coarse aggregate, cement and water in each batch, the quantity delivered, the time any water is added, and the numerical sequence of the delivery. Show the time of day batched and time of discharge from the truck. Indicate the number of revolutions of the truck mixer.
- J. Temperature and Mixing Time Control
 - 1. In cold weather, do not allow the as-mixed temperature of the concrete and concrete temperatures at the time of placement in the forms to drop below 40 degrees F.

2. If water or aggregate has been heated, combine water with aggregate in the mixer before cement is added. Do not add cement to mixtures of water and aggregate when the temperature of the mixture is greater than 90 degrees F.
3. In hot weather, cool ingredients before mixing to maintain temperature of the concrete below the maximum placing temperature of 90 degrees F. If necessary, substitute well-crushed ice for all or part of the mixing water.
4. The maximum time interval between the addition of mixing water and/or cement to the batch and the placing of concrete in the forms shall not exceed the values shown in Table 2.

TABLE 2	
MAXIMUM TIME TO DISCHARGE OF CONCRETE	
Air or Concrete Temperature (whichever is higher)	Maximum Time
80 to 90 Degree F (27 to 32 Degree C)	45 minutes
70 to 79 Degree F (21 to 26 Degree C)	60 minutes
40 to 69 Degree F (5 to 20 Degree C)	90 minutes

If an approved high-range water-reducer (plasticizer) is used to produce plasticized concrete, the maximum time interval shall not exceed 90 minutes.

3.3 CONCRETE APPEARANCE

- A. Concrete mix showing either poor cohesion or poor coating of the coarse aggregate with paste shall be remixed. If this does not correct the condition, the concrete shall be rejected. If the slump is within the allowable limit, but excessive bleeding, poor workability, or poor finishability are observed, changes in the concrete mix shall be obtained only by adjusting one or more of the following:
 1. The gradation of aggregate.
 2. The proportion of fine and coarse aggregate.
 3. The percentage of entrained air, within the allowable limits.
- B. Concrete for the work shall provide a homogeneous structure which, when hardened, will have the required strength, durability and appearance. Mixtures and workmanship shall be such that concrete surfaces, when exposed, will require no finishing. When concrete surfaces are stripped, the concrete, when viewed in good lighting from 10-ft away, shall be pleasing in appearance, and at 20-ft shall show no visible defects.

3.4 PLACING AND COMPACTING

- A. Placing
 1. Verify that all formwork completely encloses concrete to be placed and is securely braced prior to concrete placement. Remove ice, excess water, dirt and other foreign materials from forms. Confirm that reinforcement and other embedded items are securely in place. Have a competent workman at the location of the placement who can assure that reinforcing steel and embedded items remain in designated locations while concrete is being placed. Sprinkle semi-porous subgrades or forms to eliminate suction of water from the mix. Seal extremely porous subgrades in an approved manner.
 2. Deposit concrete as near its final position as possible to avoid segregation due to rehandling or flowing. Place concrete continuously at a rate which ensures the

concrete is being integrated with fresh plastic concrete. Do not deposit concrete which has partially hardened or has been contaminated by foreign materials or on concrete which has hardened sufficiently to cause formation of seams or planes of weakness within the section. If the section cannot be placed continuously, place construction joints as specified or as approved.

3. Pumping of concrete will be permitted. Use a mix design and aggregate sizes suitable for pumping and submit for approval.
 4. Remove temporary spreaders from forms when the spreader is no longer useful. Temporary spreaders may remain embedded in concrete only when made of galvanized metal or concrete and if prior approval has been obtained.
 5. Do not place concrete for supported elements until concrete previously placed in the supporting element (columns, slabs and/or walls) has reached adequate strength.
 6. Where surface mortar is to form the base of a finish, especially surfaces designated to be painted, work coarse aggregate back from forms with a suitable tool to bring the full surface of the mortar against the form. Prevent the formation of excessive surface voids.
 7. Slabs
 - a. After suitable bulkheads, screeds and jointing materials have been positioned, the concrete shall be placed continuously between construction joints beginning at a bulkhead, edge form, or corner. Each batch shall be placed into the edge of the previously placed concrete to avoid stone pockets and segregation.
 - b. Avoid delays in casting. If there is a delay in casting, the concrete placed after the delay shall be thoroughly spaded and consolidated at the edge of that previously placed to avoid cold joints. Concrete shall then be brought to correct level and struck off with a straightedge. Bullfloats or darbies shall be used to smooth the surface, leaving it free of humps or hollows.
 - c. Where slabs are to be placed integrally with the walls below them, place the walls and compact as specified. Allow 1 hour to pass between placement of the wall and the overlying slab to permit consolidation of the wall concrete. Keep the top surface of the wall moist so as to prevent cold joints.
 8. Formed Concrete
 - a. Place concrete in forms using tremie tubes and taking care to prevent segregation. Bottom of tremie tubes shall preferably be in contact with the concrete already placed. Do not permit concrete to drop freely more than 4-ft. Place concrete for walls in 12 to 24-in lifts, keeping the surface horizontal. If plasticized concrete is used, the maximum lift thickness may be increased to 4-ft.
 9. Underwater concreting shall be performed in conformity with the recommendations of ACI 304R. The tremie system shall be used to place underwater concrete. Tremie pipes shall be in the range of 8 to 12-in in diameter and be spaced at not more than 16-ft on centers nor more than 8-ft from an end form. Where concrete is being placed around a pipe, there shall be at least one tremie pipe on each side of each pipe. Where the tremie system is not practical, direct pumped concrete for underwater placement may be used subject to approval of the system including details by the Engineer.
- B. Compacting
1. Consolidate concrete by vibration, puddling, spading, rodding or forking so that concrete is thoroughly worked around reinforcement, embedded items and openings and into corners of forms. Puddling, spading, etc, shall be continuously performed along with vibration of the placement to eliminate air or stone pockets which may cause honeycombing, pitting or planes of weakness.

2. All concrete shall be placed and compacted with mechanical vibrators. The number, type and size of the units shall be approved by the Engineer in advance of placing operations. No concrete shall be ordered until sufficient approved vibrators (including standby units in working order) are on the job.
3. A minimum frequency of 7000 rpm is required for mechanical vibrators. Insert vibrators and withdraw at points from 18 to 30-in apart. At each insertion, vibrate sufficiently to consolidate concrete, generally from 5 to 15 seconds. Do not over vibrate so as to segregate. Keep a spare vibrator on the site during concrete placing operations.
4. Concrete Slabs: Concrete for slabs less than 8-in thick shall be consolidated with vibrating screeds; slabs 8 to 12-in thick shall be compacted with internal vibrators and (optionally) with vibrating screeds. Vibrators shall always be placed into concrete vertically and shall not be laid horizontally or laid over.
5. Walls and Columns: Internal vibrators (rather than form vibrators) shall be used unless otherwise approved by the Engineer. In general, for each vibrator needed to melt down the batch at the point of discharge, one or more additional vibrators must be used to densify, homogenize and perfect the surface. The vibrators shall be inserted vertically at regular intervals, through the fresh concrete and slightly into the previous lift, if any.
6. Amount of Vibration: Vibrators are to be used to consolidate properly placed concrete but shall not be used to move or transport concrete in the forms. Vibration shall continue until:
 - a. Frequency returns to normal.
 - b. Surface appears liquefied, flattened and glistening.
 - c. Trapped air ceases to rise.
 - d. Coarse aggregate has blended into surface, but has not disappeared.

3.5 CURING AND PROTECTION

- A. Protect all concrete work against injury from the elements and defacements of any nature during construction operations.
- B. Curing Methods
 1. Curing Methods for Concrete Surfaces: Cure concrete to retain moisture and maintain specified temperature at the surface for a minimum of 7 days after placement. Curing methods to be used are as follows:
 - a. Water Curing: Keep entire concrete surface wet by ponding, continuous sprinkling or covered with saturated burlap. Begin wet cure as soon as concrete attains an initial set and maintain wet cure 24 hours a day.
 - b. Sheet Material Curing: Cover entire surface with sheet material. Securely anchor sheeting to prevent wind and air from lifting the sheeting or entrapping air under the sheet. Place and secure sheet as soon as initial concrete set occurs.
 - c. Liquid Membrane Curing: Apply over the entire concrete surface except for surfaces to receive additional concrete. Curing compound shall NOT be placed on any concrete surface where additional concrete is to be placed, where concrete sealers or surface coatings are to be used, or where the concrete finish requires an integral floor product. Curing compound shall be applied as soon as the free water on the surface has disappeared and no water sheen is visible, but not after the concrete is dry or when the curing compound can be absorbed into the concrete. Application shall be in compliance with the manufacturer's recommendations.
 2. Specified applications of curing methods.
 - a. Slabs for Water Containment Structures: Water curing only.
 - b. Slabs on Grade and Footings (not used to contain water): Water curing, sheet material curing or liquid membrane curing.

- c. Structural Slabs (other than water containment): Water curing or liquid membrane curing.
 - d. Horizontal Surfaces which will Receive Additional Concrete, Coatings, Grout or Other Material that Requires Bond to the substrate: Water curing.
 - e. Formed Surfaces: None if nonabsorbent forms are left in place 7 days. Water cure if absorbent forms are used. Sheet cured or liquid membrane cured if forms are removed prior to 7 days. Exposed horizontal surfaces of formed walls or columns shall be water cured for 7 days or until next placement of concrete is made.
 - f. Surfaces of Concrete Joints: Water cured or sheet material cured.
- C. Finished surfaces and slabs shall be protected from the direct rays of the sun to prevent checking and crazing.
- D. Cold Weather Concreting:
- 1. "Cold weather" is defined as a period when for more than 3 successive days, the average daily outdoor temperature drops below 40 degrees F. The average daily temperature shall be calculated as the average of the highest and the lowest temperature during the period from midnight to midnight.
 - 2. Cold weather concreting shall conform to ACI 306.1 and the additional requirements specified herein. Temperatures at the concrete placement shall be recorded at 12 hour intervals (minimum).
 - 3. Discuss a cold weather work plan with the Engineer. The discussion shall encompass the methods and procedures proposed for use during cold weather including the production, transportation, placement, protection, curing and temperature monitoring of the concrete. The procedures to be implemented upon abrupt changes in weather conditions or equipment failures shall also be discussed. Cold weather concreting shall not begin until the work plan is acceptable to the Engineer.
 - 4. During periods of cold weather, concrete shall be protected to provide continuous warm, moist curing (with supplementary heat when required) for a total of at least 350 degree-days of curing.
 - a. Degree-days are defined as the total number of 24 hour periods multiplied by the weighted average daily air temperature at the surface of the concrete (eg: 5 days at an average 70 degrees F = 350 degree-days).
 - b. To calculate the weighted average daily air temperature, sum hourly measurements of the air temperature in the shade at the surface of the concrete taking any measurement less than 50 degrees F as 0 degrees F. Divide the sum thus calculated by 24 to obtain the weighted average temperature for that day.
 - 5. Salt, manure or other chemicals shall not be used for protection.
 - 6. The protection period for concrete being water cured shall not be terminated during cold weather until at least 24 hours after water curing has been terminated.
- E. Hot Weather Concreting
- 1. "Hot weather" is defined as any combination of high air temperatures, low relative humidity and wind velocity which produces a rate of evaporation estimated in accordance with ACI 305R, approaching or exceeding 0.2 lbs/sqft/hr).
 - 2. Concrete placed during hot weather, shall be batched, delivered, placed, cured and protected in compliance with the recommendations of ACI 305R and the additional requirements specified herein.
 - a. Temperature of concrete being placed shall not exceed 90 degrees F and every effort shall be made to maintain a uniform concrete mix temperature below this level. The temperature of the concrete shall be such that it will cause no difficulties from loss of slump, flash set or cold joints.

- b. All necessary precautions shall be taken to promptly deliver, to promptly place the concrete upon its arrival at the job and to provide vibration immediately after placement.
 - c. The Engineer may direct the Contractor to immediately cover plastic concrete with sheet material.
3. Discuss with the Engineer a work plan describing the methods and procedures proposed to use for concrete placement and curing during hot weather periods. Hot weather concreting shall not begin until the work plan is acceptable to the Engineer.

3.6 REMOVAL OF FORMS

- A. Except as otherwise specifically authorized by the Engineer, forms shall not be removed before the concrete has attained a strength of at least 70 percent of its specified design strength for beams and slabs and at least 30 percent of its specified design strength for walls and vertical surfaces, nor before reaching the following number of day-degrees of curing (whichever is the longer)

TABLE 3	
MINIMUM TIME TO FORM REMOVAL	
<u>Forms for</u>	<u>Degree Days</u>
Beams and slabs	500
Walls and vertical surfaces	100

- B. Shores shall not be removed until the concrete has attained at least 70 percent of its specified design strength and also sufficient strength to support safely its own weight and construction live loads.

3.7 INSPECTION AND FIELD TESTING

- A. The batching, mixing, transporting, placing and curing of concrete shall be subject to the inspection of the Engineer at all times. The Contractor shall advise the Engineer of his/her readiness to proceed at least 24 hours prior to each concrete placement. The Engineer will inspect the preparations for concreting including the preparation of previously placed concrete, the reinforcing steel and the alignment, cleanliness and tightness of formwork. No placement shall be made without the inspection and acceptance of the Engineer.
- B. Sets of field control cylinder specimens will be taken by the Engineer (or inspector) during the progress of the work, in compliance with ASTM C31. The number of sets of concrete test cylinders taken of each class of concrete placed each day shall not be less than one set per day, nor less than one set for each 150 cu yds of concrete nor less than one set for each 5,000 sq ft of surface area for slabs or walls.
- 1. A "set" of test cylinders consists of four cylinders: one to be tested at 7 days and two to be tested and their strengths averaged at 28 days. The fourth may be used for a special test at 3 days or to verify strength after 28 days if 28-day test results are low.
 - 2. When the average 28-day compressive strength of the cylinders in any set falls below the specified design strength or below proportional minimum 7 day strengths (where proper relation between seven and 28 day strengths have been established by tests), proportions, water content, or temperature conditions shall be changed to achieve the required strengths.
- C. Cooperate in the making of tests by allowing free access to the work for the selection of samples, providing an insulated closed curing box for specimens, affording protection to the specimens against injury or loss through the operations and furnish material and labor

required for the purpose of taking concrete cylinder samples. All shipping of specimens will be paid for by the Owner. Curing boxes shall be acceptable to the Engineer.

- D. Slump tests will be made in the field immediately prior to placing the concrete. Such tests shall be made in accordance with ASTM C143. If the slump is greater the specified range, the concrete shall be rejected.
- E. Air Content: Test for air content shall be made on fresh concrete samples. Air content for concrete made of ordinary aggregates having low absorption shall be made in compliance with either the pressure method complying with ASTM C231 or by the volumetric method complying with ASTM C173.
- F. The Engineer may have cores taken from any questionable area in the concrete work such as construction joints and other locations as required for determination of concrete quality. The results of tests on such cores shall be the basis for acceptance, rejection or determining the continuation of concrete work.
- G. Cooperate in obtaining cores by allowing free access to the work and permitting the use of ladders, scaffolding and such incidental equipment as may be required. Repair all core holes. The work of cutting and testing the cores will be at the expense of the Owner.
- H. See Specification Section 03900 for Leak Testing.

3.8 FAILURE TO MEET REQUIREMENTS

- A. Should the strengths shown by the test specimens made and tested in compliance with the previous provisions fall below the values given in Table 1, the Engineer shall have the right to require changes in proportions outlined to apply to the remainder of the work. Furthermore, the Engineer shall have the right to require additional curing on those portions of the structure represented by the test specimens which failed. The cost of such additional curing shall be at the Contractor's expense. In the event that such additional curing does not give the strength required, as evidenced by core and/or load tests, the Engineer shall have the right to require strengthening or replacement of those portions of the structure which fail to develop the required strength. The cost of all such core borings and/or load tests and any strengthening or concrete replacement required because strengths of test specimens are below that specified, shall be entirely at the expense of the Contractor. In such cases of failure to meet strength requirements the Contractor and Engineer shall confer to determine what adjustment, if any, can be made in compliance with Sections titled "Strength" and "Failure to Meet Strength Requirements" of ASTM C94. The "purchaser" referred to in ASTM C94 is the Contractor in this Section.
- B. When the tests on control specimens of concrete fall below the specified strength, the Engineer will permit check tests for strengths to be made by means of typical cores drilled from the structure in compliance with ASTM C42 and C39. In the case of cores not indicating adequate strength, the Engineer, in addition to other recourses, may require, at the Contractor's expense, load tests on any one of the slabs, beams, piles, caps, and columns in which such concrete was used. Tests need not be made until concrete has aged 60 days.
- C. Should the strength of test cylinders fall below 60 percent of the required minimum 28-day strength, the concrete shall be rejected and shall be removed and replaced.

3.9 PATCHING AND REPAIRS

- A. It is the intent of this Section to require quality work including adequate forming, proper mixture and placement of concrete and curing so completed concrete surfaces will require no patching.
- B. Defective concrete and honeycombed areas as determined by the Engineer shall be repaired as specified by the Engineer.
- C. As soon as the forms have been stripped and the concrete surfaces exposed, fins and other projections shall be removed; recesses left by the removal of form ties shall be filled; and surface defects which do not impair structural strength shall be repaired. Clean all

exposed concrete surfaces and adjoining work stained by leakage of concrete, to approval of the Engineer.

- D. Immediately after removal of forms remove plugs and break off metal ties as required by Section 03100. Promptly fill holes upon stripping as follows: Moisten the hole with water, followed by a 1/16-in brush coat of neat cement slurry mixed to the consistency of a heavy paste. Immediately plug the hole with a 1 to 1.5 mixture of cement and concrete sand mixed slightly damp to the touch (just short of "balling"). Hammer the grout into the hole until dense, and an excess of paste appears on the surface in the form of a spiderweb. Trowel smooth with heavy pressure. Avoid burnishing.
- E. When patching exposed surfaces the same source of cement and sand as used in the parent concrete shall be employed. Adjust color if necessary by addition of proper amounts of white cement. Rub lightly with a fine Carborundum stone at an age of 1 to 5 days if necessary to bring the surface down with the parent concrete. Exercise care to avoid damaging or staining the virgin skin of the surrounding parent concrete. Wash thoroughly to remove all rubbed matter.

3.10 SCHEDULE

- A. The following (Table 4) are the general applications for the various concrete classes and design strengths:

TABLE 4		
CONCRETE SCHEDULE		
Class	Design Strength (psi)	Description
A	2,500	Concrete fill and duct encasement
B	3,000	Concrete overlay slabs and pavement
C	4,000	Walls, slabs on grade, suspended slab and beam systems, columns, grade beams and all other structural concrete
D	5,000	Prestressed concrete

** END OF SECTION **

SECTION 03350
CONCRETE FINISHES

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and finish cast-in-place concrete surfaces as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Cast-In-Place Concrete is included in Section 03300.
- C. Grout is included in Section 03600.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Concrete sealer. Confirmation that the sealer is compatible with additionally applied coatings shall also be submitted.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C33 - Standard Specification for Concrete Aggregates.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Finishes
 - 1. For concrete which will receive additional applied finishes or materials, the surface finish specified is required for the proper application of the specified manufacturer's products. Where alternate products are approved for use, determine if changes in finishes are required and provide the proper finishes to receive these products.
 - 2. Changes in finishes made to accommodate products different from those specified shall be performed at no additional cost to the Owner. Submit the proposed new finishes and their construction methods to the Engineer for approval.
 - 3. Services of Manufacturer's Representative
 - a. Make available at no extra cost to the Owner, upon 72 hours notification, the services of a qualified field representative of the manufacturer of curing compound, sealer or hardener to instruct the user on the proper application of the product under prevailing job conditions.

2 PRODUCTS

2.1 MATERIALS

- A. Chemical hardener shall be Lapidolith by Sonneborn; Hornolith by A.C. Horn; Penalith by W.R. Meadows or equal fluosilicate base material.
- B. Concrete sealer shall be "MasterKure CC 180 WB", by Master Builders Solutions, Shakopee, MN or equal.

3 EXECUTION

3.1 FORMED SURFACES

- A. Forms shall not be removed before the requirements of Section 03300, have been satisfied.
- B. Exercise care to prevent damaging edges or obliterating the lines of chamfers, rustications or corners when removing the forms or performing any other work adjacent thereto.
- C. Clean all exposed concrete surfaces and adjoining work stained by leakage of concrete.
- D. Rough-Form Finish
 - 1. Immediately after stripping forms and before concrete has changed color, carefully remove all fins and projections.
 - 2. Promptly fill holes left by tie cones and defects as specified in Section 03300.
- E. Rubbed Finish
 - 1. Immediately upon stripping forms and before concrete has changed color, carefully remove all fins. While the wall is still damp apply a thin coat of medium consistency neat cement slurry by means of bristle brushes to provide a bonding coat within all pits, air holes or blemishes in the parent concrete. Avoid coating large areas with the slurry at one time.
 - 2. Before the slurry has dried or changed color, apply a dry (almost crumbly) grout proportioned by volume and consisting of 1 part cement to 1-1/2 parts of clean masonry sand having a fineness modulus of approximately 2.3 and complying with the gradation requirements of ASTM C33 for such a material. Grout shall be uniformly applied by means of damp pads of coarse burlap approximately 6-in square used as a float. Scrub grout into the pits and air holes to provide a dense mortar in all imperfections.
 - 3. Allow the mortar to partially harden for 1 or 2 hours depending upon the weather. If the air is hot and dry, keep the wall damp during this period using a fine, fog spray. When the grout has hardened sufficiently so it can be scraped from the surface with the edge of a steel trowel without damaging the grout in the small pits or holes, cut off all that can be removed with a trowel. (Note: Grout allowed to remain on the wall too long will harden and will be difficult to remove.)
 - 4. Allow the surface to dry thoroughly and rub it vigorously with clean dry burlap to completely remove any dried grout. No visible film of grout shall remain after this rubbing. The entire cleaning operation for any area must be completed the day it is started. Do not leave grout on surfaces overnight. Allow sufficient time for grout to dry after it has been cutoff with the trowel so it can be wiped off clean with the burlap.
 - 5. On the day following the repair of pits, air holes and blemishes, the walls shall again be wiped off clean with dry, used pieces of burlap containing old hardened mortar which will act as a mild abrasive. After this treatment, there shall be no built-up film remaining on the parent surface. If, however, such a film is present, a fine abrasive stone shall be used to remove all such material without breaking through the surface film of the original concrete. Such scrubbing shall be light and sufficient only to remove excess material without changing the texture of the concrete.
 - 6. A thorough wash-down with stiff bristle brushes shall follow the final bagging or stoning operation. No extraneous materials shall remain on the surface of the wall. The wall shall be sprayed with a fine fog spray periodically to maintain a continually damp condition for at least 3 days after the application of the repair grout.
 - 7. It is the intent of this finish to provide a surface that is uniform in appearance with no blemishes, imperfections, discolorations, etc.
- F. Abrasive Blast Finish

1. Coordinate with Rubbed Finish application. Do not begin until Rubbed Finish operation is complete or before concrete has reached minimum 7-day strength. The Rubbed Finish application may be deleted by the Engineer if the unfinished concrete surface is of superior quality. Apply the abrasive blast finish only where indicated on Drawings.
2. Prepare a sample area of minimum 4-ft high by 16-ft wide Blast Finish as directed by Engineer on a portion of new wall construction which will not be exposed in the final work. Sample area shall contain a variety of finishes obtained with different nozzles, nozzle pressures, grit materials and blasting techniques for selection by Engineer. Final accepted sample shall remain exposed until completion of all Blast Finish operations.
3. Blast finish operation shall meet all regulatory agency requirements. Blast Finish contractor shall be responsible for obtaining all required permits and/or licenses.
4. Perform abrasive blast finishing in as continuous an operation as possible, utilizing the same work crew to maintain continuity of finish on each surface or area of work. Maintain patterns or variances in depths of blast as present on the accepted sample.
5. Use an abrasive grit of proper type and gradation as well as equipment and technique to expose aggregate and surrounding matrix surfaces as follows:
 - a. Medium: Generally expose coarse aggregate - 1/4-in to 3/8-in reveal.
6. Abrasive blast corners and edge of patterns carefully, using back-up boards, to maintain uniform corner or edge line. Determine type of nozzle, nozzle pressure and blasting techniques required to match Architect's samples.
7. Upon completion of the Blast Finish operation, thoroughly flush finished surfaces with clean clear water to remove residual dust and grit. Allow to air dry until curing of concrete is complete.
8. After the concrete has cured for a minimum of 28 days, apply a clear acrylic sealer as directed by manufacturer.

3.2 FLOORS AND SLABS

A. Floated Finish

1. Machine Floating

- a. Screed floors and slabs with straightedges to the established grades shown on the Drawings. Immediately after final screeding, a dry cement/sand shake in the proportion of two sacks of portland cement to 350 lbs of coarse natural concrete sand shall be sprinkled evenly over the surface at the rate of approximately 500 lbs /1,000 sq ft of floor. Do not sprinkle neat, dry cement on the surface.
- b. The application of the cement/sand shake may be eliminated at the discretion of the Engineer if the base slab concrete exhibits adequate fattiness and homogeneity and the need is not indicated. When the concrete has hardened sufficiently to support the weight of a power float without its digging into or disrupting the level surface, thoroughly float the shake into the surface with a heavy revolving disc type power compacting machine capable of providing a 200 lb compaction force distributed over a 24-in diameter disc.
- c. Start floating along walls and around columns and then move systematically across the surface leaving a matte finish.
- d. The compacting machine shall be the "Kelly Power Float with Compaction Control" as manufactured by Kelley Industries of SSP Construction Equipment Inc., Pomona, CA or equal. Troweling machines equipped with float (shoe) blades that are slipped over the trowel blades may be used for floating. Floating with a troweling machine equipped with normal trowel blades will not be permitted. The use of any floating or troweling machine which has a water attachment for wetting the concrete surface during finishing will not be permitted.

2. Hand Floating

- a. In lieu of power floating, small areas may be compacted by hand floating. The dry cement/sand shake previously specified shall be used unless specifically eliminated by the Engineer. Screed the floors and slabs with straightedges to the established grades shown on the Drawings. While the concrete is still green, but sufficiently hardened to support a finisher and kneeboards with no more than 1/4-in indentation, wood float to a true, even plane with no coarse aggregate visible. Use sufficient pressure on the wood floats to bring moisture to the surface.
3. Finishing Tolerances
 - a. Level floors and slabs to a tolerance of plus or minus 1/8-in when checked with a 10-ft straightedge placed anywhere on the slab in any direction. Where drains occur, pitch floors to drains such that there are no low spots left undrained. Failure to meet either of the above requirements shall be cause for removal, grinding, or other correction as directed by the Engineer.
 - B. Broom Finish
 1. Screed slabs with straightedges to the established grades indicated on the Drawings. When the concrete has stiffened sufficiently to maintain small surface indentations, draw a stiff bristle broom lightly across the surface in the direction of drainage, or, in the case of walks and stairs, perpendicular to the direction of traffic to provide a non-slip surface.
 - C. Steel Trowel Finish
 1. Finish concrete as specified in Paragraph 3.04 and 3.05. Then, hand steel trowel to a perfectly smooth hard even finish free from high or low spots or other defects.
 - D. Concrete Sealer
 1. Prepare and seal surfaces indicated on the room finish schedule to receive a sealer as follows:
 - a. Finish concrete as specified in the preceding paragraphs and in accordance with the Schedule in Paragraph 3.05 below.
 - b. Newly Placed Concrete: Surface must be sound and properly finished. Surface is application-ready when it is damp but not wet and can no longer be marred by walking workmen.
 - c. Newly-Cured Bare Concrete: Level any spots gouged out by trades. Remove all dirt, dust, droppage, oil, grease, asphalt and foreign matter. Cleanse with caustics and detergents as required. Rinse thoroughly and allow to dry so that surface is no more than damp, and not wet.
 - d. Aged Concrete: Restore surface soundness by patching, grouting, filling cracks and holes, etc. Surface must also be free of any dust, dirt and other foreign matter. Use power tools and/or strippers to remove any incompatible sealers or coatings. Cleanse as required, following the procedure indicated under cured concrete.
 - e. Methods: Apply sealer so as to form a continuous, uniform film by spray, soft-bristle pushbroom, long-nap roller or lambswool applicator. Ordinary garden-type sprayers, using neoprene hose, are recommended for best results.
 - f. Applications: For curing only, apply first coat evenly and uniformly as soon as possible after final finishing at the rate of 200 to 400 sq ft per gallon. Apply second coat when all trades are completed and structure is ready for occupancy at the rate of 400 to 600 sq ft per gallon.
 - g. To meet guarantee and to seal and dustproof, two coats are required. For sealing new concrete, both coats shall be applied full-strength. On aged concrete, when renovating, dustproofing and sealing, the first coat should be thinned 10 to 15 percent with reducer per manufacturer's directions.

3.3 CONCRETE RECEIVING CHEMICAL HARDENER

- A. After 28 days, minimum, concrete cure, apply chemical hardener in three applications to a minimum total coverage of the undiluted chemical of 100 sq ft per gallon and in accordance with manufacturer's recommendations as reviewed.

3.4 APPROVAL OF FINISHES

- A. All concrete surfaces, when finished, will be inspected by the Engineer.
- B. Surfaces which, in the opinion of the Engineer, are unsatisfactory shall be refinished or reworked.
- C. After finishing horizontal surfaces, regardless of the finishing procedure specified, the concrete shall be cured in compliance with Section 03300 unless otherwise directed by the Engineer.

3.5 SCHEDULE OF FINISHES

- A. Concrete shall be finished as specified either to remain as natural concrete to receive an additional applied finish or material under another section.
- B. Concrete for the following conditions shall be finished as noted on the Drawings and as further specified herein:
 - 1. Concrete to Receive Dampproofing: Rough-form finish. See Paragraph 3.01D above.
 - 2. Concrete Not Exposed to View and Not Scheduled to Receive an Additional Applied Finish or Material: Rough-form finish. See Paragraph 3.01D above.
 - 3. Exterior Vertical Concrete Above Grade Exposed to View: Rubbed finish. See Paragraph 3.01E above.
 - 4. Interior Vertical Concrete Exposed to View Except in Water Containment Areas: Rubbed finish. See Paragraph 3.01E above.
 - 5. Vertical Concrete in Water Containment Areas. Rubbed finish on exposed surfaces and extending to two feet below normal operating water level: Rough-form finish on remainder of submerged areas. See Paragraphs 3.01E and 3.01D above.
 - 6. Interior and Exterior Underside of Concrete Exposed to View: Rubbed finish. See Paragraph 3.01E above.
 - 7. Exterior surfaces exposed to view and indicated to have an abrasive blast finish. See Paragraph 3.01F above.
 - 8. Interior or Exterior Horizontal Concrete not Requiring Floor Hardener or Sealer: Floated finish. See Paragraph 3.02A above.
 - 9. Concrete for Exterior Walks, Interior and Exterior Stairs: Broomed finish perpendicular to direction of traffic. See Paragraph 3.02B above.
 - 10. Concrete Slabs On Which Process Liquids Flow or In Contact with Sludge: Steel trowel finish. See Paragraph 3.02C above.
 - 11. Concrete to Receive Hardener: See Paragraph 3.03 above.
 - 12. Concrete to Receive Floor Sealer: See Paragraph 3.02D above.
 - 13. Concrete tank bottoms to be covered with grout: See Section 03600.

** END OF SECTION **



SECTION 03600
GROUT

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install grout complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Joint Accessories are included in Section 03350.
- D. Cast-in-Place Concrete is included in Section 03300.
- E. Masonry Grout is included in Section 04230.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Commercially manufactured nonshrink cementitious grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.
 - 2. Commercially manufactured nonshrink epoxy grout. The submittal shall include catalog cuts, technical data, storage requirements, product life, working time after mixing, temperature considerations, conformity to required ASTM standards and Material Safety Data Sheet.
 - 3. Cement grout. The submittal shall include the type and brand of the cement, the gradation of the fine aggregate, product data on any proposed admixtures and the proposed mix of the grout.
 - 4. Concrete grout. The submittal shall include data as required for concrete as delineated in Section 03300 and for fiber reinforcement as delineated in Section 03200. This includes the mix design, constituent quantities per cubic yard and the water/cement ratio.
- B. Laboratory Test Reports
 - 1. Submit laboratory test data as required under Section 03300 for concrete to be used as concrete grout.
- C. Certifications
 - 1. Certify that commercially manufactured grout products and concrete grout admixtures are suitable for use in contact with potable water after 30 days curing.
- D. Qualifications
 - 1. Grout manufacturers shall submit documentation that they have at least 10 years experience in the production and use of the proposed grouts which they will supply.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C531 - Standard Test Method for Linear Shrinkage and Coefficient of Thermal Expansion of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes
 - 2. ASTM C579 - Standard Test Method for Compressive Strength of Chemical Resistant Mortars, Grouts and Monolithic Surfacing and Polymer Concretes

3. ASTM C827 - Standard Test Method for Change in Height at Early Ages of Cylindrical Specimens from Cementitious Mixtures
 4. ASTM C1107 - Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink)
- B. U.S. Army Corps of Engineers Standard (CRD)
1. CRD C-621 - Corps of Engineers Specification for Nonshrink Grout
- C. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

A. Qualifications

1. Grout manufacturer shall have a minimum of 10 years experience in the production and use of the type of grout proposed for the work.

B. Pre-installation Conference

1. Well in advance of grouting, hold a pre-installation meeting to review the requirements for surface preparation, mixing, placing and curing procedures for each product proposed for use. Parties concerned with grouting shall be notified of the meeting at least 10 days prior to its scheduled date.

C. Services of Manufacturer's Representative

1. A qualified field technician of the nonshrink grout manufacturer, specifically trained in the installation of the products, shall attend the pre-installation conference and shall be present for the initial installation of each type of nonshrink grout. Additional services shall also be provided, as required, to correct installation problems.

D. Field Testing

1. All field testing and inspection services required shall be provided by the Owner. The Contractor shall assist in the sampling of materials and shall provide any ladders, platforms, etc, for access to the work. The methods of testing shall comply in detail with the applicable ASTM Standards.
2. The field testing of Concrete Grout shall be as specified for concrete in Section 03300.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials to the jobsite in original, unopened packages, clearly labeled with the manufacturer's name, product identification, batch numbers and printed instructions.
- B. Store materials in full compliance with the manufacturer's recommendations. Total storage time from date of manufacture to date of installation shall be limited to 6 months or the manufacturer's recommended storage time, whichever is less.
- C. Material which becomes damp or otherwise unacceptable shall be immediately removed from the site and replaced with acceptable material at no additional expense to the Owner.
- D. Nonshrink cement-based grouts shall be delivered as preblended, prepackaged mixes requiring only the addition of water.
- E. Nonshrink epoxy grouts shall be delivered as premeasured, prepackaged, three component systems requiring only blending as directed by the manufacturer.

1.7 DEFINITIONS

- A. Nonshrink Grout: A commercially manufactured product that does not shrink in either the plastic or hardened state, is dimensionally stable in the hardened state and bonds to a clean base plate.

2 PRODUCTS

2.1 GENERAL

- A. The use of a manufacturer's name and product or catalog number is for the purpose of establishing the standard of quality desired.
- B. Like materials shall be the products of one manufacturer or supplier in order to provide standardization of appearance.

2.2 MATERIALS

A. Nonshrink Cementitious Grout

1. Nonshrink cementitious grouts shall meet or exceed the requirements of ASTM C1107, Grades B or C and CRD C-621. Grouts shall be portland cement based, contain a pre-proportioned blend of selected aggregates and shrinkage compensating agents and shall require only the addition of water. Nonshrink cementitious grouts shall not contain expansive cement or metallic particles. The grouts shall exhibit no shrinkage when tested in conformity with ASTM C827.
 - a. General purpose nonshrink cementitious grout shall conform to the standards stated above and shall be SikaGrout 212 by Sika Corp.; Set Grout by Master Builders, Inc.; Gilco Construction Grout by Gifford Hill & Co.; Euco NS by The Euclid Chemical Co.; NBEC Grout by U. S. Grout Corp. or equal.
 - b. Flowable (Precision) nonshrink cementitious grout shall conform to the standards stated above and shall be Masterflow 928 by Master Builders, Inc.; Hi-Flow Grout by the Euclid Chemical Co.; SikaGrout 212 by Sika Corp.; Supreme Grout by Gifford Hill & Co.; Five Star Grout by U. S. Grout Corp. or equal.

B. Nonshrink Epoxy Grout

1. Nonshrink epoxy-based grout shall be a pre-proportioned, three component, 100 percent solids system consisting of epoxy resin, hardener, and blended aggregate. It shall have a compressive strength of 14,000 psi in 7 days when tested in conformity with ASTM D695 and have a maximum thermal expansion of 30×10^{-6} when tested in conformity with ASTM C531. The grout shall be Ceilcote 648 CP by Master Builders Inc.; Five Star Epoxy Grout by U.S. Grout Corp.; Sikadur 42 Grout-Pak by Sika Corp.; High Strength Epoxy Grout by the Euclid Chemical Co. or equal.

C. Cement Grout

1. Cement grouts shall be a mixture of one part portland cement conforming to ASTM C150, Types I, II, or III and 1 to 2 parts sand conforming to ASTM C33 with sufficient water to place the grout. The water content shall be sufficient to impart workability to the grout but not to the degree that it will allow the grout to flow.

D. Concrete Grout

1. Concrete grout shall conform to the requirements of Section 03300 except as specified herein. It shall be proportioned with cement, coarse and fine aggregates, water, water reducer and air entraining agent to produce a mix having an average strength of 2900 psi at 28 days, or 2500 psi nominal strength. Coarse aggregate size shall be 1/2-in maximum. Slump should not exceed 5-in and should be as low as practical yet still retain sufficient workability.
2. Synthetic reinforcing fibers as specified in Section 03200 shall be added to the concrete grout mix at the rate of 1.5 lbs of fibers per cubic yard of grout. Fibers shall be added from the manufacturer's premeasured bags and according to the manufacturer's recommendations in a manner which will ensure complete dispersion of the fiber bundles as single monofilaments within the concrete grout.

E. Water

1. Potable water, free from injurious amounts of oil, acid, alkali, organic matter, or other deleterious substances.

3 EXECUTION

3.1 PREPARATION

- A. Grout shall be placed over cured concrete which has attained its full design strength unless otherwise approved by the Engineer.
- B. Concrete surfaces to receive grout shall be clean and sound; free of ice, frost, dirt, grease, oil, curing compounds, laitance and paints and free of all loose material or foreign matter which may effect the bond or performance of the grout.
- C. Roughen concrete surfaces by chipping, sandblasting, or other mechanical means to a minimum of ¼" amplitude or provide a raked finish in order to ensure bond of the grout to the concrete. Remove loose or broken concrete. Irregular voids or projecting coarse aggregate need not be removed if they are sound, free of laitance and firmly embedded into the parent concrete.
 1. Air compressors used to clean surfaces in contact with grout shall be the oilless type or equipped with an oil trap in the air line to prevent oil from being blown onto the surface.
- D. Remove all loose rust, oil or other deleterious substances from metal embedments or bottom of baseplates prior to the installation of the grout.
- E. Concrete surfaces shall be washed clean and then kept moist for at least 24 hours prior to the placement of cementitious or cement grout. Saturation may be achieved by covering the concrete with saturated burlap bags, use of a soaker hose, flooding the surface, or other method acceptable to the Engineer. Upon completion of the 24 hour period, visible water shall be removed from the surface prior to grouting. The use of an adhesive bonding agent in lieu of surface saturation shall only be used when approved by the Engineer for each specific location of grout installation.
- F. Epoxy-based grouts do not require the saturation of the concrete substrate. Surfaces in contact with epoxy grout shall be completely dry before grouting.
- G. Construct grout forms or other leakproof containment as required. Forms shall be lined or coated with release agents recommended by the grout manufacturer. Forms shall be of adequate strength, securely anchored in place and shored to resist the forces imposed by the grout and its placement.
 1. Forms for epoxy grout shall be designed to allow the formation of a hydraulic head and shall have chamfer strips built into forms.
- H. Level and align the structural or equipment bearing plates in accordance with the structural requirements and the recommendations of the equipment manufacturer.
- I. Equipment shall be supported during alignment and installation of grout by shims, wedges, blocks or other approved means. The shims, wedges and blocking devices shall be prevented from bonding to the grout by appropriate bond breaking coatings and removed after grouting unless otherwise approved by the Engineer.

3.2 INSTALLATION – GENERAL

- A. Mix, apply and cure products in strict compliance with the manufacturer's recommendations and this Section.
- B. Have sufficient manpower and equipment available for rapid and continuous mixing and placing. Keep all necessary tools and materials ready and close at hand.
- C. Maintain temperatures of the foundation plate, supporting concrete, and grout between 40 and 90 degrees F during grouting and for at least 24 hours thereafter or as recommended by the grout manufacturer, whichever is longer. Take precautions to minimize differential heating or cooling of baseplates and grout during the curing period.
- D. Take special precautions for hot weather or cold weather grouting as recommended by the manufacturer when ambient temperatures and/or the temperature of the materials in contact with the grout are outside of the 60 and 90 degrees F range.

- E. Install grout in a manner which will preserve the isolation between the elements on either side of the joint where grout is placed in the vicinity of an expansion or control joint.
 - F. Reflect all existing underlying expansion, control and construction joints through the grout.
- 3.3 INSTALLATION - CEMENT GROUTS AND NONSHRINK CEMENTITIOUS GROUTS
- A. Mix in accordance with manufacturer's recommendations. Do not add cement, sand, pea gravel or admixtures without prior approval by the Engineer.
 - B. Avoid mixing by hand. Mixing in a mortar mixer (with moving blades) is recommended. Pre-wet the mixer and empty excess water. Add premeasured amount of water for mixing, followed by the grout. Begin with the minimum amount of water recommended by the manufacturer and then add the minimum additional water required to obtain workability. Do not exceed the manufacturer's maximum recommended water content.
 - C. Placements greater than 3-in in depth shall include the addition of clean, washed pea gravel to the grout mix when approved by the manufacturer. Comply with the manufacturer's recommendations for the size and amount of aggregate to be added.
 - D. Place grout into the designated areas in a manner which will avoid segregation or entrapment of air. Do not vibrate grout to release air or to consolidate the material. Placement should proceed in a manner which will ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
 - E. Place grout rapidly and continuously to avoid cold joints. Do not place cement grouts in layers. Do not add additional water to the mix (retemper) after initial stiffening.
 - F. Just before the grout reaches its final set, cut back the grout to the substrate at a 45 degree angle from the lower edge of bearing plate unless otherwise approved by the Engineer. Finish this surface with a wood float (brush) finish.
 - G. Begin curing immediately after form removal, cutback, and finishing. Keep grout moist and within its recommended placement temperature range for at least 24 hours after placement or longer if recommended by the manufacturer. Saturate the grout surface by use of wet burlap, soaker hoses, ponding or other approved means. Provide sunshades as necessary. If drying winds inhibit the ability of a given curing method to keep grout moist, erect wind breaks until wind is no longer a problem or curing is finished.

3.4 INSTALLATION - NONSHRINK EPOXY GROUTS

- A. Mix in accordance with the procedures recommended by the manufacturer. Do not vary the ratio of components or add solvent to change the consistency of the grout mix. Do not overmix. Mix full batches only to maintain proper proportions of resin, hardener and aggregate.
- B. Monitor ambient weather conditions and contact the grout manufacturer for special placement procedures to be used for temperatures below 60 or above 90 degrees F.
- C. Place grout into the designated areas in a manner which will avoid trapping air. Placement methods shall ensure the filling of all spaces and provide full contact between the grout and adjoining surfaces. Provide grout holes as necessary.
- D. Minimize "shoulder" length (extension of grout horizontally beyond base plate). In no case shall the shoulder length of the grout be greater than the grout thickness.
- E. Finish grout by puddling to cover all aggregate and provide a smooth finish. Break bubbles and smooth the top surface of the grout in conformity with the manufacturer's recommendations.
- F. Epoxy grouts are self curing and do not require the application of water. Maintain the formed grout within its recommended placement temperature range for at least 24 hours after placing, or longer if recommended by the manufacturer.

3.5 INSTALLATION - CONCRETE GROUT

- A. Screed underlying concrete to the grade shown on the Drawings. Prepare the surface according to 3.01B. Protect and keep the surface clean until placement of concrete grout.
- B. Remove the debris and clean the surface by sweeping and vacuuming of all dirt and other foreign materials. Wash the tank slab using a strong jet of water. Flushing of debris into tank drain lines will not be permitted.
- C. Saturate the concrete surface for at least 24 hours prior to placement of the concrete grout. Saturation may be maintained by ponding, by the use of soaker hoses, or by other methods acceptable to the Engineer. Remove excess water just prior to placement of the concrete grout. Place a cement slurry immediately ahead of the concrete grout so that the slurry is moist when the grout is placed. Work the slurry over the surface with a broom until it is coated with approximately 1/16 to 1/8-in thick cement paste. (A bonding grout composed of 1 part portland cement, 1.5 parts fine sand, an approved bonding admixture and water, mixed to achieve the consistency of thick paint, may be substituted for the cement slurry.)
- D. Place concrete grout to final grade using the scraper mechanism as a guide for surface elevation and to ensure high and low spots are eliminated. Unless specifically approved by the equipment manufacturer, mechanical scraper mechanisms shall not be used as a finishing machine or screed.
- E. Provide grout control joints as indicated on the Drawings.
- F. Finish and cure the concrete grout as specified for cast-in-place concrete.

3.6 SCHEDULE

- A. The following list indicates where the particular types of grout are to be used:
- B. General purpose nonshrink cementitious grout: Use at all locations where non shrink grout is called for on the plans except for base plates greater in area than 3-ft wide by 3-ft long and except for the setting of anchor rods, anchor bolts or reinforcing steel in concrete.
- C. Flowable nonshrink cementitious grout: Use under all base plates greater in area than 3-ft by 3-ft. Use at all locations indicated to receive flowable nonshrink grout by the Drawings. The Contractor, at his/her option and convenience, may also substitute flowable nonshrink grout for general purpose nonshrink cementitious grout.
- D. Nonshrink epoxy grout: Use for the setting of anchor rods, anchor bolts and reinforcing steel in concrete and for all locations specifically indicated to receive epoxy grout.
- E. Cement grout: Cement grout may be used for grouting of incidental base plates for structural and miscellaneous steel such as post base plates for platforms, base plates for beams, etc. It shall not be used when nonshrink grout is specifically called for on the Drawings or for grouting of primary structural steel members such as columns and girders.
- F. Concrete grout: Use for overlaying the base concrete under scraper mechanisms of clarifiers to allow more control in placing the surface grade.

** END OF SECTION **

SECTION 03740
MODIFICATIONS AND REPAIR TO CONCRETE

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and cut, remove, repair or otherwise modify parts of existing concrete structures or appurtenances as shown on the Drawings and as specified herein. Work under this Section shall also include bonding new concrete to existing concrete.

1.2 RELATED WORK

- A. Concrete Formwork is included in Section 03100.
- B. Concrete Reinforcement is included in Section 03200.
- C. Concrete Joints and Accessories are included in Section 03250.
- D. Cast-in-Place Concrete is included in Section 03300.
- E. Concrete Finishes are included in Section 03350.
- F. Grout is included in Section 03600.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, a schedule of Demolition and the detailed methods of demolition to be used at each location.
- B. Submit manufacturer's technical literature on all product brands proposed for use, to the Engineer for review. The submittal shall include the manufacturer's installation and/or application instructions.
- C. When substitutions for acceptable brands of materials specified herein are proposed, submit brochures and technical data of the proposed substitutions to the Engineer for approval before delivery to the project.

1.4 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C881 - Standard Specification for Epoxy-Resin-Base Bonding Systems for Concrete.
 - 2. ASTM C882 - Standard Test Method for Bond Strength of Epoxy-Resin Systems Used with Concrete by Slant Shear.
 - 3. ASTM C883 - Standard Test Method for Effective Shrinkage of Epoxy-Resin Systems Used with Concrete.
 - 4. ASTM D570 - Standard Test Method for Water Absorption of Plastics.
 - 5. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
 - 6. ASTM D695 - Standard Test Method for Compressive Properties of Rigid Plastics.
 - 7. ASTM D732 - Standard Test Method for Shear Strength of Plastics by Punch Tool.
 - 8. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
- B. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. No existing structure or concrete shall be shifted, cut, removed, or otherwise altered until authorization is given by the Engineer.

- B. When removing materials or portions of existing structures and when making openings in existing structures, all precautions shall be taken and all necessary barriers, shoring and bracing and other protective devices shall be erected to prevent damage to the structures beyond the limits necessary for the new work, protect personnel, control dust and to prevent damage to the structures or contents by falling or flying debris. Unless otherwise permitted, shown or specified, line drilling will be required in cutting existing concrete.
- C. Manufacturer Qualifications: The manufacturer of the specified products shall have a minimum of 10-years of experience in the manufacture of such products and shall have an ongoing program of training, certifying and technically supporting the Contractor's personnel.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver the specified products in original, unopened containers with the manufacturer's name, labels, product identification and batch numbers.
- B. Store and condition the specified product as recommended by the manufacturer.

2 PRODUCTS

2.1 MATERIALS

A. General

- 1. Materials shall comply with this Section and any state or local regulations.

B. Epoxy Bonding Agent

1. General

- a. The epoxy bonding agent shall be a two-component, solvent-free, asbestos-free moisture insensitive epoxy resin material used to bond plastic concrete to hardened concrete complying with the requirements of ASTM C881, Type II and the additional requirements specified herein.

2. Material

a. Properties of the cured material:

- 1) Compressive Strength (ASTM D695): 8500 psi minimum at 28 days.
- 2) Tensile Strength (ASTM D638): 4000 psi minimum at 14 days.
- 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 6,300 psi minimum at 14 days.
- 4) Shear Strength (ASTM D732): 5000 psi minimum at 14 days.
- 5) Water Absorption (ASTM D570 - 2 hour boil): One percent maximum at 14 days.
- 6) Bond Strength (ASTM C882) Hardened to Plastic: 1500 psi minimum at 14 days moist cure.
- 7) Effective Shrinkage (ASTM C883): Passes Test.
- 8) Color: Gray.

- 3. Approved manufacturers include: Sika Corporation, Lyndhurst, NJ - Sikadur 32, Hi-Mod; Master Builder's, Cleveland, OH - Concrete Liquid (LPL) or equal.

C. Epoxy Paste

1. General

- a. Epoxy Paste shall be a two-component, solvent-free, asbestos free, moisture insensitive epoxy resin material used to bond dissimilar materials to concrete and shall comply with the requirements of ASTM C881, Type I, Grade 3 and the additional requirements specified herein. It may also be used to patch existing surfaces where the glue line is 1/8-in or less.

2. Material

a. Properties of the cured material:

- 1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
- 2) Tensile Strength (ASTM D638): 3,000 psi minimum at 14 days. Elongation at Break - 0.3 percent minimum.
- 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 3,700 psi minimum at 14 days.
- 4) Shear Strength (ASTM D732): 2,800 psi minimum at 14 days.
- 5) Water Absorption (ASTM D570): 1.0 percent maximum at 7 days.
- 6) Bond Strength (ASTM C882): 2,000 psi at 14 days moist cure.
- 7) Color: Concrete grey.

3. Approved manufacturer's include:

- a. Sika Corporation, Lyndhurst, N.J. - Sikadur Hi-mod LV 32; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.
- b. Overhead applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-mod LV 31; Master Builders, Inc., Cleveland, OH - Concrecive 1438 or equal.

D. Repair Mortar

1. General

- a. Repair mortal shall be a two-component, polymer modified, cement based, fast-setting, trowel grade, structural repair mortar suitable for use on horizontal, vertical and overhead surfaces prepackaged product specifically formulated for the repair of concrete surface defects.

2. Material

a. Properties of the cured material:

- 1) Compressive Strength (2 hours 50 percent RH) – 150 psi minimum
- 2) Compressive Strength (28 days 50 percent RH) – 150 psi minimum
- 3) Bond Strength (pull off method) – 100 percent concrete substrate failure
- 4) This system shall conform with ANSI/NSF standards for surface contact with potable water.

3. Approved manufacturer's include:

- a. Sika Corporation, Lyndhurst, N.J. – SikaTop 122 PLUS or equal.
- b. Overhead applications: Sika Corporation, Lyndhurst, N.J. – SikaTop 123 PLUS or equal.

E. Non-Shrink Precision Cement Grout, Non-Shrink Cement Grout, Non-Shrink Epoxy Grout and Polymer Modified mortar are included in Section 03600 GROUT.

F. Adhesive anchor system and post-installed reinforcing bar connections in concrete shall be equal to HIY-HY 200 adhesive Anchoring System by Hilti Fastening Systems, Tulsa, OK, unless noted otherwise on the drawings. Installation of adhesive system shall be in accordance to the manufacturer's written instructions.

G. Acrylic Latex Bonding Agents shall not be used for this project.

H. Crack Repair Epoxy Adhesive

1. General

- a. Crack Repair Epoxy Adhesive shall be a two-component, solvent-free, moisture insensitive epoxy resin material suitable for crack grouting by injection or gravity feed. It shall be formulated for the specific size of opening or crack being injected.

- b. All concrete surfaces containing potable water or water to be treated for potable use that are repaired by the epoxy adhesive injection system shall be coated with an acceptable epoxy coating system that conforms with ANSI/NSF standards for surface contact with potable water.
2. Material
- a. Properties of the cured material
 - 1) Compressive Properties (ASTM D695): 10,000 psi minimum at 28 days.
 - 2) Tensile Strength (ASTM D638): 5,300 psi minimum at 14 days. Elongation at Break - 2 to 5 percent.
 - 3) Flexural Strength (ASTM D790 - Modulus of Rupture): 12,000 psi minimum at 14 days (gravity); 4,600 psi minimum at 14 days (injection)
 - 4) Shear Strength (ASTM D732): 3,700 psi minimum at 14 days.
 - 5) Water Absorption (ASTM D570 - 2 hour boil): 1.5 percent maximum at 7 days.
 - 6) Bond Strength (ASTM C882): 2,400 psi at 2 days dry; 2,000 psi at 14 days dry plus 12 days moist.
 - 7) Effective Shrinkage (ASTM 883): Passes Test.
 - 3. Approved manufacturer's include:
 - a. For standard applications: Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod; Master Builders Inc., Cleveland, OH - Concessive 1380 or equal.
 - b. For very thin applications; Sika Corporation, Lyndhurst, NJ - Sikadur Hi-Mod LV; Master Builders Inc., Cleveland, OH - Concessive 1468 or equal.

3 EXECUTION

3.1 GENERAL

- A. Cut, repair, reuse, demolish, excavate or otherwise modify parts of the existing structures or appurtenances, as indicated on the Drawings, specified herein, or necessary to permit completion of the Work. Finishes, joints, reinforcements, sealants, etc, are specified in respective Sections. All work shall comply with other requirements of this of Section and as shown on the Drawings.
- B. All commercial products specified in this Section shall be stored, mixed and applied in strict compliance with the manufacturer's recommendations.
- C. In all cases where concrete is repaired in the vicinity of an expansion joint or control joint the repairs shall be made to preserve the isolation between components on either side of the joint.
- D. When drilling holes for dowels/bolts at new or existing concrete, drilling shall stop if rebar is encountered. As approved by the Engineer, the hole location shall be relocated to avoid rebar. Rebar shall not be cut without prior approval by the Engineer. Where possible, rebar locations shall be identified prior to drilling using "rebar locators" so that drilled hole locations may be adjusted to avoid rebar interference.

3.2 CONCRETE REMOVAL

- A. Concrete designated to be removed to specific limits as shown on the Drawings or directed by the Engineer, shall be done by line drilling at limits followed by chipping or jack-hammering as appropriate in areas where concrete is to be taken out. Remove concrete in such a manner that surrounding concrete or existing reinforcing to be left in place and existing in place equipment is not damaged. Sawcutting at limits of concrete to be removed shall only be done if indicated on the Drawings, or after obtaining written approval from the Engineer.

- B. Where existing reinforcing is exposed due to saw cutting/core drilling and no new material is to be placed on the sawcut surface, a coating or surface treatment of epoxy paste shall be applied to the entire cut surface to a thickness of 1/4-in.
- C. In all cases where the joint between new concrete or grout and existing concrete will be exposed in the finished work, except as otherwise shown or specified, the edge of concrete removal shall be a 1-in deep saw cut on each exposed surface of the existing concrete.
- D. Concrete specified to be left in place which is damaged shall be repaired by approved means to the satisfaction of the Engineer.
- E. The Engineer may from time to time direct the Contractor to make additional repairs to existing concrete. These repairs shall be made as specified or by such other methods as may be appropriate.

3.3 SURFACE PREPARATION

- A. Connection surfaces shall be prepared as specified below for concrete areas requiring patching, repairs or modifications as shown on the Drawings, specified herein, or as directed by the Engineer.
- B. Remove all deteriorated materials, dirt, oil, grease, and all other bond inhibiting materials from the surface by dry mechanical means, i.e. - sandblasting, grinding, etc, as approved by the Engineer. Be sure the areas are not less than 1/2-in in depth. Irregular voids or surface stones need not be removed if they are sound, free of laitance, and firmly embedded into parent concrete, subject to the Engineer's final inspection.
- C. If reinforcing steel is exposed, it must be mechanically cleaned to remove all contaminants, rust, etc, as approved by the Engineer. If half of the diameter of the reinforcing steel is exposed, chip out behind the steel. The distance chipped behind the steel shall be a minimum of 1/2-in. Reinforcing to be saved shall not be damaged during the demolition operation.
- D. Reinforcing from existing demolished concrete which is shown to be incorporated in new concrete shall be cleaned by mechanical means to remove all loose material and products of corrosion before proceeding with the repair. It shall be cut, bent or lapped to new reinforcing as shown on the Drawings and provided with a minimum cover all around as specified on the contract drawings or 2-in.
- E. The following are specific concrete surface preparation "methods" are to be used where called for on the Drawings, specified herein or as directed by the Engineer. All installation of anchors shall be according to the manufacturer's recommendations.
 - 1. Method A: After the existing concrete surface at connection has been roughened and cleaned, thoroughly moisten the existing surface with water. Brush on a 1/16-in layer of cement and water mixed to the consistency of a heavy paste. Immediately after application of cement paste, place new concrete or grout mixture as detailed on the Drawings.
 - 2. Method B: After the existing concrete surface has been roughened and cleaned, apply epoxy bonding agent at connection surface. The field preparation and application of the epoxy bonding agent shall comply strictly with the manufacturer's recommendations. Place new concrete or grout mixture to limits shown on the Drawings within time constraints recommended by the manufacturer to ensure bond.
 - 3. Method C: Drill a hole 1/4-in larger than the diameter of the dowel. The hole shall be blown clear of loose particles and dust just prior to installing epoxy. The drilled hole shall first be filled with epoxy paste, and then dowels/bolts shall be buttered with paste then inserted by tapping. Unless otherwise shown on the Drawings, deformed bars shall be drilled and set to a depth of ten bar diameters and smooth bars shall be drilled and set to a depth of fifteen bar diameters. If not noted on the Drawings, the Engineer will provide details regarding the size and spacing of dowels.
 - 4. Method D: Combination of Method B and C.

5. Method E: Capsule anchor system shall be set in existing concrete by drilling holes to the required depth to develop the full tensile and shear strengths of the anchor material being used. The anchor bolts system shall be installed per the manufacturer's recommendation in holes sized as required. The anchor stud bolt, rebar or other embedment item shall be tipped with a double 45 degree chamfered point, securely fastened into the chuck of all rotary percussion hammer drill and drilled into the capsule filled hole.

3.4 GROUTING

- A. Grouting shall be as specified in Section 03600.

3.5 CRACK REPAIR

- A. Cracks on horizontal surfaces shall be repaired by gravity feeding crack sealant into cracks per manufacturer's recommendations. If cracks are less than 1/16-in in thickness they shall be pressure injected.
- B. Cracks on vertical surfaces shall be repaired by pressure injecting crack sealant through valves sealed to surface with crack repair epoxy adhesive per manufacturer's recommendations.

** END OF SECTION **

SECTION 04150
MASONRY ACCESSORIES

1 GENERAL

1.1 DESCRIPTION

- A. Work Included: Furnish and install specified joint reinforcement, anchors, ties, control joints, and related masonry accessories.

1.2 RELATED DOCUMENTS

- A. Applicable portions of the Agreement, Conditions of the Contract (General, Supplementary, and other Conditions), Drawings, Specifications, and Addenda issued prior to the execution of the Contract, other documents listed in the Agreement and Modifications issued after the execution of the Contract shall apply to this Section. The general requirements for this work are located in Division 1 of the Specifications.

1.3 SUBMITTALS AND SUBSTITUTIONS

- A. In accordance with Section 01300.

1.4 PRODUCT HANDLING

- A. Protection: Protect masonry accessory materials before, during, and after installation. Protect installed work and materials of other trades.
- B. Replacements: In event of damage, immediately make replacements necessary to approval of Architect and at Contractor's expense.

2 PRODUCTS

2.1 METAL ACCESSORIES

A. Wall Reinforcement

1. Reinforcement shall be ladder truss type, fabricated with single pair of galvanized 9-gauge side rods and continuous 9-gauge diagonal cross-rods spaced not more than 16 inches O.C. Construct to allow cross-rods to provide CMU cores completely open with no rods crossing to allow free grouting and vertical wall reinforcement spaces.
2. Reinforcement shall be manufactured by Dur-O-Wal, a Hohmann & Barnard Company; Masonry Reinforcing Corp. of America; or equal.

B. Wall Ties and Anchors

1. Brick Veneer Anchoring: Attach brick veneer to backing with metal ties. Maximum spacing shall be 24 inches vertically and 24 inches horizontally. Embed ties at least 2 inches in horizontal joint of facing.
2. Ties to steel at tops of CMU partitions and walls shall be miscellaneous steel shapes and fasteners as detailed. Ties to steel columns shall be 3/16-inch diameter galvanized trapezoidal ties, 8 inches long, Dur-O-Wal No. D/A 730 spaced at 16 inches O.C. with ¼-inch wire D/A 207 galvanized column anchors welded to structural steel. Use same anchor to beam webs spaced 32 inches O.C. horizontally. Miscellaneous corrugated metal ties shall be 1-1/2-inch wide, 16-gauge galvanized steel, length to provide embedment as shown or as approved, spaced at 16 inches O.C.
3. Provide and install miscellaneous anchors and attachment members, required both for the anchorage of work of this Section and that of other trades requiring attachment to masonry, which are not specifically provided under separate Sections.
4. All galvanizing shall be mill type conforming to ASTM A641, Class III.
5. Ties and anchors shall be manufactured by Dur-O-Wal, a Hohmann & Barnard Company; Masonry Reinforcing Corp. of America; or equal.

- C. Control joint material shall be as specified in Section 04200 "Masonry".
- D. Through-wall Flashing
 - 1. Through-wall flashing shall be factory-assembled material composed of two layers of asphalt saturated square woven glass fabric sandwiching electro-sheet copper, bonded to fabric with asphalt mastic.
 - 2. Electro sheet copper shall consist of a full sheet of copper weighing 3 oz./ft².
 - 3. Manufacturers: AFCO Products, Inc.; York Manufacturing; or equal.
- E. Reinforcing Bars: Where shown, Grade 60 conforming to ASTM A615.

2.2 FINISHES FOR METAL ACCESSORIES

- A. Finish metal accessories according to the following requirements as set forth in ASCE6/ACI 530.1:
 - 1. Joint Reinforcement, Interior Wall: ASTM A641 Class 1.
 - 2. Joint Reinforcement, wire ties or anchors, in exterior walls or interior walls exposed to moist environment: ASTM A153 Class B2.
 - 3. Sheet metal ties or anchors completely embedded in mortar or grout: ASTM A525 Class G60.
 - 4. Wire ties or anchors in interior walls: ASTM A641 Class 3.
 - 5. Sheet metal ties and anchors in exterior walls or interior walls exposed to moist environment: ASTM A153.

2.3 CONTROL JOINTS IN CONCRETE MASONRY UNITS

- A. In addition to locations shown on Drawings, locate control joints so that spacing does not exceed 1.5 times height of wall or 30 ft-0 inches O.C. for reinforced CMU or 25 ft-0 inches O.C. for non-reinforced CMU.
- B. Provide preformed gaskets placed in sash grooves of concrete masonry using Dur-O-Wal D/A 2001/2025, or approved equal. Factory extrude from solid section of natural or synthetic rubber conforming to ASTM D-2000 2AA-805, with minimum durometer hardness of not less than 80 when tested in accordance with ASTM D 2240.
- C. At exposed face of CMU, provide backer rod and sealant in addition to extruded sash groove control joint.

3 EXECUTION

3.1 INSTALLATION OF MASONRY ACCESSORIES

- A. Install masonry accessories at proper stages of masonry construction specified in Section 04200, "Unit Masonry", and as required for performance of proper masonry workmanship.

** END OF SECTION **

SECTION 04200
MASONRY

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and construct all masonry work as shown and as specified herein.
- B. The work under this Section includes, but is not necessarily limited to, the following:
 - 1. Face brick masonry
 - 2. Concrete masonry units (CMU)
 - 3. Grouting as specified herein.
 - 4. Vertically applied membrane flashing where and as detailed.

1.2 RELATED WORK

- A. Masonry Accessories are included in Division 4.
- B. Vertical and horizontal deformed steel reinforcing bars for wall reinforcing and CMU lintel reinforcing are furnished under Division 3.
 - a. Grouting of base plates and equipment is included in Division 3.
- C. Miscellaneous metals are included in Division 5.
- D. Joint Sealers is included in Division 7.

1.3 SUBMITTALS

- A. Submit 2 copies of the masonry manufacturer's specifications and other data for each type of brick or CMU unit required, including certification that each type complies with the specified requirements.
- B. Submit 3 samples of each type of exposed brick required. Include in each set the full range of exposed color and texture to be expected in the completed work. Engineer's review will be for color and texture only.

1.4 SAMPLES

- A. Submit to the Engineer for approval, representative samples of all required masonry and accessory materials. Submit manufacturer's technical information on masonry cleaning product. Submit with samples, manufacturer's technical information, all certifications and test data required to prove compliance with the Specifications and building code.
- B. Resubmit as required until approved.
- C. After approval of all masonry units and before commencing with the laying of any architectural masonry, construct on the site a sample mockup wall panel of each type of masonry work required. Mockup wall panel shall be 72 inches long x 48 inches high and shall include return ends 16 inches long x 48 inches high. Sample panel shall be typical of work as it will appear in the completed project, including a sample control joint. Sample mockup wall panel shall be approved by the engineer prior to commencement of work.
- D. Include special shapes, sills, and corners; include one complete exterior and interior vertical control joint to be caulked under Division 7. Include one length of through-wall flashing to be installed under Division 7 and weep holes as specified. Reconstruct as ordered until approved. This sample wall, when approved, shall become the standard of acceptance for masonry appearance and shall remain in place for the duration of the masonry work. Remove sample panel at the completion of the work as directed by the Engineer.
- E. Where brickwork is required to match existing building, construction a sample panel located adjacent to an existing wall to verify the match. The Owner will approve the match.

1.5 PERFORMANCE REQUIREMENTS

- A. Provide unit masonry that develops the net-area compressive strengths (f_m) at 28 days as indicated on the structural drawings. Determine compressive strength of masonry from net-area compressive strengths of masonry units and mortar types (using mortar type specified herein) according to Tables 1 and 2 in ACI 530.1/ASCE 6/TMS 602-95.

1.6 PRE-CONSTRUCTION TESTING

- A. Pre-construction Testing Service: Owner will engage a qualified independent testing agency to perform preconstruction testing indicated below. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
 - 1. Masonry Unit Test: For each type of unit required, according to ASTM C 140 for compressive strength.
 - 2. Mortar Test (Property Specification): For each mix required, according to ASTM C 109/C 109M for compressive strength, ASTM C 1506 for water retention, and ASTM C 91 for air content.
 - 3. Mortar Test (Property Specification): For each mix required, according to ASTM C 780 for compressive strength.
 - 4. Grout Test (Compressive Strength): For each mix required, according to ASTM C 1019.
 - 5. Prism Test: For each type of construction required, according to ASTM C 1314.

1.7 PROTECTION OF MATERIALS

- A. All perishable materials for the work of this Section shall be delivered stored and handled so as to preclude damage of any nature. Manufactured materials, such as cement and lime, shall be delivered and stored in their original containers, plainly marked with identification of material and maker. Materials in broken containers, or in packages showing water marks or other evidence of damage, shall not be used and shall be removed from the site.
- B. All masonry shall be shipped stacked with hay or straw protection or other suitable protective device, and shall be similarly stacked off the ground on the site. In addition, all masonry stored on the site shall be protected from the weather and staining with the use of tarpaulins or other covering approved by the Engineer.
- C. All masonry shall be particularly well covered and protected during manufacture, storage, shipping and while on the job site to prevent contamination which may lead to efflorescence in the finished work. If efflorescence occurs in the finished work, the Architect & Engineer may order the removal and replacement of areas so affected.

1.8 COLD AND HOT WEATHER CONSTRUCTION

- A. Masonry construction in cold and in hot weather shall conform to the applicable requirements of ACI530.1/ASCE6/TMS 602-95 except where more stringent requirements are specified herein. Heat and enclosures will be the only protection method allowed and no mortar additives shall be used for freezing protection in cold weather.
- B. Cold-Weather Cleaning - Use liquid cleaning methods only when air temperature is 40 degrees F and above and will remain so, until masonry has dried, but not less than 7 days after completing cleaning.

1.9 REFERENCE STANDARDS

- A. American Concrete Institute (ACI)
 - 1. ACI-530.1/ASCE6/TMS 602-95 - Specifications for Masonry Structures
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A82 - Standard Specification for Steel Wire, Plain, for Concrete Reinforcement
 - 2. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware

3. ASTM A167 - Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet and Strip
 4. ASTM C33 - Standard Specification for Concrete Aggregates
 5. ASTM C62 – Standard Specification for Building Brick (Solid Masonry Units Made From Clay or Shale)
 6. ASTM C67 - Standard Test Methods of Sampling and Testing Brick and Structural Clay Tile
 7. ASTM C90 - Standard Specification for Loadbearing Concrete Masonry Units
 8. ASTM C140 - Standard Test Methods of Sampling and Testing Concrete Masonry Units
 9. ASTM C144 - Standard Specification for Aggregate for Masonry Mortar
 10. ASTM C150 - Standard Specification for Portland Cement
 11. ASTM C207 - Standard Specification for Hydrated Lime for Masonry Purposes
 12. ASTM C270 - Standard Specification for Mortar for Unit Masonry
 13. ASTM C426 - Standard Test Method for Drying Shrinkage of Concrete Block
 14. ASTM C476 - Standard Specification for Grout for Masonry
- C. Where reference is made to one of the above standard or other standards cited below, the revision in effect at the time of bid opening shall apply except for ACI standard specified above.

2 PRODUCTS

2.1 MATERIALS – BRICK

- A. Obtain brick from one manufacture, of uniform texture and color or uniform blend in the variation thereof, for each continuous area and for visually related areas.
- B. Size: 3-5/8-inch x 3-5/8-inch x 7-5/8-inch, Jumbo utility closure.
- C. Manufacturers: Subject to Engineers and Owners approval, provide face brick to match existing structures located on the project site.
- D. Face brick units shall be made of clay or shale material, confirming to the latest specification of ASTM C 216, shall be grade SW, type FBS (normal variations) as established therein.
- E. Color and texture of brick units used shall be selected by the Owner from sample panels submitted by the Contractor from the proposed supplier, except when matching existing buildings.

2.2 MATERIALS – MASONRY

- A. Concrete Masonry Units (CMU)
 1. CMU shall conform to ASTM C90, light weight, Type II, hollow, two-core, load bearing units of 8-inch x 8-inch x 16-inch and 8-inch x 12-inch x 16-inch nominal dimensions.
 2. CMU shall be free from substances that will cause staining or pop-outs, and shall be fine, even texture with straight and true edges. All units shall be air cured in covered storage for not less than 28 days before delivery.
 3. Units shall be obtained from one manufacturer to insure even color and texture.
 4. Provide special units required by the Drawings, including solid, corner, control joint units, lintel, bond beam and jamb units.
 5. Provide units that meet equivalent thickness requirements of the building code where required for fire-rated construction.
 6. Shapes: Provide shapes indicated and as follows:

- a. Provide special shapes for lintels, corners, jambs, sashes, movement joints, headers, bonding, and other special conditions.
 - b. Provide square-edged units for outside corners, unless otherwise indicated.
7. Integral Water Repellent: Provide units made with integral water repellent.
- a. Integral Water Repellent: Liquid polymeric, integral water-repellent admixture that does not reduce flexural bond strength. Units made with integral water repellent, when tested as a wall assembly made with mortar containing integral water-repellent manufacturer's mortar additive according to ASTM E 514, with test period extended to 24 hours, show no visible water or leaks on the back of test specimen.
 - 1) Products:
 - a) ACM Chemistries; RainBloc.
 - b) BASF Aktiengesellschaft; Rheopel Plus.
 - c) Grace Construction Products, W. R. Grace & Co. - Conn.; Dry-Block.
 - d) Or equal.
8. Air and Moisture Barrier:
- a. All exterior faces of new masonry shall receive air and moisture barrier where indicated on the Drawings. Air and moisture barrier shall be a fluid applied, single component silyl-terminated-poly-ether (STPE) seamless elastomeric membrane.
 - b. Basis of design shall be R-Guard Cat 5 by Prosoco, Inc. applied to a thickness of 12 mils. Surface preparation and installation shall be in accordance with manufacturer's written requirements.
9. Color and Texture:
- a. Integrally Colored Smooth Face CMU: Gray

2.3 REINFORCING, TIES, ANCHORS AND MISCELLANEOUS

- A. Wall Reinforcement: See Section 04150, Masonry Accessories.
- B. Wall Ties and Anchors: See Section 04150, Masonry Accessories.
- C. Compressible filler for use in conjunction with masonry shall be pre-molded, 35 percent compressible, neoprene foam strips complying with ASTM D1056, Grade 2A1. Thickness shall be 3/8-inch or as otherwise shown by width required for joint and wall conditions, allowing 3/4-inch depth for backer rod and sealant where shown.

2.4 MORTAR AND GROUT MATERIALS

- A. Portland cement shall conform to ASTM C150 Type I. Masonry cements shall NOT be used.
- B. Lime for masonry mortar shall be hydrated, conforming to ASTM C207, Type S.
- C. Sand shall be carefully graded and washed natural sands or manufactured granite, marble, quartz or limestone sands meeting ASTM C33, except that gradation may vary to achieve desired finish and texture. Sand for grout shall conform to ASTM C144 or C33 as required.
- D. Water shall be free from injurious amounts of oils, acids, alkalis or organic matter, and shall be clean and fresh.
- E. Mortar Coloring
 - 1. Pigment for coloring masonry mortar shall be chemically pure, inorganic oxides in compounds suitably prepared for use in masonry mortar as approved.
 - 2. Color shall be approved by the Engineer and Owner and shall match the color on the existing buildings.
- F. Integral type waterproofing shall be used in all exterior mortar and shall be metallic stearate type, Hydrocide Powder by Sonneborn Contech; Omicron Mortarproofing by Master Builders Company; Integral Waterpeller by Euclid Chemical; or equal.

- G. Non-shrink grout shall be Masterflow 713 as manufactured by the Master Builders Company; Euco N-S by Euclid Chemical Co.; Five Star Grout by U.S. Grout Corporation; or equal. Grout shall attain a 28-day compressive strength of 6800 psi.

2.5 MORTAR AND GROUT MIXES

- A. Ingredients shall be accurately measured by volume in boxes especially constructed for the purpose. Measurement by shovel will not be allowed. Measure materials in a damp, loose condition.
- B. Portland cement mortar shall conform to ASTM C270, Type S. Provide test data as required to substantiate strength requirements of 3050 psi at 28 days.
- C. Grout for constructing CMU lintel blocks, bond beams and for grouting cores in CMU to receive embedded anchors or reinforcing shall conform to ASTM C476, Fine Grout, proportioned by volume: one part Portland cement, zero to 1/10 part lime, and sand equal to 2-1/4 to 3 times the sum of the volumes of cement and lime materials. Strength shall be 3050 psi minimum at 28 days. Mix grout to have a slump of 10 inches plus or minus 1 inch, at time of placement.
- D. Non-shrink grout where required shall be mixed as recommended by the manufacturer to give the necessary consistency for placing and to give a minimum compressive strength of 3,000 lbs. per square inch in three days.
- E. All other grout shall be one part Portland cement, one part sand.

3 EXECUTION

3.1 MORTAR

- A. Mortar shall be machine mixed in an approved type of mixer in which the quantity of water can be accurately and uniformly controlled. The mixing time shall not be less than five minutes, approximately two minutes of which shall be for mixing the dry materials and not less than three minutes for continuing the mixing after the water has been added. Where hydrated lime is used for mortar requiring lime content, there will be allowed the option of using the dry-mix method or first converting the hydrated lime into putty. Where the dry-mix method is employed, the materials for each batch shall be well turned over together until the even color of the mixed, dry materials indicates that the cementitious material has been thoroughly distributed throughout the mass, after which the water shall be gradually added until a thoroughly mixed mortar of the required plasticity is obtained.
- B. Mortar boxes shall be cleaned out at the end of each day's work, and all tools shall be kept clean. Mortar that has begun to set shall not be used.
- C. Colored mortar for face brickwork shall be uniform in color between batches as approved when in place and set up. Variations in color will be cause for removal and replacement of the affected area as ordered at no additional cost to the Owner.

3.2 MASONRY - INSTALLATION

- A. No material that is frozen or covered with frost or snow shall be used in the construction, and no antifreeze salts or ingredients shall be mixed with the mortar. Masonry shall not be laid at temperatures below 40 degrees F, without the approval of the Engineer, and all work shall be done in such a manner as to insure the proper and normal hardening of all mortar. All masonry work shall be so protected and heated that the temperature at the surface will not fall below 50 degrees F for a period of 72 hours after placing. Any completed work found to be affected by freezing shall be taken down and rebuilt at no expense to the Owner.
- B. All CMU shall be laid in a full bed of mortar, applied to shells only. Butter the vertical joint of unit already set in the wall and all contact faces of the unit to be set. Each unit shall be placed and shoved against the unit previously laid so as to produce a well compacted vertical mortar joint for the full shell thickness. Units shall set with all cells in a vertical position. The moisture content of the units when laid shall not exceed 35 percent of the total absorption as determined by laboratory test.

- C. Maintain tolerances in the erection of masonry as prescribed in ACI 530.1 except single-wythe walls where ordered shall be constructed with one better face in regard to plumb and line. Elsewhere, at single-wythe walls where ordered, provide two good faces by splitting the difference in wythe dimension as approved. The erection tolerances shall be reduced at all locations to a minimum within the parameters of good workmanship and as approved.
- D. Masonry Bonding
 - 1. CMU shall be laid in stretcher (running) bond unless otherwise shown.
 - 2. Fill all joints with mortar, dense and neat.
- E. Sizes shall be as specified and called for on the Drawings, and where "Soaps" and "Splits" are used, the space between these members and the backup material shall be slushed full of mortar.
- F. Joints of all masonry shall be tooled in accordance with the following:
 - 1. Wait until unit mortar is thumbprint hard before tooling joint. This may require as much as three hours in the shade and one hour in the sun in the summertime.
 - 2. The required personnel shall be kept on the job after hours, if necessary, to properly tool joints.
 - 3. Both vertical and horizontal joints shall be maintained uniform in spacing.
 - 4. Tool concave as approved, matching existing.
- G. Install all frames required to be set in masonry, set masonry tightly against frames, build in all frame anchors, and fill frames with mortar.
- H. Control joints with compressible filler shall be installed at the intersection of masonry walls with structural steel, precast concrete and cast-in-place concrete and elsewhere as detailed on the Drawings. The maximum length, horizontally, between vertical control joints shall be 30 ft (16 ft O.C. at CMU in parapets), but joints shall be located only as directed or shown. Joints shall be equal in width to the standard mortar joint.
- I. All masonry slots, chases, or openings required for the proper installation of the work of other Sections shall be constructed as indicated on the Drawings or in accordance with information furnished before the work is started at the points affected. No chase shall cut into any wall constructed of hollow units after it is built, except as directed and approved by the Engineer.
- J. Surfaces shall be brushed as work progresses and maintained as clean as it is practicable. Unfinished work shall be raked back where possible, and toothed only where absolutely necessary. Before leaving fresh or unfinished work, walls shall be fully covered and protected against rain and wind and before continuing work previously laid shall be swept clean. The tops of walls or other unfinished work shall be protected against all damage by frost or the elements by means of waterproof paper, tarpaulins, boards or other means approved by the Engineer.
- K. Parge all structural steel that will be built into masonry or covered by precast concrete with asphalt emulsion as specified above. Where insulation is required on steel, provide additional daubs of emulsion and embed insulation in emulsion as approved.
- L. Build in all miscellaneous items to be set in masonry for which placement is not specifically provided under separate Divisions, including anchor bolts, reglets, lintels, ties, electrical panel boxes, sleeves, vents, grilles, anchors, grounds, and exterior electric conduits and fixtures, and cooperate with other trades whose work is to be coordinated with the work under this Section.
- M. All anchorage, attachment, and bonding devices shall be set so as to prevent slippage and shall be completely covered with mortar or grout.
- N. All ties and reinforcing for masonry shall be furnished and installed under this Section. Continuous longitudinal wall reinforcing shall be provided in all CMU walls over 4 inches thick. Space at 16-inch O.C. vertically unless shown otherwise and 8-inch O.C. at parapets.

Omit ties and joint reinforcing at joints containing through wall flashing and locate in adjacent open joint.

- O. Build in and grout fully all vertical and horizontal wall reinforcing and CMU lintel reinforcement as shown in Drawings.
- P. Bed and grout for items coming in contact with masonry where grouting is required, including, but not limited to, door bucks and frames set in masonry. Install all anchor bolts, base plates, and seats in masonry walls, and build in all items required for the completion of the building as they apply to masonry.

3.3 REPAIR, POINTING, AND FINAL CLEANING

- A. Exposed masonry shall be protected against staining by wall coverings, and excess mortar shall be wiped off the surface as the work progresses to reduce need for cleaning at completion of the work.
- B. Where ordered, remove masonry units which are loose, chipped, broken, stained or otherwise damaged, and units which do not match adjoining units and install new units in fresh mortar or grout, pointed to eliminate, as approved by the Owner, evidence of replacement.
- C. Pointing
 - 1. During the tooling of joints, enlarge any voids or holes, except weep holes, and completely fill with mortar matching color as approved by the Engineer and tool to match. Point-up all joints at corners, openings and adjacent work to provide a neat, uniform appearance and properly prepare joints for application of sealants where required.
 - 2. Before final cleaning, repoint all unsatisfactory joints as specified above and as required by the Architect/Engineer.
- D. Final Cleaning of Masonry
 - 1. After mortar has thoroughly set and cured (three weeks minimum during the summer; five weeks minimum during the winter), a sample wall area (approximately 20 ft²), shall be cleaned, with an approved commercial masonry cleaner, diluted and mixed with water as recommended by the manufacturer and as approved. The sample area may be the sample wall panel specified above or an area in the finish work as directed by the Engineer.
 - 2. The Architect/Engineer's acceptance of sample cleaning shall be obtained before proceeding to clean remainder of masonry work. A minimum of one week of dry weather is required to evaluate effectiveness of cleaning and effect on masonry and mortar. Upon acceptance, all face brick masonry shall be cleaned by the same method to the satisfaction of the Architect/Engineer.
- E. Acid solutions shall not be used for cleaning CMU. Upon completion of the work, all surfaces of CMU shall be washed with soap powder and warm water, applied with a scrubbing brush, and then rinsed thoroughly with clear water. Other cleaning methods may be ordered to obtain required appearance.
- F. Masonry areas not satisfactorily cleanable will be ordered replaced at no extra cost to the Owner.

3.4 FIELD QUALITY CONTROL

- A. Testing and Inspecting: Owner will engage special inspectors to perform tests and inspections and prepare reports. Allow inspectors access to scaffolding and work areas, as needed, to perform tests and inspections. Retesting of materials that fail to comply with specified requirements shall be done at Contractor's expense.
- B. Inspections: Special inspections shall be done in accordance with Chapter 17 of the "International Building Code".
 - 1. Begin masonry construction only after inspectors have verified proportions of site-prepared mortar.

2. Place grout only after inspectors have verified compliance of grout spaces and of grades, sizes, and locations of reinforcement.
 3. Place grout only after inspectors have verified proportions of site-prepared grout.
- C. Testing Prior to Construction: One set of tests.
 - D. Testing Frequency: One set of tests for each 5000 ft² of wall area or portion thereof.
 - E. Concrete Masonry Unit Test: For each type of unit provided, according to ASTM C140 for compressive strength.
 - F. Mortar Aggregate Ratio Test (Proportion Specification): For each mix provided, according to ASTM C780.
 - G. Mortar Test (Property Specification): For each mix provided, according to ASTM C780. Test mortar for mortar air content and compressive strength.
 - H. Grout Test (Compressive Strength): For each mix provided, according to ASTM C1019.
 - I. Prism Test: For each type of construction provided, according to ASTM C1314 at seven days and at 28 days.

** END OF SECTION **

SECTION 05120
STRUCTURAL STEEL

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor and materials required and install structural steel including bearing plates, columns, beams and miscellaneous shapes and plates required to erect the structural framing as shown on the Drawings and as specified herein.
- B. Furnish only anchor bolts with templates to be installed under Division 3. Furnish and install nuts and washers for anchor bolts.

1.2 RELATED WORK

- A. Grouting of baseplates is included in Section 03600.
- B. Masonry ties to be connected to structural steel are furnished under Section 04200.
- C. Miscellaneous metal is included in Section 05500.
- D. Field painting, except as specified herein, is included in Division 9.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, erection drawings, detailed shop drawings, schedules and data for all structural steel. Approval will be for strength only and shall not relieve the Contractor of responsibility for proper fit of members, of connections not detailed on the Drawings, or for supplying all material required by the Contract Documents. Mark numbers painted on the shop assembled pieces of steel shall be the same mark numbers used on the detailed shop and erection drawings.
- B. Product data and installation instructions for Contractor proposed load indicator bolts or direct tension indicators.
- C. Certified mill test reports for the structural steel and the bolting materials.
- D. Certifications that welders are qualified, in accordance with AWS D1.1, on the shop and field welding procedures to be used.

1.4 REFERENCE STANDARDS

- A. American Institute of Steel Construction (AISC)
 - 1. AISC S303 - Code of Standard Practice for Steel Buildings and Bridges
 - 2. AISC 360 – Manual of Steel Construction – 14th Edition.
 - 3. AISC S335 - Specification for Structural Steel Buildings Allowable Stress Design and Plastic Design with Commentary.
 - 4. AISC M016 - Manual of Steel Construction Allowable Stress Design.
- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel
 - 2. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
 - 3. ASTM A123 - Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products
 - 4. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware
 - 5. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
 - 6. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

7. ASTM A490 - Standard Specification for Heat Treated Steel Structural Bolts, 150 ksi Minimum Tensile Strength
 8. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
 9. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
 10. ASTM B695 - Standard Specification for Coatings of Zinc Mechanically Deposited on Iron and Steel.
- C. American Welding Society (AWS)
1. AWS A5.1 - Specification for Carbon Steel Electrodes for Shielded Metal Arc Welding.
 2. AWS D1.1 - Structural Welding Code Steel.
- D. Research Council on Structural Connections of the Engineering Foundation (RCSCEF)
1. Specification for Structural Joints using ASTM A325 or ASTM A490 Bolts.
- E. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. Structural steel shall be in accordance with the AISC Standard for Structural Steel Buildings - Allowable Stress Design and Plastic Design and the Code of Standard Practice for Steel Buildings and Bridges, unless otherwise specified herein.
- B. Welding shall be in accordance with AWS D1.1 unless otherwise specified herein or in the AISC Standard.
- C. High strength bolt materials, accessories and installation shall be in accordance with AISC Specifications for Structural Joints Using ASTM A325 or A490 Bolts.

1.6 SYSTEM DESCRIPTION

- A. Design connections not detailed on the Drawings to support loads shown on the Drawings. Calculations for these connections shall be sealed by a registered professional engineer in the State of Georgia.
- B. Beam connections not detailed on the Drawings shall be bolted framed beam connections as shown in Table II of the AISC Manual of Steel Construction - Allowable Stress Design, Part 4.
- C. Bolted shear connections shall be bearing-type connections unless otherwise shown.

1.7 DELIVERY, STORAGE AND HANDLING

- A. Deliver materials promptly so as to cause no delay with other parts of the work.
- B. Store materials on skids and not on the ground. Pile and block materials so that they will not become bent or otherwise damaged.
- C. Handle materials with cranes or derricks as far as practicable. Do not dump steel off cars or trucks nor handle in any other manner likely to cause damage.

2 PRODUCTS

2.1 MATERIALS

- A. Rolled steel wide flange: ASTM A992.
- B. Plates, rods, bars, and other structural steel shapes other than wide flange shapes, unless otherwise noted: ASTM A36.
- C. Structural tube: ASTM A500, Grade B or ASTM A501.
- D. Structural pipe: ASTM A53, Type S, Grade B.
- E. Welding electrodes: AWS A5.1, E70XX.

- F. High strength steel bolts, nuts and washers: ASTM A325. Where galvanized material is to be connect; use ASTM A325, Type 1, mechanically galvanized to ASTM B695, Class 50, Type II.
- G. Anchor bolts: ASTM F1154, Grade 36. Provided standard headed bolts with heavy hex nuts and Grade A washers. Where galvanized anchor bolts are shown or specified, provide all components galvanized in accordance with ASTM F2329.
- H. Shop primer: As specified in Section 09900.
- I. Galvanizing: Zinc with 0.5 percent (minimum) nickel added.
- J. Galvanized surface primer: 95 percent zinc duck, organic vehicle primer.

2.2 FABRICATION

- A. Match-mark materials for field assembly. Ream unmatched holes in shop assembly of field connections. Reject and replace with new pieces any piece weakened by reaming to a point where the strength of the joint is impaired.
- B. Welding of parts shall be done only where shown on the Drawings or specified herein and by welders and welding operators qualified for the procedures used.

2.3 SURFACE PREPARATION AND SHOP COATINGS

- A. Prepare and shop prime paint non-galvanized members as specified in Section 09900. Omit paint within 3 inches of field welds. Do not prime paint faying surfaces of slip critical connections.

3 EXECUTION

3.1 INSTALLATION

- A. Furnish and install temporary bracing to provide stability during erection and to prevent distortion or damage to the framing due to wind, seismic, or erection forces. Remove temporary bracing when erection is complete.
- B. Use drift pins only to bring members into position and not to enlarge or distort holes.
- C. Make all steel to steel connections by high strength bolting except where field welding is shown or specified. Provide not less than two 3/4-in bolts per connection and use not less than 1/4-in thick clip angles.
- D. Tighten bolted connections designated as bearing-type connections to the snug tight condition. Tighten all other bolted connections to full pretension by turn-of-nut or calibrated wrench tightening.
- E. Field welding shall be done only where shown or specified and only by welders qualified for the procedures used. No welding shall be done when surfaces are wet, exposed to rain or wind, or when welders are exposed to inclement conditions that will hamper good workmanship.
- F. Each bolting crew [and welder] shall be assigned an identification mark. This mark shall be made at each completed connection with a paint stick.
- G. After erection, prime paint abrasions, field welds and unprimed surfaces, using shop primer except surfaces designated to be unpainted or surfaces in contact with concrete.
- H. After erection, prime paint abrasions, field welds, on galvanized surfaces with galvanized surface primer.

3.2 FIELD TESTING

- A. Allow the Engineer free access to the work. Notify the Engineer in writing 4 working days in advance of high strength bolting or field welding operations.
- B. High strength bolting will be inspected visually. All high strength bolts shall have the turned portion marked with reference to the steel being connected after the nut has been made snug and prior to final tightening. Retighten rejected bolts or remove and provide new

bolts. In cases of disputed bolt installations, the bolts in question shall be checked using a calibrated wrench certified by an independent testing laboratory approved by the Engineer. The certification shall be at the Contractor's expense.

- C. Field welding will be inspected visually by AWS certified welding inspectors provided by the Owner.
- D. The fact that steel work has been accepted at the shop and mill will not prevent its final rejection at the site, before or after erection, if it is found to be defective.
- E. Remove rejected steel work from the site within 10 working days after notification of rejection.

**** END OF SECTION ****

SECTION 05500
MISCELLANEOUS METAL

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all miscellaneous metal complete as shown on the Drawings and as specified herein.

1.2 RELATED WORK

- A. Concrete joint accessories are included in Section 03350.
- B. Masonry reinforcement, ties and accessories are included in Division 4.
- C. Metal doors and frames are included in Section 08100.
- D. Painting is included in Division 9.
- E. Louvers are included in Division 10.
- F. Sluice gates, slide gates, operators and appurtenances, including wall thimbles, are included in Division 11.
- G. Pipe hangers and sleeves are included in Division 15.
- H. Equipment anchor bolts are included in the respective Sections of Divisions 11, 14 and 15.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, shop drawings and product data showing materials of construction and details of installation for:
 - 1. Shop drawings, showing sizes of members, method of assembly, anchorage and connection to other members.
- B. Samples
 - 1. Submit samples as requested by the Engineer during the course of construction.
- C. Design Data
 - 1. Submit calculations sealed by a professional engineer registered in the State of Georgia or submit load tables and test data demonstrating that the railings and their attachments will resist the loads specified in the 2012 IBC Building Code at the post spacing provided.
 - 2. Submit manufacturer's load and deflection tables for grating.
- D. Test Reports
 - 1. Certified copy of mill test reports on each aluminum proposed for use showing the physical properties and chemical analysis.
- E. Certificates
 - 1. Submit certification that the railing system is in compliance with OSHA requirements and the IBC.
 - 2. Certify that welders have been qualified under AWS, within the previous 12 months, to perform the welds required under this Section.

1.4 REFERENCE STANDARDS

- A. Aluminum Association (AA)
 - 1. ABH-21 Aluminum Brazing Handbook
 - 2. ASD-1 Aluminum Standards and Data
 - 3. DAF-45 Designation System for Aluminum Finishes
 - 4. SAA-46 Standards for Anodized Architectural Aluminum

- B. American Society for Testing and Materials (ASTM)
 - 1. ASTM A36 - Standard Specification for Carbon Structural Steel.
 - 2. ASTM A48 - Standard Specification for Gray Iron Castings.
 - 3. ASTM A53 - Standard Specification for Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless.
 - 4. ASTM A108 - Standard Specification for Steel Bars, Carbon, Cold Finished, Standard Quality.
 - 5. ASTM A123 - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
 - 6. ASTM A153 - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
 - 7. ASTM A240 - Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
 - 8. ASTM A276 - Standard Specification for Stainless Steel Bars and Shapes.
 - 9. ASTM A307 - Standard Specification for Carbon Steel Bolts and Studs, 60,000 Psi Tensile Strength.
 - 10. ASTM A325 - Standard Specification for Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength.
 - 11. ASTM A366 - Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
 - 12. ASTM A500 - Standard Specification for Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes.
 - 13. ASTM A501 - Standard Specification for Hot-Formed Welded and Seamless Carbon Steel Structural Tubing.
 - 14. ASTM A536 - Standard Specification for Ductile Iron Castings.
 - 15. ASTM A570 - Standard Specification for Steel, Sheet and Strip, Carbon, Hot-Rolled, Structural Quality.
 - 16. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
 - 17. ASTM B221 - Standard Specification for Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles and Tubes.
 - 18. ASTM B429 - Standard Specification for Aluminum-Alloy Extruded Structural Pipe and Tube.
 - 19. ASTM F593 – Standard Specification for Stainless Steel Bolts, Hex Caps Screws, and Studs.
 - 20. ASTM F1554 – Standard Specification for Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength.
- C. American Iron and Steel Institute (AISI).
 - 1. Specification for Structural Steel Buildings.
- D. American Welding Society (AWS)
 - 1. AWS D1.1 - Structural Welding Code Steel.
 - 2. AWS D1.2 - Structural Welding Code Aluminum.
 - 3. AWS D1.6 - Structural Welding Code Stainless Steel.
- E. Occupational Safety and Health Administration (OSHA)
- F. 2012 International Building Code (IBC)

- G. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. The work of this Section shall be completely coordinated with the work of other Sections. Verify, at the site, both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- B. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other Sections.
- C. All welding shall be performed by qualified welders and shall conform to the applicable AWS welding code. Welding of steel shall conform to AWS D1.1 and welding of aluminum shall conform to AWS D1.2.

1.6 DELIVERY, STORAGE AND HANDLING

- A. Deliver items to be incorporated into the work of other trades in sufficient time to be checked prior to installation.
- B. Repair items which have become damaged or corroded to the satisfaction of the Engineer prior to incorporating them into the work.

1.7 PROJECT/SITE REQUIREMENTS

- A. Field measurements shall be taken at the site, prior to fabrication of items, to verify or supplement indicated dimensions and to ensure proper fitting of all items.

2 PRODUCTS

2.1 GENERAL

- A. The use of manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
- B. Like items of materials shall be the end products of one manufacturer in order to provide standardization for appearance, maintenance and manufacturer's service.

2.2 MATERIALS

- A. Unless otherwise noted, materials for miscellaneous metals shall conform to the following standards:
 - 1. Structural Steel
 - a. W Shapes: ASTM A992, Gr.50
 - b. M Shapes: ASTM A36
 - c. S, C and MC Shapes: ASTM A36
 - d. L Shapes: ASTM A36
 - e. Plates, rods and Bars: ASTM A36
 - 2. HSS Rectangular Shapes: ASTM A500, Grade B, 42 ksi
 - 3. HSS Round Shapes: ASTM A500, Grade B, 35 ksi
 - 4. Welded and Seamless Steel Pipe: ASTM A501 or ASTM A53, Type E or S, Grade B Schedule 40. Use standard malleable iron fittings, galvanized for exterior work
 - 5. Steel Sheets: ASTM A366
 - 6. Gray Iron Castings: ASTM A48, Class 35
 - 7. Ductile Iron Castings: ASTM A536, Grade 65-45-12
 - 8. Aluminum Extruded Pipe: ASTM B429, Alloy 6063 T6

9. Aluminum Extruded Shapes	ASTM B221, Alloy 6061 T6
10. Aluminum Sheet and Plate	ASTM B209, Alloy 6061 T6
11. Stainless Steel Plates, Sheets, and Structural Shapes	
a. Exterior, Submerged or Industrial Use	ASTM A240, Type 316 (Type 316L for welded)
b. Interior and Architectural Use	ASTM A240, Type 304
12. Stainless Steel Bolts, Nuts, and Washers	ASTM A276, Type 316
13. Carbon Steel Bolts and Studs	ASTM A307, Grade A or ASTM F1154, Gr.36 (galvanized unless noted otherwise)
14. High Strength Steel Bolts, Nuts and washers	ASTM A325 (mechanically galvanized per ASTM B695, Class 50, where noted)
a. Elevated Temperature Exposure	Type I
b. General Application	Type I or Type II
15. Galvanizing	ASTM A123, Zn w/0.5 percent minimum Ni
16. Galvanizing, hardware	ASTM A153, Zn w/0.5 percent minimum Ni

2.3 ANCHORS, BOLTS AND FASTENING

- A. Furnish anchors, bolts, fasteners, etc., as necessary for installation of the work of this section or as specified for securing the work of other sections.
- B. Anchor bolt material shall be ASTM F1154, Grade 36, or ASTM A307, Grade A standard headed bolts with heavy hex nuts, Grade A washers, hot-dipped galvanized, unless noted otherwise on drawings.
- C. Unless otherwise noted, bolts for the connection of carbon steel or iron shall be steel bolts; bolts for the connection of galvanized steel or iron shall be galvanized steel or stainless steel bolts; and bolts for the connection of aluminum or stainless steel shall be stainless steel bolts.
- D. Unless otherwise noted, expansion anchors shall be zinc plated carbon steel wedge type anchors complete with nuts and washers. Type 316 stainless steel, wedge type anchors shall be used where they will be submerged or exposed to the weather or where stainless steel wedge type anchors are required. When the length or embedment of the bolt is not noted on the Drawings, provide length sufficient to place the wedge and expansion sleeve portion of the bolt at least 1-in behind the concrete reinforcing steel. Expansion anchors shall be Hilti, Kwick-bolt TZ; or approved equal.
- E. Unless otherwise noted, adhesive anchors shall be a two-component chemical resin anchoring system. Capsules shall be self-contained, exactly premeasured amounts of polyester or vinyl ester resin, aggregate and hardener. Stud assemblies shall consist of a stainless steel type 316 all-thread anchor rod with nut and washer. Provide manufacturer's recommended installation tools for installing anchor components. Install anchors in full compliance with the manufacturer's recommendations. Adhesive anchor system shall be Hilti, HIT-HY 200; Simpson Strong Tie, SET-XP Epoxy-Tie or Acrylic Tie; or approved equal.
- F. Anchors used in masonry construction shall be as indicated in Section 2.03.C above where anchors are installed into solid grouted cells. When fastening to hollow concrete block or brick, adhesive anchors shall be a three-part stud, screen and chemical dispenser anchoring system. Adhesive cartridges shall contain premeasured amounts of resin and hardener which are mixed and deposited in a screen tube by a dispenser. Stud assemblies shall consist of a stainless steel type 316 all-thread anchor rod with nut and washer. Anchors shall be Hilti, HIT HY-70 System or approved equal.

- G. Automatic end welded headed anchor studs shall be flux ended studs made from cold drawn steel, ASTM A108 Grades C-1010 through C-1020. Headed anchor studs shall be Nelson, H4L Headed Concrete Anchors or equal.
- H. Machine bolts and nuts shall conform to Federal Specification FF-B-575C. Bolts and nuts shall be hexagon type. Bolts, nuts, screws, washers and related appurtenances shall be Type 316 stainless steel.
- I. Connection bolts for wood members shall be ASTM A307, galvanized where specified.
- J. Toggle bolts shall be Hilti, Toggler Bolt or equal.

2.4 METAL GRATING

- A. Grating shall have rectangular, 3/16-in thick, bearing bars spaced 1-3/16-in on center with cross bars spaced at 4-in on center. All grating panels shall be banded with a bar the same size as the bearing bars.
 - 1. Grating shall not exceed the fabricator's maximum recommended span, and meet or exceed the following load and deflection criteria for the maximum span length at the opening being covered by the grating.
 - a. The grating shall produce a deflection of 1/360 of the span or less under a uniform live load of 100 lbs/sq ft on the maximum span.
 - b. The grating shall produce a deflection of 1/360 of the span or less under a concentrated live load of 300 lbs applied at the mid point of the maximum span.
 - 2. Openings 2-in or greater in diameter/dimension and grating edges shall be banded with a bar of the same depth and thickness as the bearing bars. Cut bearing bars or cross bars shall be welded to the banding bar.
 - 3. Provide trench grating with symmetrical cross bar arrangement.
 - 4. Grating clamps, nuts, bolts, washers and other fastening devices for grating and grating supports shall be Type 316 stainless steel. All grating shall be anchored to the supporting system using saddle clips.
- B. Aluminum grating material shall be aluminum alloy 6063-T6 with a mill finish. Cross bars shall be attached to the bearing bars with interlocked swaged joints. The grating shall be Type BS by IKG Borden, Houston, TX; Type 19 SG-4 by Ohio Gratings, Inc., Canton, OH; Type 19S4 by Seidelhuber Metal Products, San Carlos, CA or equal.
- C. Metal frames and supports for grating shall be of the same material as the grating unless otherwise shown on the Drawings. Where aluminum supports are used, they shall be fabricated from aluminum alloy 6061-T6.

2.5 RAILINGS

- A. Guardrails and railing systems shall comply with the requirements of OSHA and the IBC and shall be custom pre-engineered, mechanically fastened or welded pipe aluminum railing systems. Mechanically fastened railing system shall be TUFrail as provided by Thomson Fabrication Company or equal.
- B. Rails and posts shall be 6061-T6, 6063-T6 or 6105-T5. Splice and reinforcing sleeves, brackets, end caps, toeboards, etc, shall be aluminum alloy 6061-T6, 6063-T6 or 6105-T5 alloy. Cast fittings shall be aluminum alloy No. 214. Railing system fastening hardware shall be Type 316 stainless steel. After welding, aluminum shall be anodized. All railing, posts, toeboards and exposed aluminum shall be anodized with a clear architectural Class I satin finish providing a minimum coating thickness of 0.7 mils and a minimum coating weight of 32 milligrams per square inch in compliance with AA M10C22A41.
- C. Railings shall be 2 rail welded railing systems, as shown on the Drawings, fabricated with 1-1/2-in nominal diameter pipe. Posts shall be Schedule 80 pipe, and railing shall be Schedule 40 pipe, minimum. Posts and top rails shall be continuous. The top surface of the top railing at all points, including corners and terminations, shall be smooth and shall not be interrupted by projected fittings or posts. Spacing of posts shall not exceed 5-ft on

center and shall be uniformly spaced except as otherwise shown on the Drawings. Posts will be required on each side of structure expansion joints. All railing posts shall be vertical.

- D. Welds shall be circumferential welds ground smooth and even to produce a railing that is neat in appearance and structurally sound. Welding methods shall be in conformity with AWS standards for the materials being joined. All rail to post connections shall be coped and fastened by continuous welds. There shall be no burrs, sharp edges or protrusions on any weld on any part of the handrail system. After fabrication, the welds and surrounding area shall be cleaned and hand buffed to blend with the adjacent finish. All mechanical fasteners shall be unobtrusively located in countersunk holes with the top flush with the surface of the rail. Bends in the railing shall be as indicated by the Drawings. No distortion of the circular railing shape will be allowed. Bends and terminal sections shall be made without the use of fittings. Corner bends shall be mitered and welded bends.
- E. Railing shall be assembled in sections as long as practical but shall not be greater than 24-ft in length. A field splice shall be used when an assembled section is to be attached to another section. Field splices shall be used in all railing panels that cross over structure expansion joints.
 - 1. Field splices shall use internal splice sleeves located within 8-in of railing posts. The sleeve shall be welded to the rail on one side and fastened with a set screw to the rail on other side. The field splice shall be detailed to take the differential expansion between the railing system and the supporting structure.
 - 2. When the field splice occurs in a railing panel crossing a structure expansion joint, the sleeve shall be welded to the rail on one side and be free to slide in the rail on other side. The field splice shall be detailed to take the same movement as the structure expansion joint.
- F. The bases or supports for railing posts and handrail shall be the types indicated on the Drawings.
 - 1. Where non-removable railing is set in concrete, the posts shall be placed in 2-1/2-in diameter formed concrete openings and firmly caulked with a nonsulphur compound, hydraulic cement equal to Por-Rok by Minwax Construction Products Division Sterling Drug, Montvale, NJ. Collars shall be placed around the post bases and fastened in place with set screws on the side of the post away from the walkway. Posts shall be placed with the centerline 4-in from the edge of the concrete except that posts shall be set at the centerline of concrete curbs.
 - 2. Aluminum railing posts, which may collect condensation, shall have a 3/16-in drain hole drilled immediately above the concrete encased area, the base flange, or supporting socket on the side away from the walking area. The bottom of the rail post between the drain hole and the bottom of the post shall be filled with an inert material such as a compressed closed cell neoprene rod.
- G. Toeboards shall be provided on all railing adjacent to a drop in elevation of 4-ft or more. Toeboards are not required on the inclined portion of stairway railings or where concrete or steel curbs, 4-in or more in height, are present. Toeboards shall be 4-in high channels of the same material as the railing. The channels shall have a minimum thickness of 1/8-in and have flanges of not less than 3/4-in nor more than 1-1/2-in in width. Toeboards shall be positioned with a maximum clearance of 1/4-in from the floor and fastened to railing posts with 1/4-in stainless steel U-bolts, with J-bolts at corner posts and with clip angles and two 1/4-in stainless steel expansion bolts at walls. Toeboards shall not be welded to the posts. Connection to post shall allow expansion and contracting movements.
- H. All railings shall be properly protected by paper, or by an approved coating or by both against scratching, splashes or mortar, paint, or other defacements during transportation and erection and until adjacent work by other trades has been completed. After protective materials are removed, the surfaces shall be made clean and free from stains, marks, or defects of any kind.

- I. Aluminum shapes, including mounting brackets, in contact with concrete or a different type of metal shall be separated by a 1/32" neoprene gasket or provided with a heavy coating of protective zinc chromate for separation of dissimilar materials.
- J. Safety gates, for railing openings, shall be fabricated of matching pipe and rail material and configuration. The gates shall be self-closing gates with approved stop, latch and stainless steel closure spring and hinges.
- K. Barrier chains, for railing openings, shall be fabricated of stainless steel chains. Chain shall be 1/4-in stainless steel links, with eleven links per foot as manufactured by Eastern Chain Works, Inc., NY; Lawrence Metal Products, Inc. or equal. Chains shall be fastened to the handrail posts at the elevation of each rail. One end of each chain shall be connected to one post with a 1/4-in diameter stainless steel eye bolt and the other end shall be connected to the other post by means of a heavy chromium plated bronze swivel eye slide harness snap and a similar eye bolt.

2.6 ACCESS HATCHES

- A. Access hatches shall have single or double leaf doors as indicated by the Drawings. The doors shall be 1/4-in aluminum diamond pattern plate with welded stiffeners, as necessary, to withstand a live load of 300 lbs/sq ft with a maximum deflection of 1/150th of the span. Hatches shall have a 1/4-in aluminum channel frame with a perimeter anchor flange or strap anchors for concrete embedment around the perimeter. Where hatch is supported by steel framing members, these members shall be modified as needed to support the hatch chosen. This includes the addition of angles, tube members, etc. Unless otherwise noted on the Drawings, use pivot torsion bars for counterbalance or spring operators for easy operation along with automatic door hold open. Hardware shall be durable and corrosion resistant with Type 316 stainless steel hardware used throughout. Provide removable lock handle. Finish shall be the factory mill finish for aluminum doors and frames with bituminous coating on the exterior of the frames in contact with concrete. Hatches shall be watertight and have a 1-1/2-in drainage coupling to the channel frame. Access hatches shall be Types as indicated on the Drawings by Bilco Company, New Haven, CT or equal.

2.7 MISCELLANEOUS ALUMINUM

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Welding shall be on the unexposed side as much as possible in order to prevent pitting or discoloration of the aluminum exposed surface. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous aluminum items shall include: beams, angles, closure angles, grates, hatches, floor plates, stop plates, stair nosings, and any other miscellaneous aluminum called for on the Drawings and not otherwise specified.
- D. Angle frames for hatches, beams, grates, etc, shall be complete with welded strap anchors attached.
- E. Aluminum diamond plate and floor plate shall have a minimum thickness of 3/8-in. Frames and supports shall be of aluminum construction. Fastening devices and hardware shall be Type 304 stainless steel. Plates shall have a mill finish.
- F. Stair treads for aluminum stairs shall have abrasive non-slip nosing as approved.

- G. Aluminum nosing at concrete stairs shall be Wooster Products, Inc.; Alumogrit Treads, Type 116; similar by Barry Pattern and Foundry Co.; Andco or equal. Furnish with wing type anchors and flat head stainless steel machine screws, 12-in on center. Nosing shall also be used at concrete ladder openings. Nosing shall a single piece for each step extending to within 3-in at each side of stair or full ladder width. Set nosing flush with stair tread finish at concrete stairs. Furnish treads with heavy duty protective tape cover.
- H. Miscellaneous aluminum items shall have a cleaned and degreased mill finish.

2.8 MISCELLANEOUS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.
- C. Miscellaneous steel items shall include: beams, angles, lintels, metal stairs, support brackets, base plates for other than structural steel or equipment, closure angles, bridge crane rails, monorail hoist beams, holddown straps and lugs, door frames, splice plates, subframing at roof openings and any other miscellaneous steel called for on the Drawings and not otherwise specified.
- D. Structural steel angle and channel door frames shall be shop coated with primer. Frames shall be fabricated with not less than three anchors on each jamb.
- E. Steel pipe pieces for sleeves, lifting attachments and other functions shall be Schedule 40 pipe unless otherwise shown on the Drawings. Wall and floor sleeves, of steel pipe, shall have welded circumferential steel waterstops at mid-length.
- F. Lintels, relief angles or other steel supporting masonry or embedded in masonry shall be shop coated with primer.
- G. All steel finish work shall be thoroughly cleaned, by effective means, of all loose mill scale, rust and foreign matter and shall be given one shop coat of primer compatible with the finish coat after fabrication but before shipment. Paint shall be omitted within 3-in of proposed field welds. Paint shall be applied to dry surfaces and shall be thoroughly and evenly spread and well worked into joints and other open spaces.
- H. Galvanizing, where required, shall be the hot-dip zinc process after fabrication. Coating shall be not less than 2 oz/sq ft of surface.

2.9 MISCELLANEOUS STAINLESS STEEL

- A. All miscellaneous metal work shall be formed true to detail, with clean, straight, sharply defined profiles and smooth surfaces of uniform color and texture and free from defects impairing strength or durability. Holes shall be drilled or punched. Edges shall be smooth and without burrs. Fabricate supplementary pieces necessary to complete each item though such pieces are not definitely shown or specified.
- B. Connections and accessories shall be of sufficient strength to safely withstand the stresses and strains to which they will be subjected. Exposed joints shall be close fitting and jointed where least conspicuous. Threaded connections shall have the threads concealed where practical. Welded connections shall have continuous welds or intermittent welds as specified or shown. The face of welds shall be dressed flush and smooth. Grind smooth continuous welds that will be exposed. Provide holes for temporary field connections and for attachment of the work of other trades.

- C. Miscellaneous stainless steel items shall include: beams, angles, bar racks and any other miscellaneous stainless steel called for on the Drawings and not otherwise specified.

3 EXECUTION

3.1 INSTALLATION

- A. Install all items except those to be embedded in concrete or other masonry which shall be installed under Division 3 and Division 4 respectively. Items to be attached to concrete or masonry after such work is completed shall be installed in accordance with the details shown. Fastening to wood plugs in masonry will not be permitted.
- B. Abrasions in the shop primer shall be touched up immediately after erection. Areas left unprimed for welding shall be painted with primer after welding.
- C. Zinc coating which has been burned by welding, abraded, or otherwise damaged shall be cleaned and repaired after installation. The damage area shall be thoroughly cleaned by wire brushing and all traces of welding flux and loose or cracked zinc coating removed prior to painting. The cleaned area shall be painted with two coats of zinc oxide-zinc dust paint conforming to the requirements of Military Specifications MIL-P-15145. The paint shall be properly compounded with a suitable vehicle in the ratio of one part zinc oxide to four parts zinc dust by weight.
- D. Specialty products shall be installed in accordance with the manufacturer's recommendations.
- E. Expansion bolts shall be checked for tightness a minimum of 24 hours after initial installation.
- F. Install adhesive capsule anchors using manufacture's recommended drive units and adapters and in compliance with the manufacturer's recommendations.
- G. Headed anchor studs shall be welded in accordance with manufacturer's recommendations.
- H. All railings shall be erected to line and plumb with tightly fitted joints proving smooth transitions. For mechanically fastened systems provide gaps between connecting members no greater than 1/8" unless at designated expansion joints.
- I. All steel surfaces that come into contact with exposed concrete or masonry shall receive a protective coating of an approved heavy bitumastic troweling mastic applied in accordance with the manufacturer's instructions prior to installation.
- J. Where aluminum contacts a dissimilar metal, apply a heavy brush coat of zinc-chromate primer followed by two coats of aluminum metal and masonry paint to the dissimilar metal.
- K. Where aluminum contacts masonry or concrete, apply a heavy coat of approved alkali resistant paint to the masonry or concrete.
- L. Where aluminum contacts wood, apply two coats of aluminum metal and masonry paint to the wood.
- M. Between aluminum grating, aluminum stair treads, or aluminum handrail brackets and steel supports, insert 1/4-in thick neoprene isolator pads, 85 plus or minus 5 Shore A durometer, sized for full width and length of bracket or support.

** END OF SECTION **



SECTION 06100
CARPENTRY WORK

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all items of rough and finish carpentry work complete as shown on the Drawings and as specified herein.
- B. Set in place, all pressed metal frames which are to be built into walls. Install pressed metal frames which are to be installed in concrete openings. Install hollow metal and wood doors and finish hardware furnished under other Sections.

1.2 RELATED WORK

- A. Wood forms required for concrete work are included in Division 3.
- B. Anchor bolts and other metal appurtenances except as specified herein are included in Division 5.
- C. Metal and wood doors and metal frames are furnished under Division 8.
- D. Finish hardware is furnished under Division 8.

1.3 SUBMITTALS

- A. Submit to the Engineer, in accordance with Section 01300, complete shop drawings showing details of fabrication and erection of all finish carpentry items and material furnished under this Section.

1.4 REFERENCE STANDARDS

- A. American Wood Preservers Association (AWPA)
 - 1. AWPA P5 - Waterborne Preservatives
- B. National Electrical Manufacturers Association (NEMA)
 - 1. NEMA LD3 - High-Pressure Decorative Laminates
- C. Architectural Woodwork Institute (AWI)
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.5 QUALITY ASSURANCE

- A. For finish carpentry items, comply with the specified provisions of the "Architectural Woodwork Quality Standards' Illustrated" of the AWI Premium Grade Standards.

2 PRODUCTS

2.1 MATERIALS - ROUGH CARPENTRY

- A. All lumber shall be of sound stock, delivered dry and shall be fully protected at all times from injury and dampness. Split, broken, or otherwise damaged pieces will not be allowed in the work.
- B. Wood for blocking and nailers shall be seasoned, 19 percent maximum moisture content, Construction Grade quality and of Douglas Fir; Southern Pine or Ponderosa Pine species.
 - 1. Wood members that will contact masonry or concrete shall be vacuum-pressure treated with 100 percent oxide pure chromated copper arsenate meeting AWPA P-5. Minimum net retention of solid preservative shall be 0.40 lbs/cu ft.

2. All treatment shall be performed in accordance with the requirements of AWPA for treating wood. Apply a heavy coat of the same preservative used in treating to all surfaces cut after treatment.

C. Nails, spikes, bolts, nuts and washers where sizes are not indicated or specified, shall be of suitable size and number as approved to securely fasten and hold members in place. Hot dip galvanize after fabrication.

2.2 MATERIALS - FINISH CARPENTRY

A. Core material for plastic laminate work shall be an approved particle board conforming to Commercial Standard C.S. 236 and 3/4-in minimum thickness.

B. Plastic laminate shall comply with NEMA Publication LD3 for General Purpose Type 0.050-in minimum thickness for all exposed work and 0.020-in minimum thickness for back-up sheets as required. Finish shall be matte texture and color shall be a solid light color as selected by the Engineer.

C. Provide stainless steel clad 1-1/16 O.D. clothes poles KV No. 660 or equal in lengths required with chrome plated, inside fitting flanges KV No. 734 or equal. Provide six, two-piece theft-proof coat hangers chrome plated steel, with ball top and matching receptors on rod.

3 EXECUTION

3.1 FABRICATION - FINISH CARPENTRY

A. Before proceeding with fabrication of work required to be fitted to other construction, obtain field measurements and verify dimensions and shop drawings details as required for accurate fit.

B. Employ only mechanics experienced in the fabrication and installation of items to be installed.

C. Casework for plastic laminate finish shall comply with AWI 400, Premium Grade. Provide plastic self-edges. Provide balancing and back-up sheets as required in AWI 400, Premium Grade.

D. All casework shall be fabricated to conform to the intent of the elevations, sections and details shown and shall be in accordance with the approved shop drawings.

3.2 INSTALLATION

A. All rough carpentry shall be accurately cut, fitted and installed as detailed.

B. Anchors shall be installed, where indicated or required, to anchor carpentry or other items securely to masonry or concrete.

C. Forms for structural concrete work shall be as specified under Division 3. Provide all other miscellaneous wood form work as may be required for the completion of the work.

D. Temporary wood doors and cloth or transparent plastic covered frames shall be provided for exterior wall openings during winter construction.

E. Installation of Hollow Metal Doors and Finish Hardware.

1. Doors and finish hardware will be furnished under Division 8 and shall be installed under the work of this Section, except where specifically designated otherwise herein.

2. As soon as the hardware is delivered to the job site, receive, verify and check each set and report to the Engineer any defect or shortage. Give notice to the hardware supplier for all such items which may be defective or missing. Provide a receipt to the hardware supplier for all such items as are found to be correct.

3. Finish hardware, after checking, shall be the responsibility of the Contractor until it is installed and the project is accepted in its entirety by the Owner.

4. Hardware shall be attached and placed by skilled mechanics in accordance with approved hardware templates provided with the hardware and shall be accurately fitted

and adjusted. Lever handles shall be kept covered with heavy cloth and other hardware shall be protected from damage until final acceptance of the entire project by the Owner.

5. Set each edge and joint of threshold in a seal strip of polyurethane sealant. Grout remainder of threshold in mortar.
 6. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Lubricate moving parts with type lubrication recommended by manufacturer (graphite-type if no other recommended). Replace units which cannot be adjusted and lubricated to operate freely and smoothly as intended for the application made.
 7. Wherever hardware installation is made more than 1 month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy and make a final check and adjustment of all hardware items in such space or area. Clean and relubricate operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- F. Install finish carpentry casework in a manner consistent with quality of specified grade to be plumb, level, true and straight with no distortions. Shim as required using concealed shims. Secure to substrate with concealed fasteners where possible and blind nailing as required for complete installation. Scribe and cut for accurate fit to other finished work as required.
- G. After completion of casework, clean exposed exterior and interior surfaces, remove and refinish damaged or soiled areas of finish and repair damaged or defective work or replace as directed to the satisfaction of the Engineer.
- H. Protect finished surfaces with heavy-duty canvas or polyethylene sheets. Secure loose components from damage during delivery. If such items are to be delivered separately from main body of casework, wrap each piece separately to protect finish and clearly mark to show proper location in completed casework.

** END OF SECTION **



SECTION 06615
FIBERGLASS REINFORCED PLASTIC COMPONENTS

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install the fiberglass reinforced plastic (FRP) guard rails, grating, platform, stairs and support system and as specified herein.

1.2 SUBMITTALS

- A. Submit, in accordance with Section 01300, complete shop drawings of all FRP products specified herein. Submit shop drawings and calculations for FRP platforms and stairs sealed by a licensed professional engineer registered in the State of Georgia. Submittals shall indicate construction details, sizes, thicknesses of sections, profiles, attachments, dimensions and field joints, method of support from structure, work to be built-in or provided by other sections and finishes to conform to the Drawings and this Section. Indicate connections, both shop and field. Submittals shall include the following:
1. Strength tests, physical properties, dimensions, chemical resistance tests and material composition.
 2. Manufacturer's certification that materials meet specification requirements.
- B. Certified test data based on tests of actual production samples which demonstrate that the products conforms to the stress and deflection requirements specified herein.

1.3 REFERENCE STANDARD

- A. American Society for Testing and Materials (ASTM)
1. ASTM E84 - Standard Test Methods for Surface Burning Characteristics of Building Materials
 2. ASTM D349 - Standard Test Methods for Laminated Round Rods Used for Electrical Insulation.
 3. ASTM D638 - Standard Test Method for Tensile Properties of Plastics.
 4. ASTM D790 - Standard Test Methods for Flexural Properties of Unreinforced and Reinforced Plastics and Electrical Insulating Materials.
 5. ASTM D792 - Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
- B. Occupational Safety and Health Administration (OSHA)
- C. American Iron and Steel Institute (AISI)
- D. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.

1.4 QUALITY ASSURANCE

- A. The fiberglass reinforced plastic components manufacturers shall be experienced in the manufacture of items of similar size and quality and shall present proof as required of successful installations involving the items under similar conditions to this project.
- B. The work of this Section shall be completely coordinated with the work of other sections. Verify at the site both the dimensions and work of other trades adjoining items of work in this Section before fabrication and installation of items herein specified.
- C. Furnish to the pertinent trades all items included under this Section that are to be built into the work of other sections

1.5 DESIGN CRITERIA

- A. The design of FRP products shall be in accordance with OSHA structural guidelines, ASTM standard testing procedures and generally accepted structural design practice.

- B. The design of FRP products shall be the responsibility of the manufacturer and shall be acceptable to the Engineer.
- C. Specific design criteria for individual components or structures shall be in accordance with OSHA 29 CFR 1910 Subpart D and as follows:
 - 1. The designed FRP Gratings shall meet the following loading requirements. In addition to the dead load, the FRP gratings shall be capable of supporting a uniform live load of 200 psf while maintaining a deflection of less than 0.25-in or L/360, whichever is smaller. The gratings shall also be capable of supporting a concentrated live load of 500 lbs applied over a 12-in by 1-in area at the midpoint of the spans indicated on the Drawings.
 - 2. The designed FRP elevated platform shall meet the following loading requirements. In addition to the dead load, the FRP platform shall be capable of supporting a uniform live load of 100 psf while maintaining a deflection of less than 0.25-in or L/360, whichever is smaller.
 - 3. Factor of safety shall be 5 based on ultimate stress. Grating shall be a minimum of 2-in deep, and have either a T-bar or rectangular bar shape.
 - 4. Handrails assembly to meet Uniform Building Code and OSHA Standards and shall withstand a 200 lb. load applied at any point, in any direction to the top rail.
 - 5. Handrail assembly shall be designed to support a load of 50 plf applied in any direction on the top rail.

2 PRODUCTS

2.1 MATERIALS AND PROPERTIES

- A. Resin for FRP components shall be an acceptable vinyl ester, integrally resistant without applied coatings to ultra-violet radiation; to high concentrations of hydrogen sulfide gas, its solutions and associated compounds and to the wastewater occurring at the project site.
- B. Provide compatible and equally resistant resin as acceptable for shop and field sealing of cut edges.
- C. Minimum physical properties for pultruded structural FRP shapes and plates shall be as follows:
 - 1. Tensile Strength (coupon): 30,000 psi - ASTM D638
 - 2. Tensile Strength (full section in bending): 20,000 psi at 75 degrees F
 - 3. Modulus of Elasticity: 2.3×10^6 psi at 75 degrees F, 1.8×10^6 psi at 125 degrees F - ASTM D790
 - 4. Barcol Hardness - 50
 - 5. Water Absorption - 0.75 percent (by weight) - ASTM D349
 - 6. Specific Gravity - 1.66 - ASTM D792
- D. FRP components shall have integral colors acceptable to the Engineer selected from standard resin colors.
- E. Stainless Steel
 - 1. Shapes - AISI Type 304
 - 2. Fasteners and components - Type 18-8.

2.2 GRATING

- A. FRP grating shall be Duradek by AFC Inc., Chatfield MN, similar by Imco Reinforced Plastics Inc., Moorestown NJ; Chemgrate Corp., Woodinville WA or equal.
- B. Outer surfaces, cut edges, or any surfaces that are exposed to air during cure shall be finished so as to obtain complete cure of the resin without air inhibition by coating the

surface after initial cure with resin containing paraffin. Softening or tackiness of any surface under an acetone test will be considered evidence of incomplete cure.

- C. I-bar shaped FRP grating shall be constructed of straight parallel bearing bars and composed of a glass fiber and thermosetting resin pultruded composite. The bearing bars to be placed edgewise and joined by structural crossties every 12-in, maximum. Crossties shall be 3/8-in diameter fiberglass rod with glass fiber reinforced plastic or stainless steel ferrules and polypropylene spacers. The upper bar surface shall have a coarse quartz/epoxy grit surface to provide skid resistance.
- D. Rectangular shaped FRP grating shall be constructed of straight parallel bearing bars and cross bars composed of glass fiber and resin, compression molded at high temperatures and pressure. No dry glass fibers shall be visible on any surface of bearing bars or cross bars. Bearing bars shall be spaced on 1-in centers and cross bars spaced on 6-in centers. Top surfaces shall have grit surface for skid resistance.
- E. Provide structural FRP angle frames, structural support shapes, grit impregnated plate where required and appurtenances as shown.
- F. Angle frames shall be continuous around the opening in order to present an even and flat support for the grating except as otherwise shown. The angles and anchors shall be as detailed.
- G. FRP grating shall be securely attached to supporting members and angles. Attachment to FRP supporting members shall be either stainless steel or FRP with stainless steel fasteners. Each grating panel shall be attached to supporting members at a minimum of four locations (two each edge). All materials and incidentals required for attaching grating to angle frame and supports shall be furnished and installed under this Section.
- H. Coordinate the layout of grating panels with work of other Sections to provide openings for approved mechanical equipment, operators, gates and other items which require penetrations or openings in the grating. Grating panels shall be further subdivided and supported to provide maximum panel weight of 75 lbs.

2.3 HANDRAILING

- A. FRP handrailing shall be Duradek Handrail System by AFC Inc, or similar by Imco, Chemgrate, Strongwell, or Fibergrate.
- B. System shall be composed of FRP tubes with a two square inch cross-section areas; solid FRP connector plugs fitting snugly inside the tubes; solid 1/2-in diameter FRP connector rods; and flattened corrugated 1/8-in thick, 4-in high FRP kickplates with 1/2-in deep corrugations and stainless steel drive rivets for fastening to posts.
- C. Fabricate with continuous posts and toprail, with intermediate rails cut between posts.

3 EXECUTION

3.1 FABRICATION AND SHIPPING

- A. All FRP grating and supports shall be designed and fabricated by a single manufacturer.
- B. FRP grating panels and structurals shall be shipped banded onto skids and covered with plywood to minimize shipping damage.

3.2 INSTALLATION

- A. All components shall be installed in full accordance with the Drawings, the final shop drawings and manufacturer's recommendations by mechanics skilled in the installation of this type of work.
- B. All FRP shall be installed securely and shall be level and true to line.

** END OF SECTION **



SECTION 07160
UNDER SLAB VAPOR RETARDER

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 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.3 SUMMARY

- A. Surface preparation
- B. Application of underslab vapor retarder
- C. Related Sections:
 - 1. Division 3 Section- "Reinforcing" for support systems
- D. References:
 - 1. American Society for Testing and Materials (ASTM)
 - a. ASTM E1745- Standard Specification for Plastic Water Vapor Retarders Used in Contact with Soil Or Granular Full Under Concrete Slabs.
 - b. ASTM E154- Standard Test Methods for Water Vapor Retarders Used in Contact with Earth under Concrete Slabs.
 - c. ASTM E96- Standard Test Methods for Water Vapor Transmission of Materials.
 - d. ASTM E1643- Standard Practice for Installation of Water Vapor Retarders Used in Contact with Earth of Granular Fill Under Concrete Slabs.
 - e. ASTM F1249-01- Standard Test Method for Water Vapor Transmission Rate Through Plastic Film and Sheeting Using a Modulated Infrared Sensor.
 - 2. American Concrete Institute (ACI)
 - a. ACI 302.1R-96 Vapor Barrier Component (plastic membrane) is not less than 10 mils thick.

1.4 SUBMITTALS

- A. Product Data: Include manufacturer's written instructions for preparing substrate, technical data, and tested physical and performance properties of vapor retarder.
- B. Samples: For the following products:
 - 1. 12-by-12-inch (300-by-300-mm) square of vapor retarder.
 - 2. 12-inch section of tape.
- C. Installer Certificates: Certification that Installer complies with requirements.

1.5 QUALITY ASSURANCE

- A. Installer Qualifications: A firm and employees that will work on this project have a minimum of 3 years experience working on commercial installations of similar magnitude, and are familiar with the listed ASTM and AI requirements. .

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying product name and manufacturer.
- B. Store materials in a clean dry area in accordance with manufacturer's instructions.

- C. Stack membrane on smooth ground or wood platform to eliminate warping
- D. Protect materials during handling and application to prevent damage or contamination.
- E. Environmental Requirements:
 - 1. Product not intended for uses subject to abuse or permanent exposure to the elements.
 - 2. Do not apply on frozen ground.

2 PRODUCTS

2.1 SHEET VAPOR RETARDER

- A. Available Products: Subject to compliance with requirements, other manufacturers and products that may be incorporated into the Work include, but are not limited to, the following:
- B. Basis of Design Product:
 - 1. Perminator 10 mil under slab vapor mat by W.R. Meadows Inc.
- C. Plastic Vapor Retarder Requirements:
 - 1. Vapor Retarder membrane must meet or exceed all requirements of ASTM E1745 Classes A, B, & C.
 - a. Minimum Permeance ASTM E96: 0.024 perms.
 - b. Water Vapor Transmission Rate ASTM F1249 calibrated to ASTM E 96 (water method): 0.012 grains/ft²/hr.
 - c. Resistance to Organisms and Substrates in Contact with Soil ASTM E154, Section 13: 0.051 Perms.
 - d. Tensile Strength ASTM E154, Section 9: 52 lbs force/ inch
 - e. Puncture Resistance ASTM D 1709, Method B: 3,770 g.
 - f. Water Vapor Retarder ASTM E 1745: Meets or exceeds Class A, B, & C.
 - g. Thickness of Retarded (plastic) ACI 302.1R-96: Not less than 10 mils.
- D. Seam Tape:
 - 1. High Density Polyethylene Tape with pressure sensitive adhesive. Minimum width 4 inches.
 - 2. Pipe Boots
 - a. Construct pipe boots from vapor barrier material and pressure sensitive tape per manufacturer's instructions.

3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates to receive membrane. Notify Architect if surfaces are not acceptable. Do not begin surface preparation or application until acceptable conditions have been corrected.

3.2 SURFACE PREPARATION

- A. Prepare surfaces in accordance with manufacturer's instructions.

3.3 APPLICATION

- A. Installation shall be in accordance with manufacturer's instructions and ASTM E 1643-98.
- B. Unroll vapor barrier with the longest dimension parallel with the direction of the pour. General Superintendent and Concrete Contractors will determine this.
- C. Lap vapor barrier over footings and seal with tape.

- D. Overlap joints 6 inches and seal with manufacturer's tape.
- E. Seal all penetrations (including pipes) with manufacturer's pipe boot and seal with tape.
- F. No penetration of the vapor barrier is allowed except for reinforcing steel and permanent utilities.
- G. Repair damaged areas by cutting patches of vapor barrier, overlapping damaged area 6 inches and taping all four sides with tape.

** END OF SECTION **



SECTION 07210
BUILDING INSULATION

1 GENERAL

1.1 WORK INCLUDED

- A. Thermal and draft stopping insulation required for the Work including foamed-in-place and board insulation in walls, ceilings, floors, soffits, and as shown.
- B. Distribution: Unless otherwise shown
 - 1. In masonry cavity walls, adhered board.
 - 2. In draft ways, as specified.
 - 3. Building insulation in batt form.

1.2 EXTENT OF WORK

- A. It is intended that thermal insulation be continuous from floor to floor, floor to roof, and across chases, shafts and abutting partitions in exterior walls, and from wall to wall in ceilings, soffits, and roofs, butted tight edge to edge and to surrounding framing, cut tight around recess lite fixtures and penetrating ducts and pipes, and backing up and enclosing recess cabinets, electric boxes, piping running in framed walls, etc. and that packing and foaming close all specified and remaining openings.

1.3 SUBMITTALS

- A. Product data - Each product and use.

1.4 STANDARD

- A. The International Energy Code governs the requirements for thermal insulation and draft stopping and the code compliance analysis lists required values accordingly.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS/PRODUCTS

- A. Subject to compliance with these specifications include those listed below and with item specifications, or approved equal unless otherwise shown.

2.2 BOARD

- A. Polyiso: Closed cell rigid foam board for walls and roof applied at thickness indicated on the drawings to achieve R-value indicated.
 - 1. RESISTA as manufactured by Firestone, or Engineer-approved equal.
 - 2. R2+ Silver as manufactured by Carlisle Coatings and Waterproofing, or Engineer-approved equal.

2.3 BATT INSULATION

- A. Faced Fiber Blanket
 - 1. Thermal insulation produced by combining mineral fibers of type described below with thermosetting resins to comply with ASTM C 665 as follows:
 - a. Mineral Fiber Type: Fibers manufactured from glass or slag.
 - b. Surface Burning Characteristics: Maximum flame spread and smoke developed values of 25 and 50, respectively.

2.4 ACCESSORIES

- A. Fasteners: Metal pins with friction washers or metal arrows designed to impale the insulation and hold it in place. The fastener base shall permit attachment to its supporting surface mechanically by nailing or by adhering with adhesive.

- B. Adhesive: Solvent dispersed rubber-based mastic whose carrier will not attack the material on which it is used as recommended by the insulation manufacturer, damp proof where used in exterior walls.
- C. Mastic: Trowel grade asphalt emulsion, ASTM 1277, Type 1, fibered.

3 EXECUTION

3.1 INSTALLATION OF GENERAL BUILDING INSULATION

- A. Apply insulation units to substrate by method indicated, complying with manufacturer's recommendations.
- B. Seal joints between closed-cell (nonbreaking) insulation units by applying adhesive, mastic, or sealant to edges of each unit to form a tight seal as units are shoved into place. Fill voids in completed insulation with adhesive, mastic, or sealant as recommended by insulation manufacturer.

3.2 BOARD

- A. Polyiso
 - 1. In cavity walls and Roofs – Install boards on the back of masonry with adhesive spots not over, 12-in. centers each way, pushed tight to the wall. Install on roof decking with manufacturer recommended fasteners. Completely cover surface with insulation. Butt joints between boards tightly. Fit boards close around cut outs and penetrations.

3.3 DRAFT STOPPING

- A. General
 - 1. Where not otherwise sealed for fire or sound rated constructions, insulate incidental opening in walls and roof to complete insulation system coverage and prevent infiltration of outside air, or exfiltration of inside air, or transfer of air between conditioned and unconditioned spaces and to complete smoke barrier constructions.
- B. Wall/Partition Tops: Pack between deck flutes, joist ends and other openings above exterior wall framing and exterior wall and barrier wall and partition tops. Between joist ends and under rectangular deck flutes, use unfaced mineral wool blanket cut oversize and folded into place for a compression fit, top, bottom and ends. Stuff corrugated deck flutes tight with unfaced mineral wool wads.
- C. Openings – From interior, seal the annular space inside window door, louver, fan, stack, duct, hatch and other exterior wall and roof rough opening frames, and around all electrical and communication boxes and similar unframed penetrations with packed mineral wool or foamed in place insulation.

** END OF SECTION **

SECTION 07412
STANDING-SEAM METAL ROOF PANELS

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install intumescent paints complete as shown on the drawings and as specified herein.
- B. Section includes standing-seam metal roof panels.

1.2 RELATED WORK

- A. Metal panels used in horizontal soffit applications are included in Section.
- B. Snow guards for prefabricated devices designed to hold snow on the roof surface, allowing it to melt and drain off slowly are included in Section.

1.3 SUBMITTALS

- A. Submit in accordance with Section 01300.
- B. Product Data: For each type of product.
 - 1. Include construction details, material descriptions, dimensions of individual components and profiles, and finishes for each type of panel and accessory.
- C. Shop Drawings:
 - 1. Include fabrication and installation layouts of metal panels; details of edge conditions, joints, panel profiles, corners, anchorages, attachment system, trim, flashings, closures, and accessories; and special details.
 - 2. Accessories: Include details of the flashing, trim, and anchorage systems, at a scale of not less than 1-1/2 inches per 12 inches (1:10).
- D. Samples for Initial Selection: For each type of metal panel indicated with factory-applied color finishes.
 - 1. Include similar Samples of trim and accessories involving color selection.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Metal Panels: 12 inches (305 mm) long by actual panel width. Include clips, fasteners, closures, and other metal panel accessories.
- F. Qualification Data: For Installer.
- G. Product Test Reports: For each product, for tests performed by a qualified testing agency.
- H. Field quality-control reports.
- I. Sample Warranties: For special warranties.
- J. Maintenance Data: For metal panels to include in maintenance manuals.

1.4 REFERENCED STANDARDS

- A. American Architectural Manufacturers Association
 - 1. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum
 - 2. AAMA 620 - Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Aluminum Substrates
 - 3. AAMA 621 - Voluntary Specification for High Performance Organic Coatings on Coil Coated Architectural Hot Dipped Galvanized (HDG) and Zinc-Aluminum Coated Steel Substrates
- B. ASTM International

1. ASTM A 240/A 240M - Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications
 2. ASTM A 653/A 653M - Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process
 3. ASTM A 755/A 755M - Specification for Steel Sheet, Metallic Coated by the Hot-Dip Process and Prepainted by the Coil-Coating Process for Exterior Exposed Building Products
 4. ASTM A 792/A 792M - Specification for Steel Sheet, 55 Percent Aluminum-Zinc Alloy-Coated by the Hot-Dip Process
 5. ASTM B 209 - Specification for Aluminum and Aluminum-Alloy Sheet and Plate
 6. ASTM B 209M - Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]
- 1.5 ASTM B 370 - SPECIFICATION FOR COPPER SHEET AND STRIP FOR BUILDING CONSTRUCTION
1. ASTM B 882 - Specification for Pre-Patented Copper for Architectural Applications
 2. ASTM C 645 - Specification for Nonstructural Steel Framing Members
 3. ASTM C 754 - Specification for Installation of Steel Framing Members to Receive Screw-Attached Gypsum Panel Products
 4. ASTM C 920 - Specification for Elastomeric Joint Sealants
 5. ASTM C 1311 - Specification for Solvent Release Sealants
 6. ASTM D 226/D 226M - Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing
 7. ASTM D 1970 - Specification for Self-Adhering Polymer Modified Bituminous Sheet Materials Used as Steep Roofing Underlayment for Ice Dam Protection
 8. ASTM D 2244 - Practice for Calculation of Color Differences from Instrumentally Measured Color Coordinates
 9. ASTM D 4214 - Test Methods for Evaluating the Degree of Chalking of Exterior Paint Films
 10. ASTM E 283 - Test Method for Determining Rate of Air Leakage through Exterior Windows, Curtain Walls, and Doors under Specified Pressure Differences across the Specimen
 11. ASTM E 331 - Test Method for Water Penetration of Exterior Windows, Skylights, Doors, and Curtain Walls by Uniform Static Air Pressure Difference
 12. ASTM E 1514 - Specification for Structural Standing Seam Steel Roof Panel Systems
 13. ASTM E 1592 - Test Method for Structural Performance of Sheet Metal Roof and Siding Systems by Uniform Static Air Pressure Difference
 14. ASTM E 1637 - Specification for Structural Standing Seam Aluminum Roof Panel Systems
 15. ASTM E 1646 - Test Method for Water Penetration of Exterior Metal Roof Panel Systems by Uniform Static Air Pressure Difference
 16. ASTM E 1680 - Test Method for Rate of Air Leakage through Exterior Metal Roof Panel Systems
 17. ASTM E 1980 - Practice for Calculating Solar Reflectance Index of Horizontal and Low-Sloped Opaque Surfaces
 18. ASTM E 2140 - Test Method for Weather Penetration of Metal Roof Panel Systems by Static Water Pressure Head

B. Cool Roof Rating Council

1. CRRC-1 - CRRC Product Rating Program
 - C. FM Global
 1. FMG 4471 - Approval Standard, Class I Panel Roofs
 2. Approval Guide.
 - D. Sheet Metal and Air Conditioning Contractors' National Association
 1. Architectural Sheet Metal Manual.
 - E. Underwriters Laboratories Inc.
 1. UL 580 - Tests for Uplift Resistance of Roof Assemblies
 - F. Where reference is made to one of the above standards, the revision in effect at the time of bid opening shall apply.
- 1.6 QUALITY ASSURANCE
- A. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by manufacturer.
 - B. UL-Certified, Portable Roll-Forming Equipment: UL-certified, portable roll-forming equipment capable of producing metal panels warranted by manufacturer to be the same as factory-formed products. Maintain UL certification of portable roll-forming equipment for duration of work.
- 1.7 DELIVERY, STORAGE AND HANDLING
- A. Deliver components, metal panels, and other manufactured items so as not to be damaged or deformed. Package metal panels for protection during transportation and handling.
 - B. Unload, store, and erect metal panels in a manner to prevent bending, warping, twisting, and surface damage.
 - C. Stack metal panels horizontally on platforms or pallets, covered with suitable weathertight and ventilated covering. Store metal panels to ensure dryness, with positive slope for drainage of water. Do not store metal panels in contact with other materials that might cause staining, denting, or other surface damage.
 - D. Retain strippable protective covering on metal panels during installation.
 - E. Copper Panels: Wear gloves when handling to prevent fingerprints and soiling of surface.
- 1.8 FIELD CONDITIONS
- A. Weather Limitations: Proceed with installation only when existing and forecasted weather conditions permit assembly of metal panels to be performed according to manufacturers' written instructions and warranty requirements.
- 1.9 COORDINATION
- A. Coordinate sizes and locations of roof curbs, equipment supports, and roof penetrations with actual equipment provided.
 - B. Coordinate metal panel installation with rain drainage work, flashing, trim, construction of soffits, and other adjoining work to provide a leakproof, secure, and noncorrosive installation.
- 1.10 WARRANTY
- A. Special Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace components of metal panel systems that fail in materials or workmanship within specified warranty period.
 1. Failures include, but are not limited to, the following:
 - a. Structural failures including rupturing, cracking, or puncturing.
 - b. Deterioration of metals and other materials beyond normal weathering.

2. Warranty Period: Two years from date of Substantial Completion.
- B. Special Warranty on Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period.
 1. Exposed Panel Finish: Deterioration includes, but is not limited to, the following:
 - a. Color fading more than 5 Hunter units when tested according to ASTM D 2244.
 - b. Chalking in excess of a No. 8 rating when tested according to ASTM D 4214.
 - c. Cracking, checking, peeling, or failure of paint to adhere to bare metal.
 2. Finish Warranty Period: 20 years from date of Substantial Completion.
- C. Special Weathertightness Warranty: Manufacturer's standard form in which manufacturer agrees to repair or replace standing-seam metal roof panel assemblies that fail to remain weathertight, including leaks, within specified warranty period.
 1. Warranty Period: 20 years from date of Substantial Completion.

2 PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide metal panel systems capable of withstanding the effects of the following loads, based on testing according to ASTM E 1592:
 1. Wind Loads: As indicated on Drawings.
 2. Other Design Loads: As indicated on Drawings.
 3. Deflection Limits: For wind loads, no greater than 1/240 of the span.
- B. Water Penetration under Static Pressure: No water penetration when tested according to ASTM E 1646 at the following test-pressure difference:
 1. Test-Pressure Difference: 6.24 lbf/sq. ft. (300 Pa).
- C. Hydrostatic-Head Resistance: No water penetration when tested according to ASTM E 2140.
- D. Wind-Uplift Resistance: Provide metal roof panel assemblies that comply with UL 580 for wind-uplift-resistance class indicated.
 1. Uplift Rating: UL 90.
- E. FM Global Listing: Provide metal roof panels and component materials that comply with requirements in FM Global 4471 as part of a panel roofing system and that are listed in FM Global's "Approval Guide" for Class 1 or noncombustible construction, as applicable. Identify materials with FM Global markings.
 1. Fire/Windstorm Classification: Class 1A-105.
- F. Thermal Movements: Allow for thermal movements from ambient and surface temperature changes by preventing buckling, opening of joints, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects. Base calculations on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

2.2 STANDING-SEAM METAL ROOF PANELS

- A. General: Provide factory-formed metal roof panels designed to be installed by lapping and interconnecting raised side edges of adjacent panels with joint type indicated and mechanically attaching panels to supports using concealed clips in side laps. Include clips, cleats, pressure plates, and accessories required for weathertight installation.

1. Steel Panel Systems: Unless more stringent requirements are indicated, comply with ASTM E 1514.

Vertical-Rib, Seamed-Joint, Standing-Seam Metal Roof Panels: Formed with vertical ribs at panel edges and a flat pan between ribs; designed for sequential installation by mechanically attaching panels to supports using concealed clips located under one side of panels, engaging opposite edge of adjacent panels, and mechanically seaming panels together.

2. Basis-of-Design Product: Subject to compliance with requirements, provide 238T Symmetrical Panel by Architectural Components or comparable product by one of the following:
 - a. Advanced Architectural Products.
 - b. AEP Span; a BlueScope Steel company.
 - c. Architectural Building Components.
 - d. Architectural Metal Systems; a Nucor company.
 - e. ATAS International, Inc.
 - f. Berridge Manufacturing Company.
 - g. CENTRIA Architectural Systems.
 - h. Dimensional Metals, Inc.
 - i. Englert, Inc.
 - j. Fabral.
 - k. Firestone Metal Products, LLC.
 - l. Flexospan Steel Buildings, Inc.
 - m. Garland Company, Inc. (The)
 - n. IMETCO.
 - o. MBCI; a division of NCI Building Systems, L.P.
 - p. McElroy Metal, Inc.
 - q. Merchant & Evans.
 - r. Metal-Fab Manufacturing, LLC.
 - s. Metal Sales Manufacturing Corporation.
 - t. Morin; a Kingspan Group company.
 - u. Petersen Aluminum Corporation.
 - v. Ryerson, Inc.
 - w. Ultra Seam, Inc.
 - x. Union Corrugating Company
 - y. Or equal.
3. Metallic-Coated Steel Sheet: Zinc-coated (galvanized) steel sheet complying with ASTM A 653/A 653M, G90 (Z275) coating designation, or aluminum-zinc alloy-coated steel sheet complying with ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation; structural quality. Prepainted by the coil-coating process to comply with ASTM A 755/A 755M.
 - a. Nominal Thickness: 0.028 inch (0.71 mm).
 - b. Exterior Finish: Two coat coil applied, baked-on full-strength (70% resin, PVF2) fluorocarbon coating consisting of a nominal 0.25 mil dry film thickness primer, and a nominal dry film thickness of 0.7 - 0.8 mil color coat for a total 0.9 to 1.1 mil total

system dry film thickness. Finish to be selected from manufacturer's standard color selection.<<CONFIRM>> The back side of the material should be 0.25 mil primer and 0.25 mil polyester wash coat.

- c. Color: As selected by Engineer from manufacturer's full range <Insert color>.
- 4. Clips: One-piece fixed to accommodate thermal movement.
 - a. Material: 0.064-inch- (1.63-mm-) nominal thickness, zinc-coated (galvanized) or aluminum-zinc alloy-coated steel sheet.
- 5. Joint Type: As standard with manufacturer.
- 6. Panel Coverage: 16 inches (406 mm).
- 7. Panel Height: 2.375 inches (60.325 mm).

2.3 UNDERLAYMENT MATERIALS

A. Self-Adhering, High-Temperature Underlayment: Provide self-adhering, cold-applied, sheet underlayment, a minimum of 30 mils (0.76 mm) thick, consisting of slip-resistant, polyethylene-film top surface laminated to a layer of butyl or SBS-modified asphalt adhesive, with release-paper backing. Provide primer when recommended by underlayment manufacturer.

- 1. Thermal Stability: Stable after testing at 240 deg F (116 deg C); ASTM D 1970.
- 2. Low-Temperature Flexibility: Passes after testing at minus 20 deg F (29 deg C); ASTM D 1970.
- 3. Products: Provide one of the following:
 - a. Carlisle Residential, a division of Carlisle Construction Materials; WIP 300HT.
 - b. Grace Construction Products, a unit of W. R. Grace & Co.
 - c. Henry Company; Blueskin PE200 HT.
 - d. Kirsch Building Products, LLC; Sharkskin Ultra SA.
 - e. Metal-Fab Manufacturing, LLC; MetShield.
 - f. Owens Corning; WeatherLock Metal High Temperature Underlayment.
 - g. Or equal.

B. Slip Sheet: Manufacturer's recommended slip sheet, of type required for application.

2.4 MISCELLANEOUS MATERIALS

A. Miscellaneous Metal Subframing and Furring: ASTM C 645; cold-formed, metallic-coated steel sheet, ASTM A 653/A 653M, G90 (Z275 hot-dip galvanized) coating designation or ASTM A 792/A 792M, Class AZ50 (Class AZM150) coating designation unless otherwise indicated. Provide manufacturer's standard sections as required for support and alignment of metal panel system.

B. Panel Accessories: Provide components required for a complete, weathertight panel system including trim, copings, fasciae, mullions, sills, corner units, clips, flashings, sealants, gaskets, fillers, closure strips, and similar items. Match material and finish of metal panels unless otherwise indicated.

- 1. Closures: Provide closures at eaves and ridges, fabricated of same metal as metal panels.
- 2. Backing Plates: Provide metal backing plates at panel end splices, fabricated from material recommended by manufacturer.
- 3. Closure Strips: Closed-cell, expanded, cellular, rubber or crosslinked, polyolefin-foam or closed-cell laminated polyethylene; minimum 1-inch- (25-mm-) thick, flexible closure strips; cut or premolded to match metal panel profile. Provide closure strips where indicated or necessary to ensure weathertight construction.

- C. Flashing and Trim: Provide flashing and trim formed from same material as metal panels as required to seal against weather and to provide finished appearance. Locations include, but are not limited to, eaves, rakes, corners, bases, framed openings, ridges, fasciae, and fillers. Finish flashing and trim with same finish system as adjacent metal panels.
- D. Gutters: Formed from same material as roof panels, complete with end pieces, outlet tubes, and other special pieces as required. Fabricate in minimum 96-inch (2400-mm) long sections, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Furnish gutter supports spaced a maximum of 24 inches (914 mm) o.c., fabricated from same metal as gutters. Provide wire ball strainers of compatible metal at outlets. Finish gutters to match metal roof panels.
- E. Downspouts: Formed from same material as roof panels. Fabricate in 10-foot long sections, complete with formed elbows and offsets, of size and metal thickness according to SMACNA's "Architectural Sheet Metal Manual." Finish downspouts to match gutters.
- F. Roof Curbs: Fabricated from same material as roof panels, 0.048-inch (1.2-mm) nominal thickness; with bottom of skirt profiled to match roof panel profiles and with welded top box and integral full-length cricket. Fabricate curb subframing of 0.060-inch (1.52-mm) nominal thickness, angle-, C-, or Z-shaped steel sheet. Fabricate curb and subframing to withstand indicated loads of size and height indicated. Finish roof curbs to match metal roof panels.
 - 1. Insulate roof curb with 1-inch (25-mm) thick, rigid insulation.
- G. Panel Fasteners: Self-tapping screws designed to withstand design loads.
- H. Panel Sealants: Provide sealant type recommended by manufacturer that are compatible with panel materials, are nonstaining, and do not damage panel finish.
 - 1. Sealant Tape: Pressure-sensitive, 100 percent solids, gray polyisobutylene compound sealant tape with release-paper backing. Provide permanently elastic, nonsag, nontoxic, nonstaining tape 1/2 inch (13 mm) wide and 1/8 inch (3 mm) thick.
 - 2. Joint Sealant: ASTM C 920; elastomeric polyurethane or silicone sealant; of type, grade, class, and use classifications required to seal joints in metal panels and remain weathertight; and as recommended in writing by metal panel manufacturer.
 - 3. Butyl-Rubber-Based, Solvent-Release Sealant: ASTM C 1311.

2.5 FABRICATION

- A. General: Fabricate and finish metal panels and accessories at the factory, by manufacturer's standard procedures and processes, as necessary to fulfill indicated performance requirements demonstrated by laboratory testing. Comply with indicated profiles and with dimensional and structural requirements.
- B. Provide panel profile, including major ribs and intermediate stiffening ribs, if any, for full length of panel.
- C. Fabricate metal panel joints with factory-installed captive gaskets or separator strips that provide a weathertight seal and prevent metal-to-metal contact, and that minimize noise from movements.
- D. Sheet Metal Flashing and Trim: Fabricate flashing and trim to comply with manufacturer's recommendations and recommendations in SMACNA's "Architectural Sheet Metal Manual" that apply to design, dimensions, metal, and other characteristics of item indicated.
 - 1. Form exposed sheet metal accessories that are without excessive oil canning, buckling, and tool marks and that are true to line and levels indicated, with exposed edges folded back to form hems.
 - 2. Seams for Aluminum: Fabricate nonmoving seams with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
 - 3. Seams for Other Than Aluminum: Fabricate nonmoving seams in accessories with flat-lock seams. Tin edges to be seamed, form seams, and solder.

4. Sealed Joints: Form non-expansion, but movable, joints in metal to accommodate sealant and to comply with SMACNA standards.
5. Conceal fasteners and expansion provisions where possible. Exposed fasteners are not allowed on faces of accessories exposed to view.
6. Fabricate cleats and attachment devices from same material as accessory being anchored or from compatible, noncorrosive metal recommended in writing by metal panel manufacturer.
 - a. Size: As recommended by SMACNA's "Architectural Sheet Metal Manual" or metal panel manufacturer for application, but not less than thickness of metal being secured.

2.6 FINISHES

- A. Protect mechanical and painted finishes on exposed surfaces from damage by applying a strippable, temporary protective covering before shipping.
- B. 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 same piece are unacceptable. 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.
- C. Steel Panels and Accessories:
 1. Two-Coat Fluoropolymer: AAMA 621. Fluoropolymer finish containing not less than 70 percent PVDF resin by weight in color coat. Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturers' written instructions. Color shall be chosen by Owner.
 2. Concealed Finish: Apply pretreatment and manufacturer's standard white or light-colored acrylic or polyester backer finish consisting of prime coat and wash coat with a minimum total dry film thickness of 0.5 mil (0.013 mm).

3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, with Installer present, for compliance with requirements for installation tolerances, metal panel supports, and other conditions affecting performance of the Work.
 1. Examine primary and secondary roof framing to verify that rafters, purlins, angles, channels, and other structural panel support members and anchorages have been installed within alignment tolerances required by metal roof panel manufacturer.
 2. Examine solid roof sheathing to verify that sheathing joints are supported by framing or blocking and that installation is within flatness tolerances required by metal roof panel manufacturer.
 - a. Verify that air- or water-resistive barriers have been installed over sheathing or backing substrate to prevent air infiltration or water penetration.
- B. Examine roughing-in for components and systems penetrating metal panels to verify actual locations of penetrations relative to seam locations of metal panels before installation.
- C. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Miscellaneous Supports: Install subframing, furring, and other miscellaneous panel support members and anchorages according to ASTM C 754 and metal panel manufacturer's written recommendations.

3.3 UNDERLAYMENT INSTALLATION

- A. Self-Adhering Sheet Underlayment: Apply primer if required by manufacturer. Comply with temperature restrictions of underlayment manufacturer for installation. Apply at locations indicated [below] [on Drawings], wrinkle free, in shingle fashion to shed water, and with end laps of not less than 6 inches (152 mm) staggered 24 inches (610 mm) between courses. Overlap side edges not less than 3-1/2 inches (90 mm).[Extend underlayment into gutter trough.] Roll laps with roller. Cover underlayment within 14 days.

- 1. Apply over the entire roof surface.

- B. Slip Sheet: Apply slip sheet over underlayment before installing metal roof panels.

3.4 METAL PANEL INSTALLATION

- A. General: Install metal panels according to manufacturer's written instructions in orientation, sizes, and locations indicated. Install panels perpendicular to supports unless otherwise indicated. Anchor metal panels and other components of the Work securely in place, with provisions for thermal and structural movement.

- 1. Shim or otherwise plumb substrates receiving metal panels.
 - 2. Flash and seal metal panels at perimeter of all openings. Fasten with self-tapping screws. Do not begin installation until air- or water-resistive barriers and flashings that will be concealed by metal panels are installed.
 - 3. Install screw fasteners in predrilled holes.
 - 4. Locate and space fastenings in uniform vertical and horizontal alignment.
 - 5. Install flashing and trim as metal panel work proceeds.
 - 6. Locate panel splices over, but not attached to, structural supports. Stagger panel splices and end laps to avoid a four-panel lap splice condition.
 - 7. Align bottoms of metal panels and fasten with blind rivets, bolts, or self-tapping screws. Fasten flashings and trim around openings and similar elements with self-tapping screws.
 - 8. Provide weathertight escutcheons for pipe- and conduit-penetrating panels.

- B. Fasteners:

- 1. Steel Panels: Use stainless-steel fasteners for surfaces exposed to the exterior; use galvanized-steel fasteners for surfaces exposed to the interior.

- C. Anchor Clips: Anchor metal roof panels and other components of the Work securely in place, using manufacturer's approved fasteners according to manufacturers' written instructions.

- D. Metal Protection: Where dissimilar metals contact each other or corrosive substrates, protect against galvanic action as recommended in writing by metal panel manufacturer.

- E. Standing-Seam Metal Roof Panel Installation: Fasten metal roof panels to supports with concealed clips at each standing-seam joint at location, spacing, and with fasteners recommended in writing by manufacturer.

- 1. Install clips to supports with self-tapping fasteners.
 - 2. Install pressure plates at locations indicated in manufacturer's written installation instructions.
 - 3. Seamed Joint: Crimp standing seams with manufacturer-approved, motorized seamer tool so clip, metal roof panel, and factory-applied sealant are completely engaged.
 - 4. Watertight Installation:
 - a. Apply a continuous ribbon of sealant or tape to seal joints of metal panels, using sealant or tape as recommend in writing by manufacturer as needed to make panels watertight.
 - b. Provide sealant or tape between panels and protruding equipment, vents, and accessories.

- c. At panel splices, nest panels with minimum 6-inch (152-mm) end lap, sealed with sealant and fastened together by interlocking clamping plates.
 - F. Accessory Installation: Install accessories with positive anchorage to building and weathertight mounting, and provide for thermal expansion. Coordinate installation with flashings and other components.
 - 1. Install components required for a complete metal panel system including trim, copings, corners, seam covers, flashings, sealants, gaskets, fillers, closure strips, and similar items. Provide types indicated by metal roof panel manufacturers; or, if not indicated, types recommended by metal roof panel manufacturer.
 - G. Flashing and Trim: Comply with performance requirements, manufacturer's written installation instructions, and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, and set units true to line and level as indicated. Install work with laps, joints, and seams that will be permanently watertight and weather resistant.
 - 1. Install exposed flashing and trim that is without buckling and tool marks, and that is true to line and levels indicated, with exposed edges folded back to form hems. Install sheet metal flashing and trim to fit substrates and achieve waterproof and weather-resistant performance.
 - 2. Expansion Provisions: Provide for thermal expansion of exposed flashing and trim. Space movement joints at a maximum of 10 feet (3 m) with no joints allowed within 24 inches (610 mm) of corner or intersection. Where lapped expansion provisions cannot be used or would not be sufficiently weather resistant and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1 inch (25 mm) deep, filled with mastic sealant (concealed within joints).
 - H. Gutters: Join sections with riveted and soldered or lapped and sealed joints. Attach gutters to eave with gutter hangers spaced not more than 36 inches (914 mm) o.c. using manufacturer's standard fasteners. Provide end closures and seal watertight with sealant. Provide for thermal expansion.
 - I. Downspouts: Join sections with telescoping joints. Provide fasteners designed to hold downspouts securely 1 inch (25 mm) away from walls; locate fasteners at top and bottom and at approximately 60 inches (1524 mm) o.c. in between.
 - 1. Provide elbows at base of downspouts to direct water away from building.
 - J. Roof Curbs: Install flashing around bases where they meet metal roof panels.
 - K. Pipe Flashing: Form flashing around pipe penetration and metal roof panels. Fasten and seal to metal roof panels as recommended by manufacturer.
- 3.5 ERECTION TOLERANCES
 - A. Installation Tolerances: Shim and align metal panel units within installed tolerance of 1/4 inch in 20 feet (6 mm in 6 m) on slope and location lines as indicated and within 1/8-inch (3-mm) offset of adjoining faces and of alignment of matching profiles.
- 3.6 FIELD QUALITY CONTROL
 - A. Manufacturer's Field Service: Engage a factory-authorized service representative to test and inspect metal roof panel installation, including accessories. Report results in writing.
 - B. Remove and replace applications of metal roof panels where tests and inspections indicate that they do not comply with specified requirements.
 - C. Additional tests and inspections, at Contractor's expense, are performed to determine compliance of replaced or additional work with specified requirements.
 - D. Prepare test and inspection reports.
- 3.7 CLEANING AND PROTECTION
 - A. Remove temporary protective coverings and strippable films, if any, as metal panels are installed, unless otherwise indicated in manufacturer's written installation instructions. On

completion of metal panel installation, clean finished surfaces as recommended by metal panel manufacturer. Maintain in a clean condition during construction.

- B. Replace metal panels that have been damaged or have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

**** END OF SECTION ****



SECTION 07620
SHEET METAL FLASHING AND TRIM

1 GENERAL

1.1 SUBMITTALS

- A. Product Data, Shop Drawings, and Samples for each item specified.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Subject to compliance with requirements, provide products by one of the following:

1. Through-Wall Flashing:

- a. Cheney Flashing (Dovetail); Cheney Flashing Company, Inc.
- b. Cheney Flashing (Sawtooth); Cheney Flashing Company, Inc.
- c. Keystone Three-Way Interlocking Thruwall Flashing; Keystone Flashing Co.

2. Reglets:

- a. Fry Reglet Corporation.
- b. Hickman: W.P. Hickman Co.
- c. Keystone Flashing Company.

2.2 MATERIALS

- A. Copper: ASTM B370; temper H00, cold rolled except where temper 060 is required for forming; not less than 16 oz/sq ft (0.55 mm thick), unless otherwise indicated.
- B. Aluminum Sheet: ASTM B209 (ASTM B209M), 3003-H14, mill finish, minimum thickness of 0.040-in (1.0-mm), unless otherwise indicated.
- C. Stainless-Steel Sheet: ASTM A167, Type 304, soft annealed, with No. 2D finish, except where harder temper is required for forming or performance; minimum 0.0187-in (0.5-mm) thick, unless otherwise indicated.
- D. Galvanized Steel Sheet: ASTM A526, G90 (ASTM A526M, Z275), commercial quality, or ASTM A527, G90 (ASTM A527M, Z275), lock-forming quality, hot-dip galvanized, mill phosphatized where indicated for painting; not less than 0.0396-in (1.0-mm) thick, unless otherwise indicated.
- E. Lead Sheet: ASTM B749, Type L51121, copper-bearing lead sheet, minimum thickness of 0.0625-inch (1.6-mm) except not less than 0.0937-in (2.4-mm) thick for applications where burning (welding) is involved.
- F. Concealed Through-Wall Flashing: 0.0156-in (0.4-mm) thick stainless steel.
- G. Reglets: Profile indicated; 0.0187-in (0.5-mm) thick stainless steel.
- H. Miscellaneous Materials and Accessories: As follows:
 - 1. Solder: ASTM B32, Grade Sn50.
 - 2. Solder for Stainless Steel: ASTM B32, Grade Sn60.
 - 3. Fasteners: Noncorrosive metal. Match finish of exposed heads with material being fastened.
 - 4. Asphalt Mastic: SSPC-Paint 12, asbestos free, solvent type.
 - 5. Roofing Cement: ASTM D4586, Type I, asbestos free, asphalt based.
 - 6. Mastic Sealant: Polyisobutylene; nonhardening, nonskinning, nondrying, nonmigrating sealant.

7. Elastomeric Sealant: As specified in Division 7 Section "Joint Sealants."
8. Epoxy Seam Sealer: 2-part, noncorrosive, aluminum seam-cementing compound.
9. Adhesives: Type recommended for waterproof and weather-resistant seaming and adhesive.
10. Clips, Straps, Anchoring Devices, and Similar Accessories: Compatible with material being installed.

2.3 FABRICATION

- A. Fabricate sheet metal flashing and trim to comply with recommendations of SMACNA's "Architectural Sheet Metal Manual" that apply to the design, dimensions, metal and other characteristics of the item indicated.
 1. Gutters: 0.040-in (1.0-mm) thick aluminum.
 2. Downspouts: 0.024-in (0.6-mm) thick aluminum.
 3. Conductor Heads: 0.032-in (0.8-mm) thick aluminum.
 4. Splash Pans: 0.0187-in (0.5-mm) thick stainless steel.
 5. Roof-Drain Flashing: 4.0 lb/sq ft (1.6-mm thick), hard-tempered lead.
 6. Scuppers: 16 oz/sq ft (0.55-mm thick) copper.
 7. Exposed Trim, Gravel Stops, and Fasciae: 0.0187-in (0.5-mm) thick stainless steel.
 8. Copings: 0.050-in (1.2-mm) thick aluminum.
 9. Base Flashing: 0.0187-in (0.5-mm) thick stainless steel.
 10. Counterflashing: 0.0187-in (0.5-mm) thick stainless steel.
 11. Flashing Receivers: 0.0156-in (0.4-mm) thick stainless steel.
 12. Valley Flashing: 16 oz/sq ft (0.55-mm thick) copper.
 13. Drip Edges: 0.0217-in (0.55-mm) thick galvanized steel.
 14. Eave Flashing: 0.0217-in (0.55-mm) thick galvanized steel.
 15. Equipment Support Flashing: 0.0276-in (0.7-mm) thick galvanized steel.
 16. Roof-Penetration Flashing: 0.0276-in (0.7-mm) thick galvanized steel.
 17. Shower Pans: 4.0 lb/sq ft (1.6-mm thick), hard-tempered lead.
 18. Overhead-Piping Safety Pans: 0.0250-in (0.65-mm) thick stainless steel.
 19. Roof Expansion-Joint Cover: 0.0276-in (0.7-mm) thick galvanized steel.
 20. Roof-to-Wall Expansion-Joint Cover: 0.0336-in (0.85-mm) thick galvanized steel.
- B. Coil-Coated Aluminum Finish: 2-coat fluoropolymer Hylar 5000 or Kynar 500.
 1. Color and Gloss: Match Architect's sample.
Color and Gloss: As selected by Architect.
- C. Coil-Coated Galvanized Steel Sheet Finish: 2-coat fluoropolymer Hylar 5000 or Kynar 500.
 1. Color and Gloss: As indicated by manufacturer's color and gloss designations.
Color and Gloss: Match Architect's sample.
- D. Shop Finish, Rain Drainage: Baked-on, white-acrylic shop finish on gutters, downspouts, and similar exposed units; 1.0-mil (0.025-mm) dry film thickness.

3 EXECUTION

3.1 INSTALLATION

- A. Comply with manufacturer's instructions and SMACNA's "Architectural Sheet Metal Manual" allow for thermal expansion; set true to line and level as indicated. Install Work

with laps, joints and seams permanently watertight and weatherproof; conceal fasteners where possible.

1. Roof-Edge Flashings: Secure metal flashings at roof edges according to FM Loss Prevention Data Sheet 1-49 for specified wind zone.
- B. Expansion Provisions: Provide for thermal expansion of exposed sheet metal Work. Space movement joints at maximum of 10-ft (3-m) with no joints allowed within 24-in (610-mm) of corner or intersection. Where lapped or bayonet-type expansion provisions in Work cannot be used or would not be sufficiently weatherproof and waterproof, form expansion joints of intermeshing hooked flanges, not less than 1-in (25-mm) deep, filled with mastic sealant (concealed within joints).
- C. Soldered Joints: Clean surfaces to be soldered, removing oils and foreign matter. Pretin edges of sheets to be soldered to a width of 1-1/2-in (38-mm), except where pretinned surface would show in finished Work.
 1. Do not solder aluminum.
 2. Pretinning is not required for lead.
- D. Sealed Joints: Form nonexpansion, but movable, joints in metal to accommodate elastomeric sealant to comply with SMACNA standards. Fill joint with sealant and form metal to completely conceal sealant.
- E. Seams: Fabricate nonmoving seams in sheet metal with flat-lock seams. Tin edges to be seamed, form seams and solder.
- F. Seams: Fabricate nonmoving seams in aluminum with flat-lock seams. Form seams and seal with epoxy seam sealer. Rivet joints for additional strength.
- G. Separations: Separate noncompatible metals or corrosive substrates with a coating of asphalt mastic or other permanent separation as recommended by manufacturer.
- H. Counterflashings: Coordinate installation with installation of assemblies to be protected by counterflashing. Install counterflashings in reglets or receivers. Secure in a waterproof manner by means of snap-in installation and sealant, lead wedges and sealant, interlocking folded seam, or blind rivets and sealant. Lap counterflashing joints a minimum of 2-in (50-mm) and bed with sealant.
- I. Roof-Drainage System: Coordinate installation with roofing installation. Coordinate flashing and sheet metal items for steep-sloped roofs with roofing installation.
- J. Overhead-Piping Safety Pans: Suspend pans from pipe and install drain line to plumbing waste or drain line.
- K. Equipment Support Flashing: Coordinate installation with roofing and equipment installation. Weld or seal flashing to equipment support member
- L. Roof-Penetration Flashing: Coordinate installation with roofing and installation of items penetrating roof.

** END OF SECTION **



SECTION 07900 JOINT SEALERS

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all materials, labor, equipment and incidentals required to install all sealants, caulking joint fillers, and accessories as shown on the Drawings and as specified herein.
- B. Seal joints as indicated in the schedule at the end of this Section. Joints noted on the drawings for "sealant," "caulk," or "caulking" shall be sealed as specified herein. Joints of a similar nature to those in the schedule shall be sealed in accordance with the schedule, whether so indicated on the Drawings or not.
 - 1. Seal all exterior joints between adjacent materials, joints between frames or louvers and adjacent materials, copings, masonry control joints, and all other joints shown on the Drawings or required for completion of the work.
 - 2. Seal all interior joints between frames and masonry, at tops of masonry walls, between masonry and structural concrete, between floor joints in tile, joints in rooms to be airtight, joints around plumbing fixtures, and all other joints shown on the Drawings or required for completion of the work.

1.2 RELATED WORK

- A. Concrete Joint and Joint Accessories are included in Section 03250.

1.3 DEFINITIONS

- A. Substrate type shall be as defined in ASTM C920 and as follows:
 - 1. Type M: Concrete, concrete masonry units, brick, mortar and natural stone. The term masonry shall be defined to include brick, stone, and concrete masonry work.
 - 2. Type G: Glass and transparent plastic glazing sheets.
 - 3. Type A: Metals, porcelain, glazed tile, and smooth plastics.
 - 4. Type O: Wood, unglazed tile, and substrates not included in preceding categories.

1.4 SUBMITTALS

- A. Materials and accessories for concrete joints are specified in Division 3. Materials and accessories for masonry joints are specified in Division 4. Submit sealers for concrete and masonry joints together with required joint accessories in a single package. Materials used together in the same joint shall be compatible.
- B. Shop drawings and product data, in accordance with Section 01300, showing materials of construction and details of installation for:
 - 1. Sealers. Manufacturer's catalog cuts, specification data, color chart, and installation instructions. Demonstrate compliance with ASTM standards specified including specific type, grade, and class. Identify end use and location of each material submitted. Include manufacturer's cautions regarding substrates, substrate preparation, or materials that will inhibit bond or otherwise damage the sealer.
- C. Samples
 - 1. Sealers exposed to view. Submit two sets of cured samples of actual products in full range of manufacturer's standard colors.
 - 2. Submit for review two sets of representative samples of any or all other materials required for the work of this Section when requested by the Engineer.

1.5 REFERENCE STANDARDS

- A. American Society for Testing and Materials (ASTM)
 - 1. ASTM C920 - Standard Specification for Elastomeric Joint Sealants.

- 2. ASTM C1193 - Standard Guide for Use of Joint Sealants.
 - B. National Sanitation Foundation (NSF)
 - 1. Standard 61 - Drinking Water System Components Health Effects.
 - 2. Listings - Drinking Water System Components.
 - C. Where reference is made to one of the preceding standards, the revision in effect at the time of bid opening shall apply unless specifically indicated otherwise.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver materials in unbroken, sealed original containers with legible labels showing manufacturer, product name or designation, color, shelf life, and installation instructions.
 - B. Store sealers in accordance with the manufacturer's instructions. Do not use sealers that have been stored for a period of time exceeding the recommended shelf life of the materials.
- 1.7 PROJECT/SITE REQUIREMENTS
- A. Environmental Requirements
 - 1. Do not install sealers if any of the following conditions exist:
 - a. Air or substrate temperature exceeds the range recommended by the sealer manufacturer, or is below 40°F.
 - b. Substrate is wet, damp, or covered with snow, ice, frost, or other deleterious material.
 - B. Dimensional Requirements
 - 1. Provide sealer depth as recommended by the manufacturer. If no other recommendations are provided, sealer depth shall be equal to one-half the width of the joint being sealed.
 - 2. Do not install sealers if joint dimensions are less than or greater than that recommended by the sealer manufacturer. In such cases, obtain sealer manufacturer's recommendations for alternative procedures, and advise Architect/Engineer of anticipated modifications.
- 1.8 WARRANTY
- A. Submit written warranty signed by General Contractor, Installer, and Product Manufacturer, jointly guaranteeing to correct failures in sealer work that occur within 5 years after substantial completion, without reducing or otherwise limiting any other rights to correction that the Owner may have under the provisions of these Contract Documents. Failure is defined to mean failure to remain watertight due to faulty materials or workmanship.
- 2 PRODUCTS
- 2.1 GENERAL
- A. The use of a manufacturer's name and model or catalog number is for the purpose of establishing the standard of quality and general configuration desired.
 - B. Like items of materials/equipment shall be the end products of one manufacturer in order to provide standardization for appearance.
 - C. Provide only materials that are compatible with the substrates, with each other, and with other construction to be incorporated into the joints.
 - D. Sealer colors shall be as selected by the Architect/Engineer from manufacturer's standard colors.
- 2.2 MATERIALS
- A. Elastomeric Sealant. Sealant shall comply with the requirements of ASTM C920 including specific Type, Grade, Class, and Uses indicated. Sealants for use in contact with potable

water shall be listed by NSF as complying with the requirements of NSF Standard 61 and shall be resistant to chlorine concentrations of up to 4 milligrams per liter (mg/L).

1. Polyurethane or Polysulfide Sealant
 - a. Exterior and interior sealant for joints on the horizontal plane shall be a two-part, pourable, self-leveling polyurethane or polysulfide-based sealant conforming to the requirements of ASTM C920, Class 25. Use shall be NT, M, G, A, or O as required by the substrate.
 - b. Exterior and interior sealant for joints on surfaces other than horizontal shall be a one-part, non-sag or gun-grade polyurethane or polysulfide-based conforming to the requirements of ASTM C920, Class 25. Use shall be NT, M, G, A, or O as required by the substrate.
2. Silicone Sealants
 - a. Medium Movement Silicone Sealant: One- or two-part non-acid-curing, Grade NS, Class 25, Use NT. Sealant shall provide movement capability of more than 25 percent, but less than 50 percent, in both extension and compression.
 - b. Mildew-Resistant Silicone Sealant: One-part, Type S, Grade NS, Class 25, Use NT. Sealant shall be formulated with fungicide and suitable for interior use on nonporous surfaces.

B. Sealant Backers

1. Backers shall be non-staining and as recommended by the sealant manufacturer for their specific use.
2. Backer Rod, unless otherwise restricted by the sealant manufacturer, shall be flexible, non-absorbent, non-gassing closed cell compressible polyurethane foam preformed to the appropriate size and shape.
3. Bond-Breaker Tape, unless otherwise restricted by the sealant manufacturer, shall be self-adhesive polyethylene or other plastic tape suitable for preventing sealant adhesion.

C. Miscellaneous Materials

1. Primers shall be as recommended by the sealant manufacturer.
2. Cleaners shall be as recommended by the sealant manufacturer. Cleaners shall not damage the finish of materials adjacent to the sealed area.
3. Masking tape shall be non-absorbent and non-staining.
4. Tooling agents shall be as recommended by the sealant manufacturer, and shall be non-staining to the sealant or substrate.

3 EXECUTION

3.1 PREPARATION

A. Verification of Conditions

1. Examine joints for characteristics that may affect sealer performance, including configuration and dimensions.
2. Do not begin installation of joint sealers until unsatisfactory conditions have been corrected.

B. Surface Preparation

1. Cleaning. Just before beginning sealer installation, clean out joints in accordance with the recommendations of the sealer manufacturer and as follows:
 - a. Remove all materials that might impair adhesion, including dust, dirt, coatings, paint, oil, and grease.

- b. Thoroughly dry damp and wet surfaces.
- c. Clean substrates using methods that will not leave residues or impair adhesion.
 - 1) Clean type M and type O substrates by suitable mechanical or chemical methods. Remove laitance and form-release coatings from concrete. Remove loose particles by vacuuming or blowing with oil-free compressed air.
 - 2) Clean type A and type G substrates by chemical or other methods that will not damage the substrate.
- 2. Masking. Install masking tape to keep primers and sealers off adjacent surfaces that would be damaged by contact or cleanup, and to provide a neat, finished edge. Remove tape as soon as practical.
- 3. Priming. Prime substrate as recommended by the sealer manufacturer
- 4. Install fillers where needed to provide proper joint depth or support for sealant backers.

3.2 INSTALLATION

- A. Comply with sealer manufacturers' installation instructions and recommendations, except where more restrictive requirements are specified.
- B. Backers. Install backers at depth required to provide shape and depth of installed sealant that allows the greatest joint movement without sealant failure. Make backers continuous without gaps, tears, or punctures. Do not stretch or twist backers. If backers become wet or damp before installation of sealant, thoroughly dry before proceeding.
- C. Bond-breaker tape. Use bond breaker tape where indicated or necessary to prevent sealant from adhering to back or third side of joint.
- D. Sealants. Install sealants in accordance with ASTM C1193. Using methods recommended by the manufacturer, completely fill the joints. Unless otherwise recommended by the sealant manufacturer or detailed on the Drawings, install sealant with a 2 to 1 ratio of width to thickness. Make full contact with bonding surfaces. Tool non-sag sealants to smooth surfaces, eliminating air pockets. Tooling shall be to concave joint shape shown in Figure 5A of ASTM C1193 unless otherwise indicated.

3.3 PROTECTION AND CLEANING

- A. Maintain surfaces of all materials adjoining sealed joints free of smears or soiling due to sealing operations. Clean surfaces adjacent to joints as work progresses and before sealants set using methods and materials approved by manufacturers of sealers and of surfaces to be cleaned.
- B. Protect joint sealers from contamination and damage.
- C. Remove and replace damaged sealers.

3.4 SCHEDULES

- A. General
 - 1. Unless otherwise indicated, joints around the perimeter of frames shall be sealed using sealer specified for the substrate adjacent to the frame.
- B. Expansion and control joints in exterior and interior surfaces of cast-in-place concrete or masonry walls:
 - 1. Non-sag polyurethane or polysulfide sealant; concave joint configuration.
 - 2. Backer rod or bond-breaker tape.
- C. Expansion and control joints in exterior and interior surfaces of cast-in-place concrete slabs:
 - 1. Self-leveling polyurethane or polysulfide sealant.
 - 2. Backer rod or bond-breaker tape.

- D. Interior joints at wet areas above Finish Floor (including perimeter of bath fixtures, counter tops, glazed ceramic tile areas):
 - 1. Mildew-resistant silicone sealant; concave joint configuration.
 - 2. Bond-breaker tape where appropriate.
- E. Exterior or interior joints for which no other sealer is indicated:
 - 1. Medium movement silicone sealant; concave joint configuration.
 - 2. Backer rod or bond-breaker tape.

** END OF SECTION **



SECTION 08110
STEEL DOORS AND FRAMES

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 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Standard hollow-metal steel doors.
 - 2. Standard hollow-metal steel frames.
- B. Related Sections include the following:
 - 1. Division 4 Section "Unit Masonry" for building anchors into and grouting standard steel frames in masonry construction.
 - 2. Division 8 Section "Glazing" for glazed lites in standard steel doors and frames.
 - 3. Division 8 Sections for door hardware for standard steel doors.
 - 4. Division 9 painting Sections for field painting standard steel doors and frames.

1.4 DEFINITIONS

- A. Minimum Thickness: Minimum thickness of base metal without coatings.

1.5 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance and temperature-rise ratings, and finishes for each type of steel door and frame specified, and as shown on the Door and Frame Schedule on the Drawings.
- B. Shop Drawings: In addition to requirements below, provide a schedule of standard steel doors and frames using same reference numbers for details and openings as those on Drawings:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details.
 - 3. Frame details for each frame type, including dimensioned profiles.
 - 4. Details and locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, accessories, joints, and connections.
 - 7. Details of glazing frames and stops showing glazing.
 - 8. Details of conduit and preparations for electrified door hardware and controls.
- C. Coordination Drawings: Drawings of each opening, including door and frame, drawn to scale and coordinating door hardware. Show elevations of each door design type, showing dimensions, locations of door hardware, and preparations for power, signal, and electrified control systems.
- D. Samples for Initial Selection: For units with factory-applied color finishes.

- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
- F. Qualification Data: For Installer.

1.6 QUALITY ASSURANCE

- A. Installer Qualifications: An employer of workers trained and approved by manufacturer.
- B. Source Limitations: Obtain standard steel doors and frames through one source from a single manufacturer.
- C. Smoke-Control Door Assemblies: Comply with NFPA 105 or UL 1784.
- D. Windstorm Resistant Exterior Openings (Texas Department of Insurance): Provide exterior hollow metal and door hardware assemblies approved by the Texas Department of Insurance, including anchorage, capable of withstanding wind load design pressures calculated for this project by a registered architect or engineer and are part of the construction documents per the Texas Department of Insurance, authorities having jurisdiction, and the International Building Code Design Loads Section 1609.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver doors and frames palletized, wrapped, or crated to provide protection during transit and Project-site storage. Do not use nonvented plastic.
 - 1. Provide additional protection to prevent damage to finish of factory-finished doors and frames.
- B. Deliver welded frames with two removable spreader bars across bottom of frames, tack welded to jambs and mullions.
- C. Store doors and frames under cover at Project site. Place units in a vertical position with heads up, spaced by blocking, on minimum 4-inch- (102-mm-) high wood blocking. Avoid using non-vented plastic or canvas shelters that could create a humidity chamber.
 - 1. If wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) space between each stacked door to permit air circulation.

1.8 PROJECT CONDITIONS

- A. Field Measurements: Verify openings by field measurements before fabrication and indicate measurements on shop drawings.
 - 1. Established Dimensions: Where field measurements cannot be made without delaying the Work, establish opening dimensions and proceed with fabricating standard steel frames without field measurements. Coordinate wall construction to ensure that actual opening dimensions correspond to established dimensions.

1.9 COORDINATION

- A. Coordinate installation of anchorages for standard steel frames. Furnish setting drawings, templates, and directions for installing anchorages, including sleeves, concrete inserts, anchor bolts, and items with integral anchors, that are to be embedded in concrete or masonry. Deliver such items to Project site in time for installation.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:
 - 1. Amweld Building Products, LLC.
 - 2. Ceco Door Products; an ASSA ABLOY Group Company.
 - 3. CURRIES Company; an ASSA ABLOY Group Company.

4. Steelcraft; an Ingersoll-Rand Company.
5. Or approved equal.

2.2 MATERIALS

- A. Cold-Rolled Steel Sheet: ASTM A 1008/A 1008M, Commercial Steel (CS), Type B; suitable for exposed applications.
- B. Hot-Rolled Steel Sheet: ASTM A 1011/A 1011M, Commercial Steel (CS), Type B; free of scale, pitting, or surface defects; pickled and oiled.
- C. Metallic-Coated Steel Sheet: ASTM A 653/A 653M, Commercial Steel (CS), Type B; with minimum A40 (ZF120) zinc-iron-alloy (galvannealed) coating designation.
- D. Electrolytic Zinc-Coated Steel Sheet: ASTM A 591/A 591M, Commercial Steel (CS), Class B coating; mill phosphatized.
- E. Supports and Anchors: After fabricating, galvanize units to be built into exterior walls according to ASTM A 153/A 153M, Class B.
- F. Inserts, Bolts, and Fasteners: Provide items to be built into exterior walls, hot-dip galvanized according to ASTM A 153/A 153M.
- G. Powder-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 standard steel door frames of type indicated.
- H. Grout: Comply with Division 4 Section "Unit Masonry."
- I. Grout: Comply with ASTM C 476, with a slump of 4 inches (102 mm) for standard steel door frames built into concrete or masonry, as measured according to ASTM C 143/C 143M.
- J. Mineral-Fiber Insulation: ASTM C 665, Type I (blankets without membrane facing); consisting of fibers manufactured from slag or rock wool with 6- to 12-lb/ft³ (96- to 192-kg/m³) density; with maximum flame-spread and smoke-developed indexes of 25 and 50, respectively; passing ASTM E 136 for combustion characteristics.
- K. Glazing: Comply with requirements in Division 8 Section "Glazing."
- L. Bituminous Coating: Cold-applied asphalt mastic, SSPC-Paint 12, compounded for 15-mil (0.4-mm) dry film thickness per coat. Provide inert-type noncorrosive compound free of asbestos fibers, sulfur components, and other deleterious impurities.

2.3 STANDARD STEEL DOORS

- A. General: Provide 1-3/4 inch doors of design indicated, not less than thickness indicated; fabricated with smooth surfaces, without visible joints or seams on exposed faces, unless otherwise indicated. Comply with ANSI A250.8.
 1. Design: Flush panel.
 2. Core Construction: Manufacturer's standard Kraft-paper honeycomb, polystyrene, polyurethane, mineral-board, or vertical steel-stiffener core that produces doors complying with ANSI A250.8. Provide a minimum R-value of 11-12.
 3. Vertical Edges for Single-Acting Doors: Square edge and Beveled edge unless square edge is indicated.
 - a. Beveled Edge: 1/8 inch in 2 inches (3 mm in 50 mm).
 4. Top and Bottom Edges: Closed with flush or inverted 0.042-inch- (1.0-mm-) thick end closures or channels of same material as face sheets.
 5. Tolerances: Comply with SDI 117, "Manufacturing Tolerances for Standard Steel Doors and Frames."
- B. Exterior Doors: Face sheets fabricated from metallic-coated steel sheet. Provide doors complying with requirements indicated below by referencing ANSI A250.8 for level and model and ANSI A250.4 for physical endurance level:

1. Level 2 and Physical Performance Level B (Heavy Duty), Model 1 (Full Flush) and 2 (Seamless).
- C. Hardware Reinforcement: Fabricate reinforcement plates from same material as door face sheets to comply with the following minimum sizes:
 1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than six spot welds.
 2. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
 3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.
- D. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.

2.4 STANDARD STEEL FRAMES

- A. General: Comply with ANSI A250.8 and with details indicated for type and profile.
- B. Exterior Frames: Fabricated from metallic-coated steel sheet.
 1. Fabricate frames with mitered or coped and welded face corners and seamless face joints.
- C. Interior Frames: Fabricated from cold-rolled steel sheet, unless otherwise indicated to comply with exterior frame requirements.
 1. Fabricate frames with mitered or coped and welded face corners and seamless face joints, unless otherwise indicated.
- D. Hardware Reinforcement: Fabricate reinforcement plates from same material as frames to comply with the following minimum sizes:
 1. Hinges: Minimum 0.123 inch (3.0 mm) thick by 1-1/2 inches (38 mm) wide by 6 inches (152 mm) longer than hinge, secured by not less than 6 spot welds.
 2. Lock Face, Flush Bolts, Closers, and Concealed Holders: Minimum 0.067 inch (1.7 mm) thick.
 3. All Other Surface-Mounted Hardware: Minimum 0.067 inch (1.7 mm) thick.
- E. Supports and Anchors: Fabricated from electrolytic zinc-coated or metallic-coated steel sheet.
- F. Jamb Anchors:
 1. Masonry Type: Adjustable strap-and-stirrup or T-shaped anchors to suit frame size, not less than 0.042 inch (1.0 mm) thick, with corrugated or perforated straps not less than 2 inches (50 mm) wide by 10 inches (250 mm) long; or wire anchors not less than 0.177 inch (4.5 mm) thick.
 2. Compression Type for Slip-on Frames: Adjustable compression anchors.
- G. Floor Anchors: Formed from same material as frames, not less than 0.042 inch (1.0 mm) thick, and as follows:
 1. Monolithic Concrete Slabs: Clip-type anchors, with two holes to receive fasteners.
 2. Separate Topping Concrete Slabs: Adjustable-type anchors with extension clips, allowing not less than 2-inch (50-mm) height adjustment. Terminate bottom of frames at finish floor surface.
- H. Fabricate concealed stiffeners and hardware reinforcement from either cold- or hot-rolled steel sheet.
- I. Ceiling Struts: Minimum 3/8-inch-thick by 2-inch- (9.5-mm-thick by 50-mm-) wide steel.

2.5 STOPS AND MOLDINGS

- A. Moldings for Glazed Lites in Doors: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as door face sheet in which they are installed.

- B. Fixed Frame Moldings: Formed integral with standard steel frames, minimum 5/8 inch (16 mm) high, unless otherwise indicated.
- C. Loose Stops for Glazed Lites in Frames: Minimum 0.032 inch (0.8 mm) thick, fabricated from same material as frames in which they are installed.

2.6 FABRICATION

- A. General: Fabricate standard steel doors and frames to be rigid and free of defects, warp, or buckle. Accurately form metal to required sizes and profiles, with minimum radius for thickness of metal. Where practical, fit and assemble units in manufacturer's plant. To ensure proper assembly at Project site, clearly identify work that cannot be permanently factory assembled before shipment.
- B. Standard Steel Doors:
 - 1. Exterior Doors: Provide weep-hole openings in bottom of exterior doors to permit moisture to escape. Seal joints in top edges of doors against water penetration.
 - 2. Glazed Lites: Factory cut openings in doors.
- C. Standard Steel Frames: Where frames are fabricated in sections due to shipping or handling limitations, provide alignment plates or angles at each joint, fabricated of same thickness metal as frames.
 - 1. Welded Frames: Weld flush face joints continuously; grind, fill, dress, and make smooth, flush, and invisible.
 - 2. Removable Transom Bar Frames: Provide closed tubular members with no visible face seams or joints; fabricated from same material as door frame.
 - 3. Provide countersunk, flat- or oval-head exposed screws and bolts for exposed fasteners, unless otherwise indicated.
 - 4. Plaster Guards: Weld guards to frame at back of hardware mortises in frames installed in concrete or masonry.
 - 5. Where installed in masonry, leave vertical mullions in frames open at top for grouting.
 - 6. Floor Anchors: Weld anchors to bottom of jambs and mullions with at least four spot welds per anchor.
 - 7. Jamb Anchors: Provide number and spacing of anchors as follows:
 - a. Masonry Type: Locate anchors not more than 18 inches (457 mm) from top and bottom of frame. Space anchors not more than 32 inches (813 mm) O.C. and as follows:
 - 1) Two anchors per jamb up to 60 inches (1524 mm) in height.
 - 2) Three anchors per jamb from 60 to 90 inches (1524 to 2286 mm) in height.
 - 3) Four anchors per jamb from 90 to 120 inches (2286 to 3048 mm) in height.
 - 4) Four anchors per jamb plus 1 additional anchor per jamb for each 24 inches (610 mm) or fraction thereof more than 120 inches (3048 mm) in height.
 - 8. Door Silencers: Except on weather-stripped doors, drill stops to receive door silencers as follows. Provide plastic plugs to keep holes clear during construction.
 - a. Single-Door Frames: Drill stop in strike jamb to receive three door silencers.
 - b. Double-Door Frames: Drill stop in head jamb to receive two door silencers.
- D. Hardware Preparation: Factory prepare standard steel doors and frames to receive templated mortised hardware; include cutouts, reinforcement, mortising, drilling, and tapping, according to the Door Hardware Schedule and templates furnished as specified in Division 8 Section "Door Hardware."
 - 1. Reinforce doors and frames to receive nontemplated mortised and surface-mounted door hardware.

2. Comply with applicable requirements in ANSI A250.6 and ANSI/DHI A115 Series specifications for door and frame preparation for hardware. Locate hardware as indicated on shop drawings or, if not indicated, according to ANSI A250.8.
- E. Stops and Moldings: Provide stops and moldings around glazed lites where indicated. Form corners of stops and moldings with butted or mitered hairline joints.
1. Single Glazed Lites: Provide fixed stops and moldings welded on secure side of door or frame.
 2. Provide fixed frame moldings on outside of exterior and on secure side of interior doors and frames.
 3. Provide loose stops and moldings on inside of doors and frames.
 4. Coordinate rabbet width between fixed and removable stops with type of glazing and type of installation indicated.

2.7 STEEL FINISHES

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
1. Finish standard steel door and frames after assembly.
- B. Metallic-Coated Steel Surface Preparation: Clean surfaces with nonpetroleum solvent so surfaces are free of oil and other contaminants. After cleaning, apply a conversion coating suited to the organic coating to be applied over it. Clean welds, mechanical connections, and abraded areas, and apply galvanizing repair paint specified below to comply with ASTM A 780.
1. Galvanizing Repair Paint: High-zinc-dust-content paint for re-galvanizing welds in steel, complying with SSPC-Paint 20.
- C. Steel Surface Preparation: Clean surfaces to comply with SSPC-SP 1, "Solvent Cleaning"; remove dirt, oil, grease, or other contaminants that could impair paint bond. Remove mill scale and rust, if present, from uncoated steel; comply with SSPC-SP 3, "Power Tool Cleaning," or SSPC-SP 6/NACE No. 3, "Commercial Blast Cleaning."
- D. Factory Priming for Field-Painted Finish: Apply shop primer specified below immediately after surface preparation and pretreatment. Apply a smooth coat of even consistency to provide a uniform dry film thickness of not less than 0.7 mils (0.018 mm).
1. Shop Primer: Manufacturer's standard, fast-curing, lead- and chromate-free primer complying with ANSI A250.10 acceptance criteria; recommended by primer manufacturer for substrate; compatible with substrate and field-applied finish paint system indicated; and providing a sound foundation for field-applied topcoats despite prolonged exposure.
- E. Factory-Applied Paint Finish: Manufacturer's standard, complying with ANSI A250.3 for performance and acceptance criteria.
1. Color and Gloss: Color and finish shall match existing color and finish at the project site.

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 standard steel doors and frames.
1. Examine roughing-in for embedded and built-in anchors to verify actual locations of standard steel frame connections before frame installation.
 2. For the record, prepare written report, endorsed by Installer, listing conditions detrimental to performance of work.

3. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Remove welded-in shipping spreaders installed at factory.
- B. Prior to installation and with installation spreaders in place, adjust and securely brace standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - 1. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - 2. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - 3. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - 4. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a perpendicular line from head to floor.
- C. Drill and tap doors and frames to receive nontemplated mortised and surface-mounted door hardware.

3.3 INSTALLATION

- A. General: Provide doors and frames of sizes, thicknesses, and designs indicated. Install standard steel doors and frames plumb, rigid, properly aligned, and securely fastened in place; comply with Drawings and manufacturer's written instructions.
- B. Standard Steel Frames: Install standard steel frames for doors, sidelights, transoms, borrowed lights and other openings, of size and profile indicated. Comply with SDI 105.
 - 1. Set frames accurately in position; plumbed, aligned, and braced securely until permanent anchors are set. After wall construction is complete, remove temporary braces, leaving surfaces smooth and undamaged.
 - a. At fire-protection-rated openings, install frames according to NFPA 80.
 - b. Where frames are fabricated in sections due to shipping or handling limitations, field splice at approved locations by welding face joint continuously; grind, fill, dress, and make splice smooth, flush, and invisible on exposed faces.
 - c. Install frames with removable glazing stops located on secure side of opening.
 - d. Install door silencers in frames before grouting.
 - e. Remove temporary braces necessary for installation only after frames have been properly set and secured.
 - f. Check plumb, squareness, and twist of frames as walls are constructed. Shim as necessary to comply with installation tolerances.
 - g. Apply bituminous coating to backs of frames that are filled with mortar, grout, and plaster containing antifreezing agents.
 - 2. Floor Anchors: Provide floor anchors for each jamb and mullion that extends to floor and secure with postinstalled expansion anchors.
 - a. Floor anchors may be set with powder-actuated fasteners instead of postinstalled expansion anchors if so indicated and approved on shop drawings.
 - 3. Masonry Walls: Coordinate installation of frames to allow for solidly filling space between frames and masonry with mortar as specified in Division 4 Section "Unit Masonry Assemblies."
 - 4. Ceiling Struts: Extend struts vertically from top of frame at each jamb to supporting construction above, unless frame is anchored to masonry or to other structural support at each jamb. Bend top of struts to provide flush contact for securing to supporting

construction above. Provide adjustable wedged or bolted anchorage to frame jamb members.

5. Installation Tolerances: Adjust standard steel door frames for squareness, alignment, twist, and plumb to the following tolerances:
 - a. Squareness: Plus or minus 1/16 inch (1.6 mm), measured at door rabbet on a line 90 degrees from jamb perpendicular to frame head.
 - b. Alignment: Plus or minus 1/16 inch (1.6 mm), measured at jambs on a horizontal line parallel to plane of wall.
 - c. Twist: Plus or minus 1/16 inch (1.6 mm), measured at opposite face corners of jambs on parallel lines, and perpendicular to plane of wall.
 - d. Plumbness: Plus or minus 1/16 inch (1.6 mm), measured at jambs at floor.

C. Standard Steel Doors: Fit hollow-metal doors accurately in frames, within clearances specified below. Shim as necessary.

1. Non-Fire-Rated Standard Steel Doors:

- a. Jambs and Head: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
- b. Between Edges of Pairs of Doors: 1/8 inch (3 mm) plus or minus 1/16 inch (1.6 mm).
- c. Between Bottom of Door and Top of Threshold: Maximum 3/8 inch (9.5 mm).
- d. Between Bottom of Door and Top of Finish Floor (No Threshold): Maximum 3/4 inch (19 mm).

2. Fire-Rated Doors: Install doors with clearances according to NFPA 80.

3. Smoke-Control Doors: Install doors according to NFPA 105.

D. Glazing: Comply with installation requirements in Division 8 Section "Glazing" and with standard steel door and frame manufacturer's written instructions.

1. Secure stops with countersunk flat- or oval-head machine screws spaced uniformly not more than 9 inches (230 mm) O.C., and not more than 2 inches (50 mm) O.C. from each corner.

3.4 ADJUSTING AND CLEANING

- A. Final Adjustments: Check and readjust operating hardware items immediately before final inspection. Leave work in complete and proper operating condition. Remove and replace defective work, including standard steel doors or frames that are warped, bowed, or otherwise unacceptable.
- B. Clean grout and other bonding material off standard steel doors and frames immediately after installation.
- C. Prime-Coat Touchup: Immediately after erection, sand smooth rusted or damaged areas of prime coat, and apply touch up of compatible air-drying primer.
- D. Galvannealed Surfaces: Clean abraded areas and repair with galvanizing repair paint according to manufacturer's written instructions.

** END OF SECTION **

SECTION 08220
FIBERGLASS REINFORCED PLASTIC DOORS AND FRAMES

1 GENERAL

1.1 GENERAL REQUIREMENTS

- A. Furnish all labor, materials, equipment, and incidentals required and deliver fiberglass reinforced plastic (FRP) doors and frames, with appurtenances as shown in the Drawings, as scheduled, and as herein specified.

1.2 WORK INCLUDED

- A. Fiberglass reinforced plastic doors and frames.

1.3 RELATED WORK

- A. Masonry is included in Section 04200.
- B. Door hardware is included in Section 08710.
- C. Glazing is included in Section 08800.

1.4 SUBMITTALS

- A. Product Data: Include construction details, material descriptions, core descriptions, label compliance, fire-resistance and temperature-rise ratings, and finishes for each type of door and frame specified, and as shown on the Door and Frame Schedule on the Drawings.
- B. Shop Drawings: In addition to requirements below, provide a schedule of standard doors and frames using same reference numbers for details and openings as those on Drawings:
 - 1. Elevations of each door design.
 - 2. Details of doors, including vertical and horizontal edge details.
 - 3. Frame details for each frame type, including dimensioned profiles.
 - 4. Details and locations of reinforcement and preparations for hardware.
 - 5. Details of each different wall opening condition.
 - 6. Details of anchorages, accessories, joints, and connections.
 - 7. Details of glazing frames and stops showing glazing.
 - 8. Details of conduit and preparations for electrified door hardware and controls.
- C. Coordination Drawings: Drawings of each opening, including door and frame, drawn to scale and coordinating door hardware. Show elevations of each door design type, showing dimensions, locations of door hardware, and preparations for power, signal, and electrified control systems.
- D. Samples for Initial Selection: For units with factory-applied color finishes.
- E. Samples for Verification: For each type of exposed finish required, prepared on Samples of not less than 3 by 5 inches (75 by 125 mm).
- F. Qualification Data: For Installer.

1.5 REGULATORY REQUIREMENT

- A. Fire-rated door and panel construction conforms to products tested under ASTM E152, UL10C & NFPA 252.
- B. Install door and panel assembly conforming to NFPA 80 for fire-rated class, ANSI A117.1 specifications for handicap accessibility, ADA requirements, ANSI A151.1 Mod. Swing cycle test in excess of 1,000,000 cycles.
- C. Flame Spread: All FRP component parts, including the gel coat finish, shall have a flame spread classification of 25 or less per ASTM E84 and shall be self extinguishing per ASTM D635 unless operating conditions dictate otherwise.

- D. Resins: Resins to meet with USDA and FDA standards for incidental food contact, if applicable to this project.

1.6 QUALITY ASSURANCE

- A. Provide FRP components manufactured by a single firm specializing in this type of work, unless otherwise acceptable to the Engineer.
- B. Texas Department of Insurance approved FRP doors and frames.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. All doors and frames shall be shipped with trim and all necessary items which may be required for final installation.
- B. All materials shall be delivered to the site in sealed, undamaged containers fully identified with manufacturer's name, brand, style, pattern, and color. Upon delivery to job site, materials shall be stored in original cartons, on end in such a way to prevent falling or damage to face, corners, or edges.

2 PRODUCTS

2.1 MANUFACTURERS

- A. FRP components shall be by Corrim Doors; equal by ChemPruf (with flanged frames) or equal.

2.2 TEXAS DEPARTMENT OF INSURANCE APPROVED DOORS AND FRAMES

- A. Door Fabrication FRP (Fiberglass Reinforced Plastic) Face Sheets.
 - 1. Face Sheets: Standard face sheets shall be manufactured using a corrosion resistant resin system with light stabilizing additives. The resin shall be reinforced with fiberglass, 40% by weight.
 - 2. Face sheets shall be 0.070" to 0.125" thickness. Standard being 0.120". Total door thickness to be a nominal 1-3/4".
 - 3. Finish:
 - a. Special gel coat color to be selected by the architect.
 - b. 15 mil thick coverage, +, -3 mils.
 - c. Smooth, seamless finish.
- B. Internal Construction
 - 1. Core:
 - a. Option A: Polyurethane Foam Core.
 - b. Option B: Mineral Core – fire rated (1/2 Hour, 3/4 Hour, 1 Hour, 1-1/2 Hour, 2 Hour).
 - 1) Core: Polyurethane core, a 1-1/2" thick rigid block of polyurethane shall be laminated to the interior or the panels. The "R" factor shall be 11 – 12.
 - 2) Core: Mineral core fire-rated as per schedule. (1/2 Hour, 3/4 Hour, 1 Hour, 1-1/2 Hour, 2 Hour).
 - 2. Stiles and Rails: Stiles and rails shall be 1-1/2" square pultruded fiberglass tubes. A polyester-based resin filled with 1/4" chopped glass strands and aerosil shall be used for reinforcements and corner blocks, etc. The bottom rail shall allow 1-1/4 inches of height alterability without loss of the panel's integrity. No metal or wood lumber reinforcements will be allowed.
 - 3. Fire-rated openings to be the "Polyfire Series" furnished in strict compliance with UL testing, and in accordance with ASTM-E-152/UL10C.
- C. Hardware Preparations

1. Reinforcement Blocking: non-swelling solid polymer blocking.
 2. Mortise Hardware:
 - a. Full mortise hinges - non-swelling polymer blocking.
 - b. Mortise locksets – to suit template provided.
 - c. Exit devices – to suit template provided.
 3. All doors shall be mortised and reinforced to allow application of hinges and locks, in accordance with hardware schedule and manufacturer's templates. The hinges shall be attached by using stainless steel wood screws. Pilot holes shall be in strict accordance to manufacturer's recommendations.
- D. Door Accessories
1. Glazing: Pultruded FRP tubes to fabricate the window opening. Glazing must allow for ready access for repair, in the event of damage or replacement, without affecting the sealed integrity of the cutout in the door panel itself. Openings cut directly into the core material will not be allowed.
 2. Fasteners: Provide stainless steel fasteners as required for glazing openings and louvers.
 3. Astragals: Astragals for pairs of doors to be fabricated of FRP material of manufacturer's standard flat design.

2.3 FRAMES

- A. Frame Fabrication FRP (Fiberglass Reinforced Plastic)
1. Jamb Depth: 5-3/4" standard. (Galvanized HM conforming to STEEL DOORS AND FRAMES at all fire-rated openings, gel coated to match non-rated frames.
 2. Face Dimension: 2" standard or 4" depth for hollow door stop.
 3. Return: 7/16"
 4. Stop: 5/8"
 5. Rabbet: 1-15/16"
 6. Corner Miter: Head and Jamb members shall be standard 45-deg. miter, providing a nearly mitered corner connection, fabricated for Knocked Down (KD) field assembly.
 7. Pultrusion: In compliance with pultrusion industry standards.
- B. Reinforcements and Braces/Supports
1. Corner Reinforcement: 4" x 4" x 5-3/8" x 1/4" thick pultruded fiberglass angle. Attached to head bar at factory using stainless steel screws or suitable polymer rivets.
 2. Mortise Hinge Reinforcement: 1-1/2" x 7" x 1/4" thick polymer. Attached to frame by means of bonding and stainless steel countersunk screws.
 3. Closer Reinforcement: Same as mortise hinge reinforcement, less screws.
 4. Strike Reinforcement: 1-1/2" x 9" x 3/4" thick polymer material. Attached to frame by means of bonding and stainless steel countersunk screws or suitable polymer rivets.
- C. Anchoring Systems
1. Fiberglass reinforced T-anchors, similar to those used in hollow metal door construction, shall be used to fasten frames to new masonry.
 2. Stainless steel fasteners, 300 Series as approved, shall be used for frame assembly and for all other fasteners.
 3. Gel coat: 15 mils thick, +/-3 mils on all exposed surfaces. Color to match door unless otherwise indicated.

2.4 FABRICATION

- A. Fabricate FRP doors and frames as shown on the drawings and in accordance with best shop practices. Frames shall be rigid, neat in appearance and free from defects. Field measurements shall be taken as required for coordinating with adjoining work.
- B. Form exposed surfaces free from warp, wave, and buckle, with all corners square, unless otherwise shown. Set each member in proper alignment and relationship to other members with all surfaces straight and in a true plane.
- C. Reinforce members and joints with plates, tubes or angles for rigidity and strength.
- D. Doors and frames shall be mortised and reinforced for hardware in accordance with the hardware manufacturer's instructions and templates. The reinforcing shall be designed to receive hinges, locks, strikes, closures, etc.
- E. Provide 5/8-in. glazing stops on the secured side for side, transom, borrowed and window opening lites prepared for fasteners not over 12-in. center.
- F. Furnish at least three (3) metal anchors or polymer spacers in each jamb of frames up to 84" high and one (1) additional anchor for each 24" in height above 84", in shapes, sizes and spacing shown or required for anchorage into adjoining wall construction. Fabricate joint anchor of stainless steel.
- G. Terminate bottom of frames at the indicated finished floor level.
- H. Provide clearance for doors of 1/8" at jambs and heads; 1/4" clearance above threshold.

3 EXECUTION

3.1 INSTALLATION

- A. General: Install FRP doors, frames and accessories in accordance with final shop drawings, NFPA 80 standards at fire-rated openings, and as herein specified. Installation to be similar to that of hollow metal doors and frames, and in accordance with FRP manufacturer's written instructions. Screws, nuts, washers, bolts, and other miscellaneous fastening devices for hardware shall be as specified in and furnished under Section 08710.
- B. Frame Installation
 - 1. Conform to STANDARD STEEL DOORS AND FRAMES.
- C. Door Installation
 - 1. Fit FRP doors accurately in frames, within clearances specified in Paragraph 2.04G of this section.

3.2 TOLERANCES

- A. Maximum Diagonal Distortion: 1/4" measured with a straight edge, corner to corner. Maximum measurable plane is 4-0' x 7-0'.

3.3 ADJUSTING

- A. At substantial completion, adjust all operable components to ensure proper installation and that they function smooth and freely.

3.4 CLEANING

- A. Remove dirt and excess sealant from exposed surfaces. Follow the manufacturer's recommended cleaning techniques and procedures for cleaning all surfaces. Use only cleaning products that will not scratch or damage the surfaces, and are recommended by the manufacturer.
- B. Remove debris from project site.

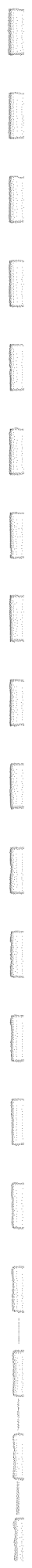
3.5 WARRANTY

- A. To include ten (10) years free from defects in material and workmanship from date of shipment, and lifetime from degradation of failure due to corrosion from date of shipment, provided that the structural integrity of the doors and frames have not been violated or

compromised. (No unauthorized cuts, bores, or other structural alterations affecting the core of the door, or the structure of the frame.)

- B. Normal wear and tear, or physical abuse of a specific installation is not part of this warranty.

** END OF SECTION **



SECTION 08331
OVERHEAD COILING DOORS

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 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.3 SUMMARY

- A. This Section includes the following types of manually and electric-motor-operated overhead coiling doors:

- 1. Manual, insulated service doors.

1.4 RELATED SECTIONS INCLUDE THE FOLLOWING:

- A. Division 5 Section "Metal Fabrications" for miscellaneous steel supports.
- B. Division 8 Section "Door Hardware" for lock cylinders and keying.
- C. Division 16 Sections for electrical service and connections for powered operators and accessories.

1.5 DEFINITIONS

- A. Operation Cycle: One cycle of a door is complete when it is moved from the closed position to the fully open position and returned to the closed position.

1.6 PERFORMANCE REQUIREMENTS

- A. Structural Performance: Provide overhead coiling doors capable of withstanding the effects of gravity loads and the following loads and stresses without evidencing permanent deformation of door components:

- 1. Wind Load: As shown on Drawings, acting inward and outward.
- 2. Impact Test for Flying Debris: Comply with ASTM E 1996, tested according to ASTM E 1886.
 - a. Level of Protection: Enhanced Protection.
 - b. Wind Zone: Wind speed as shown on the Drawings, pressure test to 1/2 and 1-1/2 x design pressure (positive and negative).

- B. Operation-Cycle Requirements: Provide overhead coiling door components and operators capable of operating for not less than 20,000 cycles and for 10 cycles per day.

- 1. Include tamperproof cycle counter.

- C. Air Leakage Requirements: Provide overhead door which meets air infiltration requirements of a maximum of 1.0 cfm/ft² per NRFC 400.

1.7 SUBMITTALS

- A. Product Data: For each type and size of overhead coiling door and accessory. Include the following:
- B. Shop Drawings: For special components and installations not dimensioned or detailed in manufacturer's product data.
- C. Samples for Initial Selection: Manufacturer's color charts showing full range of colors available for units with factory-applied finishes.

- D. Samples for Verification: Of each type of exposed finish required, prepared on Samples of size indicated below.
 - 1. Curtain Slats: 12 inches (305 mm) long.
 - 2. Guides: 6 inches (150 mm) long.
 - 3. Brackets: 6 inches (150 mm) square. Not required if same as Guides.
 - 4. Hood: 6 inches (150 mm) square.
- E. Qualification Data: For Installer.

1.8 QUALITY ASSURANCE

- A. Installer Qualifications: Manufacturer's authorized representative who is trained and approved for both installation and maintenance of units required for this Project.
- B. Source Limitations: Obtain overhead coiling doors through one source from a single manufacturer.
 - 1. Obtain operators and controls from overhead coiling door manufacturer.
- C. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturer: Subject to compliance with requirements, provide products by one of the following:
 - 1. Alpine Overhead Doors, Inc.
 - 2. Atlas Door; Div. of Clopay Building Products Company, Inc.
 - 3. Cookson Company
 - 4. Cornell Iron Works, Inc.
 - 5. Mahon Door Corporation
 - 6. Overhead Door Corporation
 - 7. Raynor.
 - 8. Windsor Door, a MAGNATRAX Corporation.

2.2 DOOR CURTAIN MATERIALS AND CONSTRUCTION

- A. Door Curtains: Fabricate overhead coiling door curtain of interlocking slats, designed to withstand wind loading indicated, in a continuous length for width of door without splices. Unless otherwise indicated, provide slats of thickness and mechanical properties recommended by door manufacturer for performance, size, and type of door indicated, and as follows:
 - 1. Door Curtain Slats: Interlocking 0.50-inch thick, roll-formed aluminum slats
 - a. Minimum Base-Metal (Uncoated) Minimum Thickness: 0.050 inch thick
 - b. Flat profile slats.
 - 2. Insulation: Fill slat with manufacturer's standard rigid cellular polyisocyanurate or polyurethane-foam-type thermal insulation complying with maximum flame-spread and smoke-developed indexes of 75 and 450, respectively, according to ASTM E 84. Enclose insulation completely within metal slat faces.
 - 3. Inside Curtain Slat Face: To match material of outside metal curtain slat, except 24 ga., 0.0239 inches (0.61 mm) minimum thickness.
- B. Endlocks and Windlocks for Service Doors: Malleable-iron casings galvanized after fabrication, secured to curtain slats with galvanized rivets or high-strength nylon. Provide

locks on not less than alternate curtain slats for curtain alignment and resistance against lateral movement.

- C. Bottom Bar for Service Doors: Consisting of 2 angles, each not less than 1-1/2 by 1-1/2 by 1/8 inch (38 by 38 by 3 mm) thick; aluminum extrusions to suit type of curtain slats.
- D. Curtain Jamb Guides for Service Doors: Fabricate curtain jamb guides of steel angles or channels and angles, with sufficient depth and strength to retain curtain, to allow curtain to operate smoothly, and to withstand loading. Build up units with not less than 3/16-inch- (5-mm-) thick galvanized steel sections complying with ASTM A 36/A 36M and ASTM A 123/A 123M. Slot bolt holes for guide adjustment. Provide removable stops on guides to prevent overtravel of curtain, and a continuous bar for holding windlocks.

2.3 HOODS AND ACCESSORIES

- A. Hood: Form to act as weatherseal and entirely enclose coiled curtain and operating mechanism at opening head. Contour to fit end brackets to which hood is attached. Roll and reinforce top and bottom edges for stiffness. Provide closed ends for surface-mounted hoods and provide fascia for any portion of between-jamb mounting projecting beyond wall face. Provide intermediate support brackets as required to prevent sagging.
 - 1. Fabricate hoods to be minimum 24 Ga., 0.040-inch- (1.016-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
 - 2. Shape: Round.
- B. Integral Frame, Hood, and Fascia: Provide welded assemblies of the following sheet metal:
 - 1. Fabricate from minimum 0.064-inch- (1.6-mm-) thick, hot-dip galvanized steel sheet with G90 (Z275) zinc coating, complying with ASTM A 653/A 653M.
- C. Integral Sills: Fabricate sills as integral part of frame assembly of same sheet metal; 0.078-inch (2.0-mm) minimum thickness.
- D. Weather seals: Provide replaceable, adjustable, continuous, compressible weather-stripping gaskets fitted to bottom and top of exterior doors, unless otherwise indicated. At door head, use 1/8-inch- (3-mm-) thick, replaceable, continuous sheet secured to inside of hood.
 - 1. Provide doors with bottom weather seal.
 - 2. In addition, provide replaceable, adjustable, continuous, flexible, 1/8-inch- (3-mm-) thick seals of flexible vinyl, rubber, or neoprene at door jambs for a weathertight installation.
- E. Push/Pull Handles: For push-up-operated or emergency-operated doors, provide galvanized steel lifting handles on inside of door.
 - 1. Provide pull-down straps or pole hooks for doors more than 84 inches (2130 mm) high.
- F. Fabricate locking device assembly with lock, spring-loaded dead bolt, operating handle, cam plate, and adjustable locking bar to engage through slots in tracks.
 - 1. Locking Bars: Single-jamb side operable from inside and outside.
 - 2. Lock cylinder is specified in Division 8 Section "Door Hardware."
- G. If door unit is power operated, provide safety interlock switch to disengage power supply when door is locked.

2.4 COUNTERBALANCING MECHANISM

- A. General: Counterbalance doors by means of adjustable-tension, steel helical torsion spring mounted around a steel shaft and contained in a spring barrel connected to door curtain with barrel rings. Use grease-sealed bearings or self-lubricating graphite bearings for rotating members.
- B. Counterbalance Barrel: Fabricate spring barrel of hot-formed, structural-quality, welded or seamless carbon-steel pipe, of sufficient diameter and wall thickness to support rolled-up

curtain without distortion of slats and to limit barrel deflection to not more than 0.03 inches/ft (2.5 mm/m) of span under full load.

- C. Provide spring balance of one or more oil-tempered, heat-treated steel helical torsion springs. Size springs to counterbalance weight of curtain, with uniform adjustment accessible from outside barrel. Provide cast-steel barrel plugs to secure ends of springs to barrel and shaft.
- D. Fabricate torsion rod for counterbalance shaft of cold-rolled steel, sized to hold fixed spring ends and carry torsional load.
- E. Brackets: Provide mounting brackets of manufacturer's standard design, either cast iron or cold-rolled steel plate.

2.5 FINISHES, GENERAL

- A. General: Comply with NAAMM's "Metal Finishes Manual for Architectural and Metal Products" for recommendations for applying and designating finishes.
- B. 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.
- C. Finish: Factory applied, Kynar 500. Color to match color of existing overhead coiling doors at the project site.

2.6 MANUAL DOOR OPERATORS

- A. Chain hoist.

3 EXECUTION

3.1 INSTALLATION

- A. General: Install coiling doors and operating equipment complete with necessary hardware, jamb and head molding strips, anchors, inserts, hangers, and equipment supports.
 - 1. Install fire-rated doors to comply with NFPA 80.

3.2 ADJUSTING

- A. Lubricate bearings and sliding parts; adjust doors to operate easily, free of warp, twist, or distortion and with weathertight fit around entire perimeter.

3.3 DEMONSTRATION

- A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain overhead coiling doors. Refer to Division 1 Section "Demonstration and Training."

** END OF SECTION **

SECTION 08520
ALUMINUM WINDOWS

1 GENERAL

1.1 DESCRIPTION

- A. This Section includes heavy commercial-grade aluminum window units of the performance class indicated. Window types required include:
 - 1. Horizontal sliding windows.
 - 2. Top-hinged outswing windows.
 - 3. Fixed windows.
- B. Related Sections: The following sections contain requirements that relate to this Section:
 - 1. Glass and Glazing is included in Section 08800: Glass and Glazing.

1.2 SYSTEM PERFORMANCE REQUIREMENTS

- A. General: Provide aluminum window units that comply with performance requirements specified, as demonstrated by testing manufacturer's corresponding stock systems according to test methods indicated.
- B. Design Requirements: Comply with structural performance, air infiltration, and water penetration requirements indicated in AAMA 101 for type, grade, and performance class of window units required.
 - 1. Optional Performance Class Requirements: Where the required design pressure exceeds the minimum for the specified window grade, comply with requirements of AAMA 101, Section 3, "Optional Performance Classes" for higher than minimum performance class.
 - 2. Heights of window units above grade at the window centerline are indicated or can be determined from the drawings. Consult with the Architect for clarification needed to confirm required loading and test pressures.
 - 3. Design wind p
- C. Testing: Test each type and size of required window unit through a recognized independent testing laboratory or agency, in accordance with ASTM E 330 for structural performance, with ASTM E 283 for air infiltration, and with ASTM E 547 for water penetration. Provide certified test results.
 - 1. Structural Performance: Provide window units with no failure or permanent deflection in excess of 0.4 percent of any member's span after removal of the imposed load, for a positive (inward) and negative (outward) test pressure of 30 lbf/sq. ft.
 - 2. Air Infiltration: Provide units with air infiltration rate of not more than 0.37 cfm/ft. of operable sash joint for an inward test pressure of 6.24 lbf/sq. ft.
 - 3. Water Penetration: Provide units with no water penetration as defined in the test method at an inward test pressure of 15 percent of the design pressure.
 - 4. Condensation Resistance: Where window units are indicated to be of "thermal-break construction," provide units that have been tested for thermal performance in accordance with AAMA 1503.1 showing a condensation resistance factor (CRF) of 45.
 - 5. Forced-Entry Resistance: Provide window units that comply with requirements for Performance Level 10 when tested in accordance with ASTM F 588.
- D. Sound Insulation Construction: Fabricate aluminum window units that have been certified to provide a sound transmission class (STC) rating of at least 40 when tested in accordance with ASTM E 90 and classified according to ASTM E 413.
- E. Window Wall Tests: Provide window units that comply with performance requirements of specification section "Glazed Aluminum Curtain Wall."

1.3 SUBMITTALS

- A. General: Submit the following in accordance with Conditions of the Contract and Division 1 Specification Sections.
 - 1. Product data for each type of window required, including:
 - a. Construction details and fabrication methods.
 - b. Profiles and dimensions of individual components.
 - c. Data on hardware, accessories, and finishes.
 - d. Recommendations for maintenance and cleaning of exterior surfaces.
 - 2. Shop drawings for each type of window required. Include information not fully detailed in manufacturer's standard product data and the following:
 - a. Layout and installation details, including anchors.
 - b. Elevations of continuous work at 1/4-inch scale and typical window unit elevations at 3/4-inch scale.
 - c. Full-size section details of typical composite members, including reinforcement.
 - d. Hardware including operators.
 - e. Glazing details.
 - f. Accessories.
 - 3. Samples for Initial Color Selection: Submit samples of each specified finish on 12-inch-long sections of window members. Where finishes involve normal color variations, include sample sets showing the full range of variations expected.
 - 4. Samples for Verification Purposes: The Architect reserves the right to require additional samples, that show fabrication techniques and workmanship, and design of hardware and accessories.
 - 5. Certification: Provide certification by a recognized independent testing laboratory or agency showing that each type, grade, and size of window unit complies with performance requirements indicated.

1.4 QUALITY ASSURANCE

- A. Installer Qualifications: Engage an experienced Installer who has completed installation of aluminum windows similar in design and extent to those required for the project and whose work has resulted in construction with a record of successful in-service performance.
- B. Standards: Requirements for aluminum windows, terminology and standards of performance, and fabrication workmanship are those specified and recommended in AAMA 101 and applicable general recommendations published by AAMA.
- C. Single-Source Responsibility: Provide aluminum window units from one source and produced by a single manufacturer.
- D. Design Concept: The drawings indicate the size, profiles, and dimensional requirements of the aluminum window types required and are based on the specific type and model indicated. Aluminum windows by other manufacturers may be considered provided deviations in dimensions and profiles are minor and do not change the design concept as judged by the Architect. The burden of proof of equality is on the proposer.

1.5 PROJECT CONDITIONS

- A. Field Measurements: Check actual window openings by accurate field measurement before fabrication. Show recorded measurements on final shop drawings. Coordinate fabrication schedule with construction progress to avoid delay of work.
 - 1. Where necessary, proceed with fabrication without field measurements, and coordinate fabrication tolerances to ensure proper fit of window units.

1.6 WARRANTY

- A. Aluminum Window Warranty: Submit a written warranty, executed by the window manufacturer, agreeing to repair or replace window units that fail in materials or workmanship within the specified warranty period. Failures include but are not necessarily limited to:
 - 1. Structural failures including excessive deflection, excessive leakage, or air infiltration.
 - 2. Faulty operation of sash and hardware.
 - 3. Deterioration of metals, metal finishes, and other materials beyond normal weathering.
- B. Warranty Period: 10 years after the date of Substantial Completion.
- C. The warranty shall not deprive the Owner of other rights or remedies that the Owner may have under other provisions of the Contract Documents and is in addition to and runs concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products of one of the following:
 - 1. Horizontal Sliding Windows:
 - a. Alenco, Division of Redman Industries, Inc.
 - b. Capitol Products Corporation.
 - c. Kawneer Company.
 - 2. Top-Hinged Outswing Windows:
 - a. Alenco, Division of Redman Industries, Inc.
 - b. Capitol Products Corporation.
 - c. Kawneer Company, Inc.
 - 3. Fixed Windows:
 - a. Alenco, Division of Redman Industries, Inc.
 - b. Capitol Windows.
 - c. Kawneer Company, Inc.

2.2 MATERIALS

- A. Aluminum Extrusions: Provide alloy and temper recommended by the window manufacturer for the strength, corrosion resistance, and application of required finish, but not less than 22,000-psi ultimate tensile strength and not less than 0.062-inch-thick at any location for main frame and sash members.
- B. Fasteners: Provide aluminum, nonmagnetic stainless steel, epoxy adhesive, or other materials warranted by the manufacturer to be noncorrosive and compatible with aluminum window members, trim, hardware, anchors, and other components of window units.
 - 1. Reinforcement: Where fasteners screw-anchor into aluminum less than 0.125-inch-thick, reinforce the interior with aluminum or nonmagnetic stainless steel to receive screw threads or provide standard noncorrosive pressed-in splined grommet nuts.
 - 2. Exposed Fasteners: Except where unavoidable for application of hardware, do not use exposed fasteners. For application of hardware, use fasteners that match the finish of the member or hardware being fastened, as appropriate.
- C. Anchors, Clips, and Window Accessories: Fabricate anchors, clips, and window accessories of aluminum, nonmagnetic stainless steel, or hot-dip zinc-coated steel or iron

complying with the requirements of ASTM B 633; provide sufficient strength to withstand design pressure indicated.

- D. Compression-Type Glazing Strips and Weatherstripping: Unless otherwise indicated, and at the manufacturer's option, provide compressible stripping for glazing and weatherstripping such as molded EPDM or neoprene gaskets complying with AAMA SG-1 or with ASTM D 2000 Designation 2BC415 to 3BC620, or molded PVC gaskets complying with ASTM D 2287, or molded expanded EPDM or neoprene gaskets complying with ASTM C 509, Grade 4.
- E. Sliding-Type Weatherstripping: Provide woven pile weatherstripping of wool, polypropylene, or nylon pile and resin-impregnated backing fabric. Comply with AAMA 701.2.
- F. Sealant: For sealants required within fabricated window units, provide type recommended by the manufacturer for joint size and movement. Sealant shall remain permanently elastic, nonshrinking, and nonmigrating. Comply with Division 7 Section "Joint Sealants" of these specifications for selection and installation of sealants.
- G. Wire Fabric Insect Screen: Provide 18 by 18, 18 by 16, or 18 by 14 mesh of 0.013-inch-diameter coated aluminum wire, complying with FS RR-W-365, Type VII.

2.3 HARDWARE

- A. General: Provide the manufacturer's standard hardware fabricated from aluminum, stainless steel, or other corrosion-resistant material compatible with aluminum and of sufficient strength to perform the function for which it is intended.

2.4 ACCESSORIES

- A. General: Provide the manufacturer's standard accessories that comply with indicated standards.
- B. Insect Screens: Provide insect screens for each operable exterior sash or ventilator. Locate screens on the inside or outside of the window sash or ventilator, depending upon window type. Design windows and hardware to accommodate screens in a tight-fitting removable arrangement, with a minimum of exposed fasteners and latches.
 - 1. Screen Frames: Fabricate frames of tubular-shaped extruded or formed aluminum members of 0.040-inch minimum wall thickness, with mitered or coped joints and concealed mechanical fasteners. Finish frames to match window units.
 - a. Provide removable PVC spline-anchor concealing the edge of the screen frame.
- C. Weatherstripping: Provide sliding-type weatherstripping where sash rails slide horizontally or vertically along the unit frame. Provide compression-type weatherstripping at the perimeter of each operating sash where sliding type is not appropriate.
 - 1. Provide weatherstripping locked in to extruded grooves in the sash.
- D. Window Grade and Class: Provide window units that comply with requirements of AAMA Grade and Performance Class HC40, including vertical deflection test, hardware load test, and torsion test performance requirements specified in AAMA 101.

2.5 HORIZONTAL SLIDING WINDOWS

- A. Window Grade and Class: Provide window units that comply with requirements of AAMA Grade and Performance Class HC40, including operating force and deglazing test requirements specified in AAMA 101.
 - 1. Provide window units with sash that can be removed from the inside for cleaning.
- B. Hardware: Provide the following operating equipment and hardware:
 - 1. Sash Rollers: Nylon rollers.
 - 2. Sash Lock: Cam action sweep sash lock and keeper at meeting rails.

2.6 TOP-HINGED WINDOWS

- A. Window Grade and Class: Provide window units that comply with requirements of AAMA Grade and Performance Class HC40. Window units shall successfully pass the following test requirements as specified in AAMA 101:

- 1. Hold-open arm or stay bar load test.
- 2. Torsion test.
- 3. Horizontal concentrated load test.
- 4. Vertical concentrated load test.

2.7 FIXED WINDOWS

- A. Window Grade and Class: Comply with requirements of AAMA Grade and Performance Class HC40.

2.8 FABRICATION

- A. General: Fabricate aluminum window units to comply with indicated standards. Include a complete system for assembly of components and anchorage of window units.
 - 1. Provide units that are reglazable without dismantling sash or ventilator framing.
 - 2. Prepare window sash or ventilators for glazing except where preglazing at the factory is indicated.
- B. Thermal-Break Construction: Fabricate window units with an integral concealed low-conductance thermal barrier, located between exterior materials and window members exposed on the interior, in a manner that eliminates direct metal-to-metal contact.
 - 1. Provide thermal-break construction that has been in use for not less than 3 years, has been tested to demonstrate resistance to thermal conductance and condensation, and has been tested to show adequate strength and security of glass retention.
 - 2. Provide hardware with low conductivity or nonmetallic material for hardware bridging thermal breaks at frame or vent sash.
 - 3. Weepholes: Provide weepholes and internal passages to conduct infiltrating water to the exterior.
 - 4. Provide water-shed members above side-hinged ventilators and similar lines of natural water penetration.
 - 5. Subframes: Provide subframes with anchors for window units, where shown, of profile and dimensions indicated but not less than 0.062-inch-thick extruded aluminum. Miter or cope corners, and weld and dress smooth with concealed mechanical joint fasteners. Finish to match window units.
 - 6. Mullions: Provide mullions and cover plates as shown, matching window units, complete with anchors for support to structure and installation of window units. Allow for erection tolerances and provide for movement of window units due to thermal expansion and building deflections, in the manner indicated.
 - 7. Glazing Stops: Provide screw-applied or snap-on glazing stops, coordinated with glass selection and glazing system indicated. Finish glazing stops to match window units.
- C. Preglazed Fabrication: Preglaze window units at the factory where possible and practical for applications indicated. Comply with glass and glazing requirements of the "Glass and Glazing" sections of these specifications and AAMA 101.

2.9 FINISHES

- A. General: Comply with NAAMM "Metal Finishes Manual" for recommendations relative to application and designations of finishes.
- B. Finish designations prefixed by "AA" conform to the system established by the Aluminum Association for designating aluminum finishes.
- C. Finish aluminum windows to match color of existing aluminum windows at the project site.

- D. High-Performance Organic Coating: AA-C12C42R1x (Chemical Finish: cleaned with inhibited chemicals; Chemical Finish: chemical conversion coating, acid chromate-fluoride- phosphate pretreatment; Organic Coating: as specified below). Prepare, pretreat, and apply coating to exposed metal surfaces to comply with coating and resin manufacturer's instructions.
 - 1. KYNAR-500 Fluoropolymer 2-Coat Coating System: Manufacturer's standard 2-coat thermocured system, complying with AAMA 605.2, composed of specially formulated inhibitive primer and fluorocarbon color topcoat containing not less than 70 percent polyvinylidene fluoride resin by weight.
 - 2. Color and Gloss: Match existing color and finish at the project site.

3 EXECUTION

3.1 INSPECTION

- A. Inspect openings before beginning installation. Verify that rough or masonry opening is correct and the sill plate is level.

3.2 INSTALLATION

- A. Refer to the "Glazed Aluminum Curtain Wall" section for requirements for installation of aluminum window units in glazed curtain walls.
- B. Comply with manufacturer's specifications and recommendations for installation of window units, hardware, operators, and other components of the work.
- C. Set window units plumb, level, and true to line, without warp or rack of frames or sash. Provide proper support and anchor securely in place.
 - 1. Separate aluminum and other corrodible surfaces from sources of corrosion or electrolytic action at points of contact with other materials by complying with the requirements specified under paragraph "Dissimilar Materials" in the Appendix to AAMA 101.
- D. Set sill members and other members in a bed of compound or with joint fillers or gaskets, as shown, to provide weathertight construction. Refer to the "Joint Sealer" sections of Division 7 for compounds, fillers, and gaskets to be installed concurrently with window units. Coordinate installation with wall flashings and other components of the work.
 - 1. Compounds, joint fillers, and gaskets to be installed after installation of window units are specified as work in another section in Division 7.

3.3 ADJUSTING

- A. Adjust operating sash and hardware to provide a tight fit at contact points and at weatherstripping for smooth operation and a weathertight closure.

3.4 CLEANING

- A. Clean aluminum surfaces promptly after installation of windows. Exercise care to avoid damage to protective coatings and finishes. Remove excess glazing and sealant compounds, dirt, and other substances. Lubricate hardware and other moving parts.
- B. Clean glass of preglazed units promptly after installation of windows. Comply with requirements of the "Glass and Glazing" section for cleaning and maintenance.

3.5 PROTECTION

- A. Initiate and maintain protection and other precautions required through the remainder of the construction period, to ensure that, except for normal weathering, window units will be free of damage or deterioration at the time of Substantial Completion.

** END OF SECTION **

SECTION 08710
DOOR HARDWARE

1 GENERAL

1.1 SCOPE OF WORK

- A. Provide finish hardware throughout the Work, indicated and specified hereinafter and as needed for a complete and proper installation. As needed, hardware shall be of the type and quality suitable to the service required and comparable to other hardware, as specified.
- B. "Finish Hardware" includes items known commercially as finish hardware which are required for swing, sliding and folding doors, except special types of unique and non-matching hardware specified in the same section as the door and door frame.
- C. Extent of finish hardware required is indicated on Drawings and in schedules.
- D. Types of finish hardware required include the following:
 - 1. Butt Hinges
 - 2. Lock Cylinders and Keys
 - 3. Lock and Latch Sets
 - 4. Exit Devices
 - 5. Closers
 - 6. Electronic Door Control Devices
 - 7. Overhead Holders
 - 8. Door Trim Units
- E. If items of hardware are not definitely specified and should they be required for completion of the work, such items shall be furnished of type and quality suitable to the service required and comparable to adjacent hardware at no extra cost to the Owner.

1.2 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid Item.

1.3 RELATED SECTIONS

- A. Standard Steel Doors and Frames are included in Section 08111.
- B. Fiberglass Reinforced Plastic Doors and Frames are included in Section 08220.

1.4 SUBMITTALS

- A. Product Data: Submit manufacturer's technical product data for each item of hardware in accordance with Division 1 Section "Submittals". Include whatever information may be necessary to show compliance with requirements, and include instructions for installation and for maintenance of operating parts and finish.
- B. Hardware Schedule: Submit final hardware schedule in a vertical format as recognized by the Door and Hardware Institute (DHI). Horizontal schedule format will not be accepted. Coordinate hardware with doors, frames, and related work to ensure proper size, thickness, hand, function, and finish of hardware.
 - 1. Final Hardware Schedule Content: Based on finish hardware indicated, organize hardware schedule into "hardware sets" indicating complete designations of every item required for each door or opening. Include the following information:
 - a. Type, style, function, size and finish of each hardware item.
 - b. Name and manufacturer of each item.
 - c. Fastenings and other pertinent information.

- d. Index to include location of hardware set cross referenced to indications on Drawings both on floor plans and in door and frame schedule.
 - e. Explanation of all abbreviations, symbols, codes, etc., contained in schedule.
 - f. Mounting locations for hardware.
 - g. Door and frame sizes and materials.
 - h. Keying information.
 - i. Wiring diagrams with theory of operation.
- C. Submittal Sequence: Submit schedule in accordance to Division 1, particularly where acceptance of hardware schedule must precede fabrication of other work (e.g., hollow metal frames) which is critical in the Project construction schedule. Include with schedule the product data, samples, shop drawings of other work affected by finish hardware, and other information essential to the coordinated review of hardware schedule.
 - D. Keying Schedule: Submit separate detailed schedule indicating clearly how the Owner's final instructions on keying of locks has been fulfilled.
 - E. Samples if Requested: Prior to submittal of the final hardware schedule and prior to final ordering of finish hardware, submit one sample of each type of exposed hardware unit, finish as required, and tagged with full description for coordination with schedule.
 - F. Templates: Furnish hardware templates to each fabricator of doors, frames and other work to be factory prepared for the installation of hardware. Upon request, check shop drawings of such other work, to confirm that adequate provisions are made for proper location and installation of hardware.

1.5 QUALITY ASSURANCE

- A. Manufacturer: Obtain each type of hardware (latch and lock sets, etc.) from a single manufacturer.
- B. Supplier: A recognized architectural finish hardware supplier, with warehousing facilities, who has been furnishing hardware in the Project's vicinity for a period of not less than two years, and who is, or who employs an experienced architectural hardware consultant who is available, at reasonable times during the course of the Work, for consultation about Project's hardware requirements, to Owner, Engineer and Contractor.
- C. Fire Rated Openings: Provide hardware for fire rated openings in compliance with NFPA Standard No. 80 and local building code requirements. Provide only hardware which has been tested and listed by UL or an approved testing agency for types and sizes of doors required and complies with requirements of door and door frame labels.
- D. Where emergency exit devices are required on fire rated doors (with supplementary marking on doors with labels indicating "Fire Door to be Equipped with Fire Exit Hardware") provide labels on exit devices indicating "Fire Exit Hardware".
- E. This supplier shall be responsible to field check existing openings for proper application of hinge and strikes sizes for all openings.

1.6 REGULATORY REQUIREMENTS

- A. Regulatory Requirements
 - 1. Conform to the 2012 International Building Code and Americans with Disabilities Act (ADA).
 - 2. Conform to the U.L. Standards of the Underwriters Laboratories, Inc.
 - 3. Conform to the American National Standards Institute (A.N.S.I.), A115-IG (Installation Guide for Doors and Hardware).
 - 4. Conform to Steel Door Institute (SDI).
- B. Substitutions: Requests shall be in accordance with requirements of the General Conditions of these Specifications the Project Manual. Finish hardware substitutions will

not be accepted without written approval of the Owner Engineer or the Consultant. Substituted hardware without Owner approval shall be removed and replaced with specified hardware, at no added cost to the Owner.

- C. Manufacture: Unless specified otherwise, each type of finish hardware used throughout the Work shall be of the same make or manufacture, although several may be indicated as equal product complying with requirements unless otherwise specified.
- D. Hardware Supplier: Supplier must be a recognized builder hardware supplier who has been furnishing hardware in the projects vicinity for a period of not less than two years. Supplier must be or employ an experienced Hardware Consultant who is available, at reasonable times during the course of the Work, for consultation about the project's hardware requirements to the Engineer or Consultant at no additional cost to the Owner.
- E. Pre-scheduled Conferences: Prior to final approval of the submittals and installation of the cylinders and keys, the Contractor and Hardware Supplier shall meet in the field with the Engineer, or the Owner's authorized representative and the Consultant to finalize all finish hardware information, the keying schedules and keying requirements, and obtain final instructions in writing.

1.7 PRODUCT HANDLING

- A. Tag each item or package separately, with identification related to final hardware schedule, and include basic installation instructions with each item or package.
- B. Inventory hardware jointly with representatives of hardware supplier and hardware installer until each is satisfied that count is correct.
- C. Deliver individually packaged hardware items at the proper times to the proper locations (shop or project site) for installation.
- D. Provide secure lock up for hardware delivered to the Project, but not yet installed. Control handling and installation of hardware items which are not immediately replaceable, so that completion of the Work will not be delayed by hardware losses, both before and after installation.

1.8 GUARANTEES

- A. All hardware shall be guaranteed for a period specified below of two years from date of acceptance of the Work. Correct defects in materials and workmanship and operation occurring during the guarantee period to the complete satisfaction of the Owner at no added cost to the Owner. All surface door closers shall be guaranteed for five years. Submit guaranty certification for review prior to start of Work.
 - 1. Door Closer: Five years, except electronic closers (two years).
 - 2. Exit Devices: Three years.
 - 3. Hinges: 10 years.
 - 4. All other Hardware: Two years.

1.9 CLEAN-UP

- A. In addition to the requirements noted in Division 1, Contractor, upon completion of the Work of this Section, shall remove all oil, grease, or other soiling from exposed surfaces of finish hardware; shall remove all cartons, wrapping, and other debris resulting from work herein; and shall leave the building in a neat, clean, and acceptable condition to the approval of the Owner Engineer or the Consultant.

2 PRODUCTS

2.1 GENERAL

- A. The following materials may be suitable or other materials maybe selected for use during the detailed design at the discretion of the Design-Builder subject to the approval of the Owner.

- B. The use of a manufacturer's name and/or equipment model number is for the purpose of establishing the standard of quality and general configuration desired and is not intended as a recommendation or approval of the specific name or model number for the Design-Builder's design.

2.2 SCHEDULED HARDWARE

- A. Requirements for design, grade, function, finish, size, and other distinctive qualities of each type of finish hardware are indicated in the Finish Hardware Data Sheet and Hardware Schedule at the end of this Section. Products are identified by using hardware designation numbers of the following.
- B. Manufacturer's Product Designations
 1. Butt Hinges: Hager
 2. Continuous Hinges: Hager
 3. Trim Sets: Von Duprin
 4. Locksets: Schlage Lock Co.
 5. Electromechanical Locks: Stanley/Best
 6. Exit Devices: Von Duprin
 7. Closers: Falcon
 8. Automatic Door Operators: LCN Closers
 9. Access Control: Sielox (provided by others)
 10. Overhead Holders: Glynn-Johnson
 11. Kickplates: Ives
 12. Silencers: Ives
 13. Floor/Wall Stops: Ives
 14. Threshold and Weatherstrip: National Guard Products
 15. Drip and Storm Guard: Pemko
 16. Card Reader: HID Global; Irvine, CA (provided by others)
- C. Obtain each type of hardware from only one manufacturer. The identification of each hardware item in the following schedules is that of the first approved manufacturers listed for the item, if not otherwise noted.
- D. Provided numbers listed in the following specifications are taken from the catalogs of manufacturers listed as follows:
 1. (V) Von Duprin, Inc.; Indianapolis, Indiana
 2. (D) Dor-O-Matic; Hardwood Heights, Illinois
 3. (R) Rockwood Manufacturing; Rockwood, Pennsylvania
 4. (NG) National Guard Products; Memphis, Tennessee
 5. (SC) Schlage; Brisbane, California
 6. (ST) Stanley Best Access System; Indianapolis, Indiana
 7. (H) Hager Companies; St. Louis, Missouri
 8. (P) Pemko; Memphis, TN
 9. (HID) HID Global (provided with access security control)
 10. (B) Stanley: Best

2.3 MATERIALS AND FABRICATION

- A. General

1. Hand of door: Drawings show direction of slide, swing or hand of each door leaf. Furnish each item of hardware for proper installation and operation of door movement as shown.
2. Manufacturer's Name Plate: Do not use manufacturer's products which have manufacturer's name or trade name displayed in a visible location (omit removable nameplates), except in conjunction with required UL labels and as otherwise acceptable to Engineer.
3. Manufacturer's identification will be permitted on rim of lock cylinders only.
4. Finish: All hardware shall receive finish as specified herein or selected by the Engineer. In general and unless otherwise shown or specified, all but hinges, locsets, exit devices, and flatware shall be stainless steel with US 32D finish. Cast item such as stops, bumpers, flush bolts, etc., shall have US 26D dull chrome finish. Those items not available in US32D or US 26D finish shall be aluminum or anodized aluminum.
5. Lockset Design: Lever handle design shall be similar to SPA as manufactured by Schlage Lock Co.
6. Fasteners: Provide hardware manufactured to conform to published templates, generally prepared for machine screw installation. Do not provide hardware which has been prepared for self tapping sheet metal screws, except as specifically indicated.
7. Furnish screws for installation, with each hardware item. Provide Phillips flat head screws except as otherwise indicated. Finish exposed (exposed under any condition) screws to match hardware finish or, if exposed in surfaces of other work, to match finish of such other work as closely as possible, including "prepared for paint" in surfaces to receive painted finish.
8. Provide concealed fasteners for hardware units which are exposed when door is closed, except to extent no standard units of type specified are available with concealed fasteners. Do not use thru bolts for installation where bolt head or nut on opposite face is exposed in other work, except where it is not feasible to adequately reinforce the Work. In such cases, provide sleeves for each thru bolt or use sex screw fasteners.
9. Tools and Maintenance Instructions for Maintenance: Furnish a complete set of specialized tools and maintenance instructions as needed for Owner's continued adjustment, maintenance, and removal and replacement of finish hardware.

2.4 HINGES, BUTTS, AND PIVOTS

- A. Templates: Except for hinges and pivots to be installed entirely (both leaves) into wood doors and frames, provide only template produced units.
- B. Screws: Furnish Phillips flat head or machine screws for installation of units, except furnish Phillips flat head or wood screws for installation of units into wood. Finish screw heads to match surface of hinges or pivots.
- C. Hinge Pins: Except as otherwise indicated, provide hinge pins as follows:
 1. Steel Hinges: Steel pins.
 2. Non-ferrous Hinges: Stainless steel pins.
 3. Out swing Corridor Doors: Non-removable pins.
 4. Interior Doors: Non-rising pins.
 5. Tips: Flat button and matching plug, finished to match leaves.
 6. Number of hinges: Provide number of hinges indicated but not less than three hinges per door leaf for doors 90-in. or less in height and one additional hinge for each 30-in. of additional height.
- D. Acceptable Manufacturers
 1. Ives

2. McKinney
 3. Hager
- E. Supplier shall be responsible for the correct hinge size to fit any existing frames or doors.
- F. Furnish hinges in sizes and types as required by architect's details to achieve maximum degree of opening.

2.5 LOCK CYLINDERS AND KEYING

- A. General: Supplier will meet with Owner to finalize keying requirements and obtain final instructions in writing.
- B. Review the keying system with the Owner and provide the type required (master, grandmaster or great grandmaster), either new or integrated with Owner's existing system
- C. Furnish Schlage Everest Restricted Patented Keyway Removable Core cylinders for all doors unless specified otherwise, keyed as directed by the Owner.
- D. Furnish temporary keyed cores for the construction period, and remove these when directed. The construction cores remain property of the supplier and shall be returned to the supplier when they are removed. Contractor shall install the permanent cores in the presence of the Owner's representative.
- E. Metals: Construct lock cylinder parts from brass/bronze, stainless steel or nickel silver.
- F. Comply with Owner's instructions for masterkeying and, except as otherwise indicated, provide individual change key for each lock which is not designated to be keyed alike with a group of related locks.
- G. Permanently inscribe each key and cylinder with Visual Key Control that identifies cylinder manufacturer key symbol, and inscribe key with the notation "DO NOT DUPLICATE".
- H. Key Material: Provide keys of nickel silver only.
- I. Key Quantity
1. Furnish three change keys for each lock.
 2. Three master keys for each master system.
 3. One grandmaster keys for each grandmaster system.
 4. One extra blank for each lock.
 5. Three Control Keys (Construction and Permanent).
 6. Four Construction master keys.
- J. Deliver keys as directed by the Owner.
- K. Key Control System: Provide a key control system including envelopes, labels tags with self-locking clips, receipt forms, three-way visible card index, and standard metal cabinet, with a capaOwner for 150 percent of the number of locks required for this Project.
1. Key cabinet and system shall be provided as a part of this contract by the hardware supplier. Cabinet shall be indexed and set up by supplier with the Owner's representative.

2.6 LOCKS, LATCHES, AND BOLTS

- A. Locks shall meet these certifications:
1. Cylindrical Locks - ANSI A156.2 Series 4000, Grade 1 Strength and Operational requirements. Meets A117.1 Accessibility Codes. Latch bolts shall be steel with minimum 1/2-in. throw, deadlocking on keyed and exterior functions; 3/4-in. throw anti-friction latchbolt on pairs of fire doors. Strikes: Provide manufacturer's standard wrought box strike for each latch or lock bolt, with curved lip extended to protect frame. Locksets to be tested to exceed 3,000,000 cycles. Lock case shall be steel. Lock shall incorporate one piece spring cage and spindle. Provide 5/8-in. minimum throw of latch and deadbolt used on pairs of doors. Provide seven-year warranty.

- a. Lock design shall be Schlage L series "L9000" design – Finish to be 626.
- B. Comply with UL requirements for throw of bolts and latch bolts on rated fire openings.
- C. Lock Manufacturers: Subject to compliance with requirements, provide lockset products of the following approved manufacturers:
 - 1. Schlage Lock Co., "L Series"
 - 2. Stanley/Best Locks, 40H, Full Mortise
- D. Flush Bolt Heads: Minimum of 1/2-in. diameter rods of brass, bronze or stainless steel, with minimum 12-in. long rod for doors up to 7-ft., 0-in. in height. Provide longer rods as necessary for doors exceeding 7-ft., 0-in. in height.
- E. Provide dust-proof strikes for foot bolts, except where special threshold construction provides non-recessed strike for bolt.

2.7 CLOSERS AND DOOR CONTROL DEVICES

- A. Where manual closers are indicated for doors required to be accessible to the physically challenged, provide adjustable units complying with ANSI A117.1 provisions for door opening force and delayed action closing.
- B. Shall conform to ANSI A156.4, Grade 1, NFPA 80, NFPA 101 and UL10C.
- C. Closers shall be aluminum construction with steel lever arms, independent adjusting valves for closing, latching and back check. Hydraulic regulation controlled by tamper-proof, non-critical screw valves. All closer adjustments shall be shielded by plastic cover plate after installation. Pressure relief valve, PRV, door closers will not be permitted.
- D. Full rack-and-pinion type closer with full complement bearings, single piece forged piston, chrome silicon steel spring, non-critical screw valves; back check, sweep and latch.
- E. Closers to be non-sized, field adjustable from size 1 to 6.
- F. Furnish all large cylinder non-sized closers with minimum 1-1/2-in. diameter piston. Furnish all medium cylinder non-sized closers with minimum 1-3/8-in. diameter piston.
- G. Install closers to allow maximum degree of opening, position back check to activate well in advance of the stop position to cushion the opening swing and prevent door and frame damage. Do not use door closer to stop door travel. Unless specified, install closers with through bolt mounting method on metal and wood doors. Do not through-bolt if there has been special blocking specified in the wood door specification. Coordinate with the wood door specification.
- H. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the Work include:

Dor-O-Matic	Sargent	Norton
SC71	351	7501

2.8 EXIT DEVICES

- A. General: All devices and mullions shall be of one manufacturer to provide for proper installation and servicing. Devices shall be furnished non handed and capable of direct field conversion for all available trim functions. All devices shall carry a three year warranty against manufacturing defects and workmanship. Exit device(s) being submitted for approval shall have been manufactured for at least 10 years. A list of 10-year-old projects using submitted exit device shall be available upon request.
 - 1. Furnish maintenance kit VonDuprin #050046 to Owner at closeout of project.
 - 2. Furnish mullion stabilizer similar to Von Duprin #154 for all mullions.
 - 3. Furnish cylinders for all locking function exit devices.
 - 4. Exit device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory. A written certification showing successful

completion of a minimum of 1,000,000 cycles for surface and concealed vertical rod devices; 5,000,000 cycles for rim devices; and 10,000,000 cycles for mortise devices.

5. Furnish Von Duprin exit devices with integrated exit monitor switch as required.

B. Surface-mounted/Concealed Vertical Rod Exit Devices:

1. Devices shall be push through type touch pad design with a straight or horizontal motion to eliminate pinch points. The angular motion type pad with end cavity exposed when depressed is unacceptable. Latch bolt shall have a self lubricating coating which reduces friction and wear. Plated latch bolts are unacceptable. Device housing shall be heavy duty extruded aluminum
2. Mechanism Case or Housing: Shall have an average minimum thickness of (.140-in.) EXTRUDED aluminum, and shall have the adaptability to convert from standard hex key dogging to a high security cylinder dog operation in the field.
3. No exposed screws shall be seen from the back side (pull side) of the device through a glass lite.
 - a. The use of plastic parts to retract the latchbolt is unacceptable.
4. Springs: Only minimum (1/16-in.) diameter compression springs are acceptable. All internal parts shall be zinc dichromate coated to prevent rusting.
5. Quiet Feature: All devices shall incorporate a hydraulic sound damper to which decelerates the touchpad on its return stroke and eliminates noise associated with exit device operation.
6. Touch Pad: Shall be architectural metal with a minimum height of 2-3/16-in. Plastic is not acceptable.
7. Outside Trim: Shall be heavy duty type and fastened by means of concealed welded lugs and thru bolts from the inside. Lever trim shall be forged brass with a minimum average thickness on the escutcheon of (.130-in.). Plate with pull shall be minimum average thickness of (.090-in.) and have forged pulls. Lever trim shall be furnished with "Break-Away Levers" (994L Trim).
8. End caps shall be sloped and of heavy-duty metal alloy construction and provide horizontal adjustment to provide flush alignment with device cover plate. When device end cap is installed, no raised edges will protrude. End cap shall be cast metal or forged aluminum and have a minimum thickness of (.250-in.). Plastic or metal stamping will not be acceptable.
9. All devices with US28 finish to have stainless steel touch bars with US26D trim.
10. All floor strikes on interior vertical rod panic devices to be similar to Von Duprin 385A.
11. Provide all shim kits and filler plates to allow flush mounting of exit devices on all types of doors used in this Project.
12. Furnish all exit devices with deadlocking latchbolts.
13. Surface Vertical Rod Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 5,000,000 cycles must be provided by the independent laboratory. Rim Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 5,000,000 cycles must be provided by the independent laboratory. Mortise Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 10,000,000 cycles must be provided by the independent laboratory. Concealed Vertical Rod Series Exit Device shall be tested to ANSI/BHMA A156.3 test requirements by a BHMA certified independent testing laboratory; a written certification showing successful completion of a minimum of 1,000,000 cycles must be provided by the independent laboratory.

C. Acceptable Manufacturers: Subject to compliance with requirements, provide exit device products of the following manufacturers:

1. Von Duprin - No substitution.
2. Von Duprin – Coordinated with exit devices with integrated exit monitor switches.

2.9 DOOR TRIM UNITS

- A. Fasteners: Provide manufacturer's standard exposed fasteners for door trim units (kick plates, edge trim, viewers, knockers, mail drops and similar units); either machine screws or self-tapping screws.
- B. Fabricate protection plates (armor, kick or mop) not more than 1-1/2-in. less than door width on stop side and not more than 1/2-in. less than door width on pull side, x the height indicated. All protection plates shall have all edges beveled (B4E).
- C. Metal Plates: Stainless steel, .050-in. (U.S. 18 ga.).
- D. All pull plates and handles to be thru-bolted. Install pull plate prior to push plate to conceal thru-bolts. Provide concealed fasteners for all push/pull applications.
- E. Acceptable Manufacturers
 1. Ives.
 2. Rockwood.
 3. Quality.
 4. Securitech as required at access control doors.

2.10 WEATHERSTRIP AND GASKETING

- A. General: Except as otherwise indicated, provide continuous weather stripping at each leaf of every exterior door. Provide type, sizes and profiles shown or scheduled. Provide non-corrosive fasteners as recommended by manufacturer for application indicated.
- B. Replaceable Seal Strips: Provide only those units where resilient or flexible seal strips is easily replaceable and readily available from stocks maintained by the manufacturer.
- C. Acceptable Manufacturers
 1. Pemko Mfg. Co.
 2. Reese
 3. National Guard Products

2.11 THRESHOLDS

- A. General: Except as otherwise indicated provide standard aluminum threshold unit of type, size, and profile as shown or detailed.
- B. Provide welded custom thresholds where scheduled and noted in the hardware sets. Provide cover plates where scheduled.
- C. Provide thresholds that are 1-in. wider than depth of frame unless specified or detailed otherwise.
- D. Acceptable Manufacturers
 1. Pemko Mfg. Co.
 2. Reese
 3. National Guard Products

2.12 DOOR SILENCERS

- A. All hollow metal frames shall have grey resilient type silencers. Quantity three on single doors, and quantity two on pairs of doors.

3 EXECUTION

3.1 INSTALLATION

- A. Mount hardware units at heights indicated in "Recommended Locations for Builders Hardware for Standard Steel Doors and Frames" by the Door and Hardware Institute, except as specifically indicated or required to comply with governing regulations, and except as may be otherwise directed by Architect.
- B. Install each hardware item in compliance with the manufacturer's instructions and recommendations. Wherever cutting and fitting is required to install hardware onto or into surfaces which are later to be painted or finished in another way, coordinate removal, storage and reinstallation or application of surface protections with finishing work specified in the Division 9 Sections. Do not install surface-mounted items until finishes have been completed on the substrate.
- C. Set units level, plumb and true to line and location. Adjust and reinforce the attachment substrate as necessary for proper installation and operation.
- D. Drill and countersink units which are not factory prepared for anchorage fasteners. Space fasteners and anchors in accordance with industry standards.
- E. Set thresholds for exterior doors in full bed of butyl rubber or polyisobutylene mastic sealant.

3.2 ADJUST AND CLEAN

- A. Adjust and check each operating item of hardware and each door, to ensure proper operation or function of every unit. Replace units which cannot be adjusted to operate freely and smoothly as intended for the application made.
- B. Clean adjacent surfaces soiled by hardware installation.
- C. Final Adjustment: Wherever hardware installation is made more than one (1) month prior to acceptance or occupancy of a space or area, return to the work during the week prior to acceptance or occupancy, and make final check and adjustment of all hardware items in such space or area. Clean operating items as necessary to restore proper function and finish of hardware and doors. Adjust door control devices to compensate for final operation of heating and ventilating equipment.
- D. Instruct Owner's Personnel in proper adjustment and maintenance of hardware and hardware finishes, during the final adjustment of hardware.
- E. Continued Maintenance Service: Approximately six months after the acceptance of hardware in each area, the Installer, accompanied by the representative of the latch and lock manufacturer, shall return to the Project and re adjust every item of hardware to restore proper function of doors and hardware. Consult with and instruct Owner's personnel in recommended additions to the maintenance procedures. Replace hardware items which have deteriorated or failed due to faulty design, materials or installation of hardware units. Prepare a written report of current and predictable problems (of substantial nature) in the performance of the hardware.

3.3 HARDWARE SETS

- A. The following is a general listing of the minimum hardware requirements. Any item of hardware normally required by good practice, or as to meet state or local codes, shall be furnished even though it may not be specifically mentioned.

HW-1

Each to have:

(H)3	EA	HINGES	BB1191 4 ½ X 4 ½
(V)1	EA	EXIT DEVICE	99L X 996L R&V
(SC)1	EA	LOCKSET	
(SC)1	EA	CYLINDER PRIVACY	ND405 SPAR
(D)1	EA	CLOSER	SC81-STD
(H)1	EA	STOP	242F

(R)1	EA	KICK PLATE	1905 10X34.5
3	EA	SILENCERS (INSTALLED ON FRAME)	
1	EA	WALL BUMPER OR FLOOR STOP AS REQUIRED	
1	EA	PANIC THRESHOLD	

HW-2

Each to have:

(H)6	EA	HINGES	BB1191 4 ½ X 4 ½
(V)2	EA	EXIT DEVICE	99L X 996L R&V
(SC)1	EA	LOCKSET	
(SC)1	EA	CYLINDER	
(R)2	EA	FLUSH BOLT	555-12"
(D)1	EA	CLOSER	SC81-STD-FULL-H/PA
(R)1	EA	KICK PLATE	1905 10X34.5
(R)2	EA	STOPS	471
1	EA	PANIC THRESHOLD	
(NG)1	EA	WEATHERSTRIP	160V
(NG)2	EA	SWEEPS	200NA
(P)2	EA	RAIN DRIP/STORM GUARD	

HW-3

Each to have:

(H)3	EA	HINGES	BB1191 4 ½ X 4 ½
(SC)1	EA	LOCKSET	
(SC)1	EA	CYLINDER	
(D)1	EA	CLOSER	SC81-STD-FULL-H/PA
(R)1	EA	STOP	471
3	EA	SILENCERS (INSTALLED ON FRAME)	

HW-4

Each to have:

(H)3	EA	HINGES	BB1191 4 ½ X 4 ½
(SC)1	EA	LOCKSET	(Mortise Lockset and Strike)
(SC)1	EA	CYLINDER	
(D)1	EA	CLOSER	SC81-STD-FULL-H/PA
(R)1	EA	KICK PLATE	1905 10X34.5
(H)1	EA	STOP	242F
1	EA	FLUSH LATCHBOLT	
3	EA	SILENCERS (INSTALLED ON FRAME)	

HW-5

Each to have:

1	EA	OVERHEAD COILING DOOR HARDWARE FURNISHED BY DOOR MANUFACTURER.	
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HW-6

Each to have:

(H)3	EA	HINGES	BB1191 4 ½ X 4 ½
(D)1	EA	CLOSER	SC81-STD-FULL-H/PA
(R)1	EA	STOP	471
(R)1	EA	KICK PLATE	1905 10X34.5
3	EA	SILENCERS (INSTALLED ON FRAME)	

1	EA	WALL BUMPER OR FLOOR STOP AS REQUIRED
1	EA	PULLPLATE
1	EA	PUSHPLATE

** END OF SECTION **

SECTION 08800
GLAZING

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 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.3 SUMMARY

- A. This Section includes glazing for the following products and applications, including those specified in other Sections where glazing requirements are specified by reference to this Section:
 - 1. Doors.
 - 2. Windows.

1.4 DEFINITIONS

- A. Manufacturers of Glass Products: Firms that produce primary glass, fabricated glass, or both, as defined in referenced glazing publications.
- B. Glass Thicknesses: Indicated by thickness designations in millimeters according to ASTM C 1036.
- C. Interspace: Space between lites of an insulating glass unit that contains dehydrated air or a specified gas.
- D. Deterioration of Coated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage, and practices for maintaining and cleaning coated glass contrary to manufacturer's written instructions. Defects include peeling, cracking, and other indications of deterioration in metallic coating.
- E. Deterioration of Insulating Glass: Failure of hermetic seal under normal use that is attributed to the manufacturing process and not to causes other than glass breakage, and practices for maintaining and cleaning insulating glass contrary to manufacturer's written instructions. Evidence of failure is the obstruction of vision by dust, moisture, or film on interior surfaces of glass.
- F. Deterioration of Laminated Glass: Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage, and practices for maintaining and cleaning laminated glass contrary to manufacturer's written instructions. Defects include edge separation, delamination materially obstructing vision through glass, and blemishes exceeding those allowed by referenced laminated-glass standard.

1.5 PERFORMANCE REQUIREMENTS

- A. General: Provide glazing systems capable of withstanding normal thermal movement and wind and impact loads (where applicable) without failure, including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; or other defects in construction.
- B. Glass Design: Glass thickness designations indicated are minimums and are for detailing only. Confirm glass thicknesses by analyzing Project loads and in-service conditions. Provide glass lites in the thickness designations indicated for various size openings, but not less than thicknesses and in strengths (annealed or heat treated) required to meet or exceed the following criteria:

1. Glass Thicknesses: Select minimum glass thicknesses to comply with ASTM E 1300, according to the following requirements:
 - a. Specified Design Wind Loads: As shown on Drawings.
 - b. Design Wind Loads: Determine design wind loads applicable to Project from basic wind speed indicated in miles per hour (meters per second) at 33 feet (10 m) above grade, according to ASCE 7, "Minimum Design Loads for Buildings and Other Structures": Section 6.5, "Method 2-Analytical Procedure," based on mean roof heights above grade indicated on Drawings.
 - c. Maximum Lateral Deflection: For the following types of glass supported on all 4 edges, provide thickness required that limits center deflection at design wind pressure to 1/50 times the short side length or 1 inch (25 mm), whichever is less, without damage.
 - 1) For monolithic-glass lites heat treated to resist wind loads.
 - 2) For insulating glass.
 - 3) For laminated-glass lites.
 - d. Minimum Glass Thickness for Exterior Lites: Not less than 9/16 inch.
 - e. Thickness of Tinted and Heat-Absorbing Glass: Provide the same thickness for each tint color indicated throughout Project.
- C. Thermal Movements: Provide glazing that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures acting on glass framing members and glazing components. Base engineering calculation on surface temperatures of materials due to both solar heat gain and nighttime-sky heat loss.
 1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.
- D. Thermal and Optical Performance Properties: Provide glass with performance properties specified based on manufacturer's published test data, as determined according to procedures indicated below:
 1. For monolithic-glass lites, properties are based on units with lites 6.0 mm thick of thickness indicated.
 2. For laminated-glass lites, properties are based on products of construction indicated.
 3. For insulating-glass units, properties are based on units of thickness indicated for overall unit and for each lite.
 4. Center-of-Glass Values: Based on using LBL-44789 WINDOW 5.0 computer program for the following methodologies:
 - a. U-Factors: NFRC 100 expressed as Btu/ft² x h x deg F (W/m² x K)
 - b. Solar Heat Gain Coefficient: NFRC 200
 - c. Solar Optical Properties: NFRC 300

1.6 SUBMITTALS

- A. Product Data: For each glass product and glazing material indicated.
- B. Samples: For the following products, in the form of 12-inch- (300-mm-) square Samples for glass.
 1. Each color of tinted float glass.
 2. Each type of laminated glass with colored interlayer.
 3. Insulating glass for each designation indicated.
 4. For each color (except black) of exposed glazing sealant indicated.
- C. Product Certificates: Signed by manufacturers of glass and glazing products certifying that products furnished comply with requirements.

1. For solar-control low-e-coated glass, provide documentation demonstrating that manufacturer of coated glass is certified by coating manufacturer.

D. Qualification Data: For installers.

E. Product Test Reports: For each of the following types of glazing products:

1. Glazing sealants.

F. Warranties: Special warranties specified in this Section.

1.7 QUALITY ASSURANCE

A. Installer Qualifications: An experienced installer who has completed glazing similar in material, design, and extent to that indicated for this Project; whose work has resulted in glass installations with a record of successful in-service performance; and who employs glass installers for this Project who are certified under the National Glass Association's Certified Glass Installer Program.

B. Source Limitations for Glass: Obtain the following through one source from a single manufacturer for each glass type: clear float glass, coated float glass, laminated glass, glass-clad polycarbonate, and insulating glass.

C. Source Limitations for Glazing Accessories: Obtain glazing accessories through one source from a single manufacturer for each product and installation method indicated.

D. Glazing for Fire-Rated Door Assemblies: Glazing for assemblies that comply with NFPA 80 and that are listed and labeled by a testing and inspecting agency acceptable to authorities having jurisdiction, for fire-protection ratings indicated, based on testing according to NFPA 252.

E. Safety Glazing Products: Comply with testing requirements in 16 CFR 1201 and, for wired glass, ANSI Z97.1.

1. Subject to compliance with requirements, obtain safety glazing products permanently marked with certification label of the Safety Glazing Certification Council or another certification agency or manufacturer acceptable to authorities having jurisdiction.

2. Where glazing units, including Kind FT glass and laminated glass, are specified in Part 2 articles for glazing lites more than 9 ft² (0.84 m²) in exposed surface area of one side, provide glazing products that comply with Category II materials, for lites 9 ft² (0.84 m²) or less in exposed surface area of one side, provide glazing products that comply with Category I or II materials, except for hazardous locations where Category II materials are required by 16 CFR 1201 and regulations of authorities having jurisdiction.

F. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, unless more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards.

1. GANA Publications: GANA Laminated Division's "Laminated Glass Design Guide" and GANA's "Glazing Manual".

2. IGMA Publication for Insulating Glass: SIGMA TM-3000, "Glazing Guidelines for Sealed Insulating Glass Units".

1.8 DELIVERY, STORAGE, AND HANDLING

A. Protect glazing materials according to manufacturer's written instructions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.9 PROJECT CONDITIONS

A. Environmental Limitations: Do not proceed with glazing when ambient and substrate temperature conditions are outside limits permitted by glazing material manufacturers and when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Do not install liquid glazing sealants when ambient and substrate temperature conditions are outside limits permitted by glazing sealant manufacturer or below 40 deg F (4.4 deg C).

1.10 WARRANTY

- A. Manufacturer's Special Warranty for Coated-Glass Products: Manufacturer's standard form, made out to Owner and signed by coated-glass manufacturer agreeing to replace coated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: 10 years from date of Substantial Completion.
- B. Manufacturer's Special Warranty on Laminated Glass: Manufacturer's standard form, made out to Owner and signed by laminated-glass manufacturer agreeing to replace laminated-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: Five years from date of Substantial Completion.
- C. Manufacturer's Special Warranty on Insulating Glass: Manufacturer's standard form, made out to Owner and signed by insulating-glass manufacturer agreeing to replace insulating-glass units that deteriorate as defined in "Definitions" Article, f.o.b. the nearest shipping point to Project site, within specified warranty period indicated below.
 1. Warranty Period: 10 years from date of Substantial Completion.

2 PRODUCTS

2.1 MANUFACTURERS

- A. AFG Industries, INC.
- B. Guardian Industries Corp.
- C. PPG Industries, INC.
- D. Or equal.
- E. In other Part 2 articles where titles below introduce lists, the following requirements apply to product selection:
 1. Basis-of-Design Product: The design for each glazing product is based on the product named. Subject to compliance with requirements, provide either the named product or a comparable product by one of the other manufacturers specified.

2.2 GLASS PRODUCTS

- A. Heat-Treated Float Glass: ASTM C 1048; Type I (transparent flat glass); Quality-Q3; of class, kind, and condition indicated.
 1. Fabrication Process: By horizontal (roller-hearth) process with roll-wave distortion parallel to bottom edge of glass as installed, unless otherwise indicated.
 2. Provide Kind HS (heat-strengthened) float glass in place of annealed float glass where needed to resist thermal stresses induced by differential shading of individual glass lites and to comply with glass design requirements specified in Part 1 "Performance Requirements" Article.
 3. For uncoated glass, comply with requirements for Condition A.
 4. For coated vision glass, comply with requirements for Condition C (other uncoated glass).
 5. Provide Kind FT (fully tempered) float glass in place of annealed or Kind HS (heat-strengthened) float glass where safety glass is indicated.

2.3 GLAZING SEALANTS

- A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants that are compatible with one another and with other materials they will contact, including glass products, seals of insulating-glass units, and glazing channel substrates, under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.
 2. Suitability: Comply with sealant and glass manufacturers' written instructions for selecting glazing sealants suitable for applications indicated and for conditions existing at time of installation.
 3. Colors of Exposed Glazing Sealants: As selected by Architect from manufacturer's full range.
- B. Elastomeric Glazing Sealants: Comply with ASTM C 920 and other requirements indicated for each liquid-applied chemically curing sealant specified, including those referencing ASTM C 920 classifications for type, grade, class, and uses related to exposure and joint substrates.
1. Single-Component Neutral- and Basic-Curing or Neutral-Curing Silicone Glazing Sealants:
 - a. Available Products:
 - 1) Dow Corning Corporation; 993
 - 2) GE Silicones; SilPruf SCS2000
 - 3) Tremco; Spectrem 3
 - b. Type and Grade: S (single component) and NS (non-sag).
 - c. Class: 50.
 - d. Use Related to Exposure: NT (non-traffic).
 - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - 1) Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.
 2. Class 25 Neutral-Curing Silicone Glazing Sealant:
 - a. Available Products:
 - 1) Dow Corning Corporation; 797
 - 2) GE Silicones; UltraGlaze SSG4000
 - 3) GE Silicones; UltraGlaze SSG4000AC
 - 4) Polymeric Systems Inc.; PSI-631
 - 5) Schnee-Morehead, Inc.; SM5731 Poly-Glaze Plus
 - 6) Tremco; Proglaze SG
 - 7) Tremco; Spectrem 2
 - 8) Tremco; Tremsil 600
 - b. Type and Grade: S (single component) and NS (nonsag).
 - c. Class: 25.
 - d. Use Related to Exposure: NT (non-traffic).
 - e. Uses Related to Glazing Substrates: M, G, A, and, as applicable to glazing substrates indicated, O.
 - 1) Use O Glazing Substrates: Coated glass, color anodic aluminum, aluminum coated with a high-performance coating, galvanized steel, and wood.
- C. Glazing Sealants for Fire-Resistive Glazing Products: Identical to products used in test assemblies to obtain fire-protection rating.

2.4 MISCELLANEOUS GLAZING MATERIALS

- A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials for application indicated, and with a proven record of compatibility with surfaces contacted in installation.
- B. Cleaners, Primers, and Sealers: Types recommended by sealant or gasket manufacturer.
- C. Setting Blocks: Elastomeric material with a Shore, Type A durometer hardness of 85, plus or minus 5.
- D. Spacers: Elastomeric blocks or continuous extrusions with a Shore, Type A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.
- E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side walking).
- F. Cylindrical Glazing Sealant Backing: ASTM C 1330, Type O (open-cell material), of size and density to control glazing sealant depth and otherwise produce optimum glazing sealant performance.
- G. Perimeter Insulation for Fire-Resistive Glazing: Identical to product used in test assembly to obtain fire-resistance rating.

2.5 FABRICATION OF GLAZING UNITS

- A. Fabricate glazing units in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with written instructions of product manufacturer and referenced glazing publications, to comply with system performance requirements.
- B. Clean-cut or flat-grind vertical edges of butt-glazed monolithic lites in a manner that produces square edges with slight kerfs at junctions with outdoor and indoor faces.
- C. Grind smooth and polish exposed glass edges and corners.

2.6 LAMINATED-GLASS UNITS

- A. Heat-Treated Laminated-Glass Units LG: 1 (For Interior and Exterior Doors)
 - 1. Kind LT, consisting of two lites of fully tempered float glass.
 - 2. Lite: 2 (tinted) float glass.
 - a. Tint Color: "Azurlite" by PPG Industries, Inc., Blue-green.
 - b. Kind FT (fully tempered).
 - c. Thickness: 6.0 mm minimum.
 - 3. Inner Lite: Class 1 (clear) float glass.
 - a. Kind FT (fully tempered).
 - b. Thickness: 6.0 mm.
 - 4. Plastic Interlayer:
 - a. Thickness: 0.060 inch (1.52 mm), but not less than that required to comply as a Type II safety glass material.
 - b. Interlayer Color: Clear
 - 5. Overall Thickness: 9/16 inch

3 EXECUTION

3.1 EXAMINATION

- A. Examine framing glazing, with Installer present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, and offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

A. Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings not firmly bonded to substrates.

3.3 GLAZING, GENERAL

- A. Comply with combined written instructions of manufacturers of glass, sealants, gaskets, and other glazing materials, unless more stringent requirements are indicated, including those in referenced glazing publications.
- B. Glazing channel dimensions, as indicated on Drawings, provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.
- C. Protect glass edges from damage during handling and installation. Remove damaged glass from Project site and legally dispose of off Project site. Damaged glass is glass with edge damage or other imperfections that, when installed, could weaken glass and impair performance and appearance.
- D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing.
- E. Install setting blocks in sill rabbets, sized and located to comply with referenced glazing publications, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead.
- F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.
- G. Provide spacers for glass lites where length plus width is larger than 50 inches (1270 mm) as follows:
 1. Locate spacers directly opposite each other on both inside and outside faces of glass. Install correct size and spacing to preserve required face clearances, unless gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and to comply with system performance requirements.
 2. Provide 1/8-inch (3-mm) minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.
- H. Provide edge blocking where indicated or needed to prevent glass lites from moving sideways in glazing channel, as recommended in writing by glass manufacturer and according to requirements in referenced glazing publications.
- I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.
- J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.
- K. Square cut wedge-shaped gaskets at corners and install gaskets in a manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.4 SEALANT GLAZING (WET)

A. Install continuous spacers, or spacers combined with cylindrical sealant backing, between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from

extruding into glass channel and blocking weep systems until sealants cure. Secure spacers or spacers and backings in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

- B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.
- C. Tool exposed surfaces of sealants to provide a substantial wash away from glass.

3.5 CLEANING AND PROTECTION

- A. Protect exterior glass from damage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove non-permanent labels, and clean surfaces.
- B. Protect glass from contact with contaminating substances resulting from construction operations, including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove substances immediately as recommended by glass manufacturer.
- C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for buildup of dirt, scum, alkaline deposits, or stains; remove as recommended in writing by glass manufacturer.
- D. Remove and replace glass that is broken, chipped, cracked, or abraded or that is damaged from natural causes, accidents, and vandalism, during construction period.
- E. Wash glass on both exposed surfaces in each area of Project not more than four days before date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended in writing by glass manufacturer.

** END OF SECTION **

SECTION 09260
GYPSUM BOARD ASSEMBLIES

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 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.3 SUMMARY

- A. This Section includes the following:
 - 1. Interior gypsum wallboard.
- B. Related Sections include the following:
 - 1. Division 7 Section "Building Insulation" for insulation and vapor retarders installed in gypsum board assemblies.
 - 2. Division 9 Section "Interior Painting" for primers and paint applied to gypsum board surfaces.

1.4 DEFINITIONS

- A. Gypsum Board Terminology: Refer to ASTM C 11 for definitions of terms for gypsum board assemblies not defined in this Section or in other referenced standards.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Shop Drawings: Show locations, fabrication, and installation of control and expansion joints including plans, elevations, sections, details of components, and attachments to other units of Work.
- C. Samples: For the following products:
 - 1. Trim Accessories: Full-size sample in 12-inch- (300-mm-) long length for each trim accessory indicated.
 - 2. Textured Finishes: Manufacturer's standard size for each textured finish indicated and on same backing indicated for Work.

1.6 DELIVERY, STORAGE, AND HANDLING

- A. Deliver materials in original packages, containers, or bundles bearing brand name and identification of manufacturer or supplier.
- B. Store materials inside under cover and keep them dry and protected against damage from weather, direct sunlight, surface contamination, corrosion, construction traffic, and other causes. Stack gypsum panels flat to prevent sagging.

1.7 PROJECT CONDITIONS

- A. Environmental Limitations: Comply with ASTM C 840 requirements or gypsum board manufacturer's written recommendations, whichever are more stringent.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Gypsum Board and Related Products:

- a. American Gypsum Co.
- b. G-P Gypsum Corp.
- c. National Gypsum Company.
- d. United States Gypsum Co.

2.2 INTERIOR GYPSUM WALLBOARD

- A. Panel Size: Provide in maximum lengths and widths available that will minimize joints in each area and correspond with support system indicated.
- B. Moisture- and Mold-Resistant Gypsum Board: ASTM C 1396/C 1396M. With moisture- and mold-resistant core and paper surfaces.
 1. Core: 5/8 inch, Type X
 2. Long Edges: Tapered
 3. Mold Resistance: ASTM D 3273, score of 10 as rated according to ASTM D 3274

2.3 TRIM ACCESSORIES

- A. Interior Trim: ASTM C 1047.
 1. Material: Galvanized or aluminum-coated steel sheet or rolled zinc.
 2. Shapes:
 - a. Corner Bead: Use at outside corners, unless otherwise indicated.
 - b. LC-Bead: J-shaped; exposed long flange receives joint compound; use at exposed panel edges.
 - c. L-Bead: L-shaped; exposed long leg receives joint compound; use where indicated.
 - d. U-Bead: J-shaped; exposed short flange does not receive joint compound; use at exposed panel edges where indicated.
 - e. Expansion (Control) Joint: Use where indicated.
 - f. Curved-Edge Corner Bead: With notched or flexible flanges; use at curved openings.
- B. Aluminum Trim: Extruded accessories of profiles and dimensions indicated.
 1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - a. Fry Reglet Corp.
 - b. Gordon, Inc.
 - c. MM Systems Corporation.
 - d. Pittcon Industries.
 2. Aluminum: Alloy and temper with not less than the strength and durability properties of ASTM B 221 (ASTM B 221M), alloy 6063-T5.
 3. Finish: Corrosion-resistant primer compatible with joint compound and finish materials specified.

2.4 JOINT TREATMENT MATERIALS

- A. General: Comply with ASTM C 475.
- B. Joint Tape:
 1. Interior Gypsum Wallboard: Paper
- C. Joint Compound for Interior Gypsum Wallboard: For each coat use formulation that is compatible with other compounds applied on previous or for successive coats.

1. Pre-filling: 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 sandable drying-type, all-purpose compound.
4. Finish Coat: For third coat, use drying-type, all-purpose compound.
5. Skim Coat: For final coat of Level 5 finish, use sandable drying-type, all-purpose compound.

2.5 AUXILIARY MATERIALS

- A. General: Provide auxiliary materials that comply with referenced installation standards and manufacturer's written recommendations.

3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and substrates, with Installer present, and including cast-in anchors and structural framing, for compliance with requirements and other conditions affecting performance. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Suspended Ceilings: Coordinate installation of ceiling suspension systems with installation of overhead structure to ensure that inserts and other provisions for anchorages to building structure have been installed to receive ceiling hangers at spacing required to support ceilings and that hangers will develop their full strength.
 1. Furnish concrete inserts and other devices indicated to other trades for installation in advance of time needed for coordination and construction.

3.3 APPLYING AND FINISHING PANELS, GENERAL

- A. Gypsum Board Application and Finishing Standards: ASTM C 840 and GA-216.
- B. Install ceiling board panels across framing to minimize the number of abutting end joints and to avoid abutting end joints in the central area of each ceiling. Stagger abutting end joints of adjacent panels not less than one framing member.
- C. Install gypsum panels with face side out. Butt panels together for a light contact at edges and ends with not more than 1/16 inch (1.5 mm) of open space between panels. Do not force into place.
- D. Locate edge and end joints over supports, except in ceiling applications where intermediate supports or gypsum board back-blocking is provided behind end joints. Do not place tapered edges against cut edges or ends. Stagger vertical joints on opposite sides of partitions. Do not make joints other than control joints at corners of framed openings.
- E. Attach gypsum panels to steel studs so leading edge or end of each panel is attached to open (unsupported) edges of stud flanges first.
- F. Attach gypsum panels to framing provided at openings and cutouts.
- G. Do not attach gypsum panels across the flat grain of wide-dimension lumber, including floor joists and headers. Float gypsum panels over these members using resilient channels, or provide control joints to counteract wood shrinkage.
- H. Form control and expansion joints with space between edges of adjoining gypsum panels.
- I. Cover both faces of steel stud partition framing with gypsum panels in concealed spaces (above ceilings, etc.), except in chases braced internally.

1. Unless concealed application is indicated or required for sound, fire, air, or smoke ratings, coverage may be accomplished with scraps of not less than 8 ft² (0.7 m²) in area.
 2. Fit gypsum panels around ducts, pipes, and conduits.
 3. Where partitions intersect open concrete coffers, concrete joists, and other structural members projecting below underside of floor/roof slabs and decks, cut gypsum panels to fit profile formed by coffers, joists, and other structural members; allow 1/4- to 3/8-inch- (6.4- to 9.5-mm-) wide joints to install sealant.
- J. Isolate perimeter of non-load-bearing gypsum board partitions at structural abutments, except floors. Provide 1/4- to 1/2-inch- (6.4- to 12.7-mm-) wide spaces at these locations, and trim edges with U-bead edge trim where edges of gypsum panels are exposed. Seal joints between edges and abutting structural surfaces with acoustical sealant.
- K. Space fasteners in gypsum panels according to referenced gypsum board application and finishing standard and manufacturer's written recommendations.
1. Space screws a maximum of 12 inches (304.8 mm) O.C. for vertical applications.
- L. Space fasteners in panels that are tile substrates a maximum of 8 inches (203.2 mm) O.C.
- 3.4 PANEL APPLICATION METHODS
- A. Single-Layer Application:
1. On ceilings, apply gypsum panels before wall/partition board application to the greatest extent possible and at right angles to framing, unless otherwise indicated.
- B. Single-Layer Fastening Methods: Apply gypsum panels to supports with steel drill screws.
- 3.5 INSTALLING TRIM ACCESSORIES
- A. General: 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.
- B. Control Joints: Install control joints at locations indicated on Drawings and according to ASTM C 840 and in specific locations approved by Engineer for visual effect.
- 3.6 FINISHING GYPSUM BOARD ASSEMBLIES
- A. General: Treat gypsum board joints, interior angles, edge trim, control joints, penetrations, fastener heads, surface defects, and elsewhere as required to prepare gypsum board surfaces for decoration. Promptly remove residual joint compound from adjacent surfaces.
- B. Pre-fill open joints, rounded edges, and damaged surface areas.
- C. Apply joint tape over gypsum board joints, except those with trim having flanges not intended for tape.
- D. Gypsum Board Finish Levels: Finish panels to levels indicated below, according to ASTM C 840, for locations indicated:
1. Level 1: Embed tape at joints in ceiling plenum areas, concealed areas, and where indicated, unless a higher level of finish is required for fire-resistance-rated assemblies and sound-rated assemblies.
 2. Level 2: Embed tape and apply separate first coat of joint compound to tape, fasteners, and trim flanges where panels are substrate for tile and where indicated.
 3. Level 4: Embed tape and apply separate first, fill, and finish coats of joint compound to tape, fasteners, and trim flanges at panel surfaces that will be exposed to view at typical area, unless otherwise indicated.
- E. Cementitious Backer Units: Finish according to manufacturer's written instructions.
- 3.7 FIELD QUALITY CONTROL
- A. Above-Ceiling Observation: Before Contractor installs gypsum board ceilings, Engineer will conduct an above-ceiling observation and report deficiencies in the Work observed. Do not

proceed with installation of gypsum board to ceiling support framing until deficiencies have been corrected.

1. Notify Engineer seven days in advance of date and time when Project, or part of Project, will be ready for above-ceiling observation.
2. Before notifying Engineer, complete the following in areas to receive gypsum board ceilings:
 - a. Installation of 80 percent of lighting fixtures, powered for operation.
 - b. Installation, insulation, and leak and pressure testing of water piping systems.
 - c. Installation of air-duct systems.
 - d. Installation of air devices.
 - e. Installation of mechanical system control-air tubing.
 - f. Installation of ceiling support framing.

** END OF SECTION **



SECTION 09310
TILE AND MARBLE WORK

1 GENERAL

1.1 WORK INCLUDED

- A. Description: This Section specifies the furnishing and installation of ceramic tile, associated thresholds, marble window sills, and setting and grouting materials.

1.2 QUALITY ASSURANCE

- A. Source Quality Control: Tile shall be quality tested, certified and bear the Certification Mark of the Tile Council of America, Incorporated hereinafter known as TCA.
- B. Reference Standards: The Contractor shall comply with the applicable requirements on the following standards as published by TCA.
1. Recommended Standard Specifications for Ceramic Tile, ANSI 137.1
 2. American National Standard Specifications for the Installation of Ceramic Tile, ANSI A108.5 and ANSI A118.4

1.3 SUBMITTALS

- A. Manufacturer's data sheets for all materials shall be submitted to establish conformance to all Specification items. Shop drawings shall be submitted in accordance with Section 01300, Submittals.
- B. Samples
1. Submit color chips for not less than 6 colorations for selection by the Owner.
 2. After color schemes are selected, individual samples from three (3) color selections shall be submitted. Samples shall include the following:
 - a. Sample Panel: Sample panels using the materials and setting methods specified for the finished work. Panels shall be approximately 12-inches square and shall indicate the color, texture and workmanship to be expected in the finished work.
 - b. Trim Tile Units: Each type of trim tile unit, showing size, shape, color and texture.
 - c. Thresholds: Six-inch-long samples of marble threshold, showing shape, coloration and texture.
- C. Certificates: Six (6) copies shall be submitted of the Master Grade Certificate for tile, signed by the tile and manufacturer and the installer.
- D. Maintenance Materials: Maintenance materials shall be provided equal to five (5) percent of the installed quantity. Maintenance materials shall be provided in original, unopened containers with each container identified as to location in the project.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Materials shall be delivered in manufacturer's original, unopened containers, clearly labeled with the manufacturer's name and address, type, color, grade conformance seal and statement of compliance with TCA 137.1
- B. Materials shall be stored in original, unopened containers, protected from direct contact with the ground and under protection from the elements.
- C. Materials shall be handled in a manner to prevent breakage and damage to the surfaces of the tiles.

2 PRODUCTS

2.1 MATERIALS

- A. Ceramic Tile Units: Ceramic tile shall comply with ANSI 137.1, Ceramic Tile, Standard Grade. Colors and patterns shall be selected by the Engineer.
1. Flat tile units for walls shall be 6"x6" glazed and floors shall be 12"x12" unglazed ceramic mosaic tile units, by ¼-inch thickness, plain-backed, cushioned-edge uniformly mounted and of the color to be selected from standard colors.
 2. Trim tile units shall be unglazed ceramic mosaic tile units of the same thickness and color as flat tile units. Internal corners to be coved, external corners and edges to be bullnosed.
- B. Thresholds: Thresholds shall be sound Group A white marble with a fine sand textured finish and a hardness of not less than 10.0 when tested in accordance with ASTM C 241. Marble thresholds shall be equal to the Georgia Marble Company's, White Cherokee, size and shapes as shown on the Drawings.
- C. Mortar:
1. Dry-set Portland cement mortar for ceramic mosaic floor tile where concrete floor slab is not recessed shall conform to ANSI A 118.1 and shall be Formula 759 manufactured under license by the Tile Council of America. Containers shall bear T.C.A.- trademark and each container shall be properly identified as "Floor Mix."
 2. Thin-set materials shall be in accordance with ANSI A118.4 and as manufactured by L & M - Surco Company; the Upco Company; Jamo, Inc.; or approved equal, modified with latex additive. Latex liquid additive shall be Laticrete 4237 or equal.
- D. Grout: Grout shall be prepackaged, precolored, commercial waterproof Portland cement grout; Acid-R Grout by L & M - Surco Company; Hydroment Ceramic Tile Grout by the Ipco Company; Star Brand Acid Resistant Grout by Jamo, Incorporated; or approved equal modified by a latex additive.
1. Latex liquid additive shall be Laticrete 3701 as manufactured by Uniroyal Incorporated for Laticrete International Incorporated, or approved equal.
 2. Grout mix shall be a brand of mix as approved by the manufacturer of the latex additive.
- E. Sealant:
1. Sealant for expansion joints in tile field shall be a single-component, synthetic-rubber-base type or a two-component, rubber-base type at the option of the Contractor. Color of sealant shall be as approved to match or blend with adjacent materials. It shall have a Shore A hardness of 25 for joints in horizontal surfaces. Single-component sealant shall be non-sag type complying with Fed. Spec. TT-S-00230. Two-component sealant shall comply with Fed. Spec. TT-S-227b, Type 1, self-leveling.
 2. Back up material for joints to receive sealant shall be flexible and compressible type as recommended by manufacturer of the sealant. Material shall be furnished in sizes and shapes indicated by joint details or as recommended by the sealant manufacturer for the size of joint and type of materials. Materials shall be non-staining and compatible with the sealants used.
 3. Bond-breaker material where required for joints to receive sealant shall be strips of polyethylene tape, wax paper or aluminum foil the same width as the joint.
- F. Cementitious Backer Units:
1. Provide cementitious backer units at all showers complying with ANSI A118.9, of thickness and width indicated below, and in maximum lengths available to minimize end-to-end butt joints.
 - a. Thickness: ½ inch (12.7), unless otherwise indicated.
 - b. Width: Manufacturer's standard width, but not less than 32 inches (813 mm).

2. Available Products: Subject to compliance with requirements, cementitious backer units that may be incorporated into the Work, include, but are not limited to, the following:
 - a. DomCrete Cementitious Tile-Backer Board; Domtar Gypsum.
 - b. Util-A-Crete Concrete Backer Board; FinPan, Inc.
 - c. DUROCK Cement Board; United States Gypsum Co.
- G. Waterproof: Waterproof cleavage membrane shall be any of the following materials at the Contractor's option.
 1. Waterproof building felt conforming to ASTM D226, 15 lb, asphalt saturated or ASTM D227, 13 lb. coal-tar saturated.
 2. Reinforced asphalt paper, duplex type conforming to Fed Spec. UU-B-790A.
 3. Polyethylene sheeting at least nominal thickness of 0.004-inch and conforming to ASTM C 156.
- H. Anti-fracture Membrane: Laticrete 9235 Anti-fracture Membranes.

3 EXECUTION

3.1 INSPECTION

- A. Substrate surfaces shall be examined for conditions that will adversely affect the quality of the installation. Do not proceed with the installation until all adverse conditions have been corrected and the following finishes and tolerances have been provided.
 1. Floor Finish and Tolerance: Concrete substrate shall have a steel trowel and fine broom finish and a maximum variation of 1/8-inch in 10 feet from the required plane.
 2. Wall Tolerance: Substrate shall have a maximum variation of 1/8-inch by eight feet from the required plane and be plumb and true with square corners.

3.2 PREPARATION

- A. Dust, dirt, debris and oily or waxy films shall be removed in advance of tile setting operations. Standing water shall be removed and surfaces shall be allowed to dry thoroughly before starting installation.
- B. Mixing Mortar and Grout:
 1. Latex-Portland cement mortar and grout shall be mixed in accordance with manufacturer's printed instructions.
 2. Dry mortar or grout mix shall be added to the amount of latex as specified by the manufacturer and mix thoroughly to obtain complete and visually uniform wetting of the dry mix.
 3. Mortar consistency shall be such that when applied with the notched trowel to the backing, the ridges formed in the mortar will not flow or slump.
 4. Grout consistency shall be adequate to firmly bond the compressed grout to the setting mortar and the tile units.
 5. Mortar or grout shall be remixed occasionally during use. Additional material shall not be added after initial mixing, nor shall mortar or grout be used after initial set.

3.3 INSTALLATION:

- A. Workmanship shall conform to the following:
 1. Tiles shall be smooth cut. All tiles having jagged or flaked edges shall be discarded.
 2. Tiles shall be carefully fitted to all items protruding through surface, in a manner to allow cut edges to be covered by escutcheons, plates or collars.
 3. Tile floors shall be slightly dished at floor drains.

4. The finished tile installation shall be clean and free of cracked, chipped, broken and unbonded tiles.

B. Setting of tile shall conform to the following:

1. Tile joints shall be straight, level, perpendicular and of even width not exceeding 1/16-inch for ceramic tile. Vertical joints shall be maintained plumb for the entire height of the tile work. Damaged or defective tile shall be replaced. All work shall conform to the best current practice of the industry and shall comply with ANSI standard installation specifications A108.1 through A108.7 and Tile Council of America "Handbook for Ceramic Tile Installation".
2. Floor tile to be set in dry-set mortar shall be set dry. A 1/8-inch thick (minimum) layer of dry-set mortar shall be spread on the floor surface not more than 30 minutes before covering with tile. Dry set mortar shall be combed with a 1/4-inch square notched trowel not more than 5 minutes before tile is set. Tile shall be beaten-in and leveled with uniform joints as specified above.
3. Wall tile shall be set with thinset materials. Tile shall be plumb and all joints shall be straight and true.
4. Tile shall be placed symmetrically, starting at center of floor or wall. Eliminate tiles of less than half full size wherever possible. Cut tiles in both floors and walls shall be located in inconspicuous locations.
5. All wall and floor joints shall be aligned to give uniform lines plumb and level.

C. Grouting shall conform to the following:

1. All ceramic tile shall be grouted with a commercial Portland cement grout mixed and applied in strict accordance with the grout manufacturer's instructions. Tile joints shall be tooled slightly concave, and the mortar shall be cut off and wiped from the face of the tile. Interstices or depressions left in the mortar joints after the grout has been cleaned from the surface shall be roughened at once and filled to the spring line of the cushion edge before the mortar begins to harden.
2. Ceramic floor tile shall be grouted with a thick slurry of commercial Portland cement grout mixed with a minimum amount of water, and the slurry shall be brushed or squeegeed over the floor until all joints are thoroughly filled and excess slurry removed.
3. Grout shall not be installed until ceramic tile has set for a minimum of 48 hours.

- D. At all showers install cementitious backer units and treat joints to comply with ANSI A108.11 and manufacturer's written instructions for type of application indicated.

3.4 CLEANING

- A. At completion of installation, finished tile surfaces shall be cleaned using materials and methods as recommended by the tile manufacturer.

3.5 PROTECTION

- A. The finished installation shall be covered with a non-staining, reinforced building paper taped in place. Protective paper shall be lapped not less than six inches at joints and continuously taped at all joints.
- B. One half inch thick plywood shall be laid over protective paper in all areas to be used as passageways during subsequent construction.
- C. All traffic shall be prohibited from using tiled floors for at least three days following completion of installation.
- D. Immediately prior to final acceptance, all protective coverings shall be removed and tile surfaces washed.

** END OF SECTION **

SECTION 09511
ACOUSTICAL PANEL CEILINGS

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 MEASUREMENT AND PAYMENT

- A. No separate payment will be made for work performed under this Section. Include the cost for this work in the lump sum Base Bid.

1.3 SUMMARY

- A. This Section includes acoustical panels and exposed suspension systems for ceilings.
- B. Products furnished, but not installed under this Section, include anchors, clips, and other ceiling attachment devices to be cast in concrete at ceilings.

1.4 DEFINITIONS

- A. AC: Articulation Class.
- B. CAC: Ceiling Attenuation Class.
- C. LR: Light Reflectance coefficient.
- D. NRC: Noise Reduction Coefficient.

1.5 SUBMITTALS

- A. Product Data: For each type of product indicated.
- B. Coordination Drawings: Reflected ceiling plans, drawn to scale, on which the following items are shown and coordinated with each other, based on input from installers of the items involved:
 - 1. Ceiling suspension system members.
 - 2. Method of attaching hangers to building structure.
 - 3. Ceiling-mounted items including lighting fixtures, diffusers, grilles, speakers, sprinklers, access panels, and special moldings.
 - 4. Minimum Drawing Scale: 1/8 inch = 1 foot (1:96).
- C. Samples for Initial Selection: For components with factory-applied color finishes.
- D. Qualification Data: For testing agency.
- E. Field quality-control test reports.
- F. Maintenance Data: For finishes to include in maintenance manuals.

1.6 QUALITY ASSURANCE

- A. Acoustical Testing Agency Qualifications: An independent testing laboratory, or an NVLAP-accredited laboratory, with the experience and capability to conduct the testing indicated. NVLAP-accredited laboratories must document accreditation, based on a "Certificate of Accreditation" and a "Scope of Accreditation" listing the test methods specified.
- B. Source Limitations:
 - 1. Acoustical Ceiling Panel: Obtain each type through one source from a single manufacturer.
 - 2. Suspension System: Obtain each type through one source from a single manufacturer.

C. Fire-Test-Response Characteristics: Provide acoustical panel ceilings that comply with the following requirements:

1. Surface-Burning Characteristics: Provide acoustical panels with the following surface-burning characteristics complying with ASTM E 1264 for Class A materials as determined by testing identical products per ASTM E 84:
 - a. Smoke-Developed Index: 50 or less.

1.7 DELIVERY, STORAGE, AND HANDLING

- A. Deliver acoustical panels, suspension system components, and accessories to Project site in original, unopened packages and store them in a fully enclosed, conditioned space where they will be protected against damage from moisture, humidity, temperature extremes, direct sunlight, surface contamination, and other causes.
- B. Before installing acoustical panels, permit them to reach room temperature and a stabilized moisture content.
- C. Handle acoustical panels carefully to avoid chipping edges or damaging units in any way.

1.8 PROJECT CONDITIONS

- A. Environmental Limitations: Do not install acoustical panel ceilings until spaces are enclosed and weatherproof, wet work in spaces is complete and dry, work above ceilings is complete, and ambient temperature and humidity conditions are maintained at the levels indicated for Project when occupied for its intended use.
 1. Pressurized Plenums: Operate ventilation system for not less than 48 hours before beginning acoustical panel ceiling installation.

1.9 COORDINATION

- A. Coordinate layout and installation of acoustical panels and suspension system with other construction that penetrates ceilings or is supported by them, including light fixtures, HVAC equipment, fire-suppression system, and partition assemblies.

1.10 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 1. Acoustical Ceiling Panels: Full-size panels equal to 2.0 percent of quantity installed.
 2. Suspension System Components: Quantity of each exposed component equal to 2.0 percent of quantity installed.

2 PRODUCTS

2.1 ACOUSTICAL PANELS

- A. Acoustical Panels: Armstrong Ultima 1910, or equal.
- B. Material: Wet-formed mineral fiber with acoustically transparent membrane.
- C. Surface Finish: White, vinyl latex paint
- D. Fire Performance
 1. ASTM E84
 2. Flame Spread Index: 25 or less
 3. Smoke Developed Index: 50 or less
- E. Classification: ASTM E1264, Form 2, Pattern E, Fire Class A
- F. Color: White, vinyl latex paint.
- G. LR: Minimum 0.90.
- H. NRC: Minimum 0.75

- I. CAC: Minimum 35
 - J. Edge/Joint Detail: Square.
 - K. Thickness: 3/4"
 - L. Modular Size: 24"x24"
 - M. Antimicrobial Treatment: Broad spectrum fungicide and bactericide based.
 - N. Sag Resistance: Humiguard Plus, or equal
- 2.2 METAL SUSPENSION SYSTEM FOR ACOUSTICAL PANEL CEILING
- A. Suspension System: Armstrong Prelude XL, or equal
 - B. Material: Hot dipped galvanized steel
 - C. Surface Finish: Baked polyester
 - D. Color: White
 - E. Face Dimension: 15/16"
 - F. Profile: Exposed tee
 - G. Cross Tee/Main Beam Interface: Override
 - H. End Detail
 - 1. Main Beam: Staked-on clip
 - 2. Cross Tee: Staked-on clip
 - I. Duty Classification: Heavy duty
 - J. Hanger Wire
 - 1. Zinc-Coated, Carbon-Steel Wire in accordance with ASTM A641/A641M, Class 1 zinc coating, soft temper.
 - 2. Select wire diameter so its stress at 3 times hanger design load (ASTM C635, Table 1, "Direct Hung") will be less than yield stress of wire; however, wire diameter shall not be less than 0.106-inches.

3 EXECUTION

3.1 EXAMINATION

- A. Examine substrates, areas, and conditions, including structural framing to which acoustical panel ceilings attach or abut, with Installer present, for compliance with requirements specified in this and other Sections that affect ceiling installation and anchorage and with requirements for installation tolerances and other conditions affecting performance of acoustical panel ceilings.

- 1. Proceed with installation only after unsatisfactory conditions have been corrected.

3.2 PREPARATION

- A. Measure each ceiling area and establish layout of acoustical panels to balance border widths at opposite edges of each ceiling. Avoid using less-than-half-width panels at borders, and comply with layout shown on reflected ceiling plans.

3.3 INSTALLATION

- A. General: Install acoustical panel ceilings to comply with ASTM C636 and UBC Standard 25-2 and seismic design requirements indicated, per manufacturer's written instructions and CISCA's "Ceiling Systems Handbook."
- B. Suspend ceiling hangers from building's structural members and as follows:
 - 1. Install hangers plumb and free from contact with insulation or other objects within ceiling plenum that are not part of supporting structure or of ceiling suspension system.

2. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 3. Splay hangers only where required to miss obstructions; offset resulting horizontal forces by bracing, countersplaying, or other equally effective means.
 4. Where width of ducts and other construction within ceiling plenum produces hanger spacings that interfere with location of hangers at spacings required to support standard suspension system members, install supplemental suspension members and hangers in form of trapezes or equivalent devices.
 5. Secure wire hangers to ceiling suspension members and to supports above with a minimum of three tight turns. Connect hangers directly either to structures or to inserts, eye screws, or other devices that are secure and appropriate for substrate and that will not deteriorate or otherwise fail due to age, corrosion, or elevated temperatures.
 6. Secure flat, angle, channel, and rod hangers to structure, including intermediate framing members, by attaching to inserts, eye screws, or other devices that are secure and appropriate for both structure to which hangers are attached and type of hanger involved. Install hangers in a manner that will not cause them to deteriorate or fail due to age, corrosion, or elevated temperatures.
 7. Do not support ceilings directly from permanent metal forms or floor deck. Fasten hangers to cast-in-place hanger inserts, post-installed mechanical or adhesive anchors, or power-actuated fasteners that extend through forms into concrete.
 8. When steel framing does not permit installation of hanger wires at spacing required, install carrying channels or other supplemental support for attachment of hanger wires.
 9. Do not attach hangers to steel deck tabs, or thin angles on bottom cord of bar joists.
 10. Do not attach hangers to steel roof deck. Attach hangers to structural members.
 11. Space hangers not more than 48 inches (1200 mm) o.c. along each member supported directly from hangers, unless otherwise indicated; provide hangers not more than 8 inches (200 mm) from ends of each member.
 12. Size supplemental suspension members and hangers to support ceiling loads within performance limits established by referenced standards and publications.
- C. Secure bracing wires to ceiling suspension members and to supports with a minimum of four tight turns. Suspend bracing from building's structural members as required for hangers, without attaching to permanent metal forms, steel deck, or steel deck tabs. Fasten bracing wires into concrete with cast-in-place or post-installed anchors.
- D. Install edge moldings and trim of type indicated at perimeter of acoustical ceiling area and where necessary to conceal edges of acoustical panels.
1. Apply acoustical sealant in a continuous ribbon concealed on back of vertical legs of moldings before they are installed.
 2. Screw attach moldings to substrate at intervals not more than 16 inches (400 mm) o.c. and not more than 3 inches (75 mm) from ends, leveling with ceiling suspension system to a tolerance of 1/8 inch in 12 feet (3.2 mm in 3.6 m). Miter corners accurately and connect securely.
 3. Do not use exposed fasteners, including pop rivets, on moldings and trim.
- E. Install suspension system runners so they are square and securely interlocked with one another. Remove and replace dented, bent, or kinked members.
- F. Install acoustical panels with undamaged edges and fit accurately into suspension system runners and edge moldings. Scribe and cut panels at borders and penetrations to provide a neat, precise fit.
1. Arrange directionally patterned acoustical panels as follows:
 - a. As indicated on reflected ceiling plans.

- b. Install panels with pattern running in one direction parallel to short axis of space.
2. For square-edged panels, install panels with edges fully hidden from view by flanges of suspension system runners and moldings.

3.4 FIELD QUALITY CONTROL

- A. Special Inspections: Engage a qualified special inspector to perform the following special inspections and prepare reports:
 1. Suspended ceiling system.
 2. Hangers, anchors and fasteners.
- B. Testing Agency: Engage a qualified testing agency to perform tests and inspections and prepare test reports.
- C. Tests and Inspections: Testing and inspecting of completed installations of acoustical panel ceiling hangers and anchors and fasteners shall take place in successive stages, in areas of extent and using methods as follows. Do not proceed with installations of acoustical panel ceiling hangers for the next area until test results for previously completed installations of acoustical panel ceiling hangers show compliance with requirements.
 1. Extent of Each Test Area: When installation of ceiling suspension systems on each floor has reached 20 percent completion but no panels have been installed.
 - a. Within each test area, testing agency will select 1 of every 10 power-actuated fasteners and post-installed anchors used to attach hangers to concrete and will test them for 200 lbf (890 N) of tension; it will also select one of every 2 post-installed anchors used to attach bracing wires to concrete and will test them for 440 lbf (1957 N) of tension.
 - b. When testing discovers fasteners and anchors that do not comply with requirements, testing agency will test those anchors not previously tested until 20 pass consecutively and then will resume initial testing frequency.
- D. Remove and replace acoustical panel ceiling hangers and anchors and fasteners that do not pass tests and inspections and retest as specified above.

3.5 CLEANING

- A. Clean exposed surfaces of acoustical panel ceilings, including trim, edge moldings, and suspension system members. Comply with manufacturer's written instructions for cleaning and touchup of minor finish damage. Remove and replace ceiling components that cannot be successfully cleaned and repaired to permanently eliminate evidence of damage.

** END OF SECTION **



SECTION 09650
RESILIENT FLOORING AND BASES

1 GENERAL

1.1 WORK INCLUDES

- A. The work under this Section includes furnishing and installing resilient tile flooring, as identified on the Drawings (Finish Schedule).

1.2 SUBMITTALS

- A. Submit catalog information and technical data sheets on all materials proposed.
- B. Submit sample of each type of tile proposed, 6"x12".

2 PRODUCTS

2.1 NONCONDUCTIVE FLOORING SYSTEM

- A. Vinyl Tile: Bliss Southern Expressions, Ashville Y001-851
- B. Base: Rubber cove base, 1/8-inch thick by 4 inches high with round top, coved base, and ribbed back. A toeless flat base shall be used where vinyl base is used with carpet. All internal and external corners shall be pre-molded. Color: gray.
- C. Adhesive: Adhesive shall be as recommended by the manufacturer of the tile. Adhesive shall be suitable for vinyl tile on concrete floors.
- D. Door Trim: Provide aluminum door trim for all non-threshold door entrances to tiled floor room where tile terminates.

3 EXECUTION

3.1 PREPARATION

- A. Floors shall be cleaned thoroughly and where necessary, brought to level before installation of tile. Tile shall not be installed until all other work in that section is complete.

3.2 INSTALLATION

- A. Tile shall be laid by starting in center of each room and working toward walls so as to provide equal edges on opposite side of the room. Position either a tile or a joint on the centerline so that edge strips wherever possible shall be greater than 1/2 tile in width.
- B. Floor tile and base shall be installed in accordance with the manufacturer's recommendations.
- C. Tile shall be installed so that corners of four adjacent tile meet at a common point.

3.3 CLEANING

- A. Upon completion, floor shall be thoroughly cleaned and excess adhesive removed from all surfaces with an approved solvent.

** END OF SECTION **



SECTION 09680
CARPETING

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install all carpet, cushion, and related installation accessories necessary for the complete and satisfactory installation of carpeting as called for on the Drawings and in these Specifications.

1.2 SUBMITTALS

A. Seaming Diagram

- 1. The Contractor shall submit 3 copies of a seaming diagram showing the proposed location of all seams to the Engineer. No cushion or carpet shall be installed prior to the Engineer's review of the seaming diagram.

B. Manufacturer's Literature

- 1. The Contractor shall submit the following manufacturer's literature to the Engineer prior to beginning installation operations:
 - a. Two copies of a complete installation manual.
 - b. Five copies of a complete maintenance manual.

C. Certification

- 1. The Contractor shall furnish the following certification to the Engineer prior to beginning carpeting work:
 - a. Manufacturer's certification that all materials furnished under this section meet or exceed all requirements of these Specifications. Each certificate shall be signed by an officer of the manufacturer and shall contain the project name, description of material and quantities supplied.
 - b. Certification from the manufacturer or the manufacturer's authorized representative indicating that the Installing Contractor has adequate knowledge and experience to successfully and satisfactorily install the manufacturer's products.

1.3 GUARANTEE

- A. The Contractor shall furnish a guarantee covering the repair or replacement of defects in material or workmanship.
- B. The Contractor shall restretch the carpet at least once during the guarantee period. Such restretching shall be performed within 14 days of the receipt of notice from the Engineer.

1.4 DELIVERY AND STORAGE OF MATERIALS

- A. Delivery: The Contractor shall deliver carpet, cushion, and other materials supplied under this item to the job site in the manufacturer's original protective packaging or mill wrappings. Each bundle shall be clearly marked as to material, manufacturer, size or quantity, dye lot, and required conditions.
- B. Storage: Materials shall be stored in areas designated for the storage of materials. The Contractor shall provide all protection necessary to prevent soiling and damaging of carpet and cushioning prior to their installation.

1.5 SPARE STOCK

- A. The Contractor shall furnish 12 square yards of each pattern and coloration used as spare stock to be used for patching or repair by the Owner. Spare stock shall each consist of a single, continuous piece not less than 12 feet in width.

2 PRODUCTS

2.1 MATERIALS

A. Cushion

1. Construction
 - a. Type: Rubber-coated hair and India Fiber
 - b. Weight: 50 oz./sq. yd. minimum
2. Flammability (ASTM E 84)
 - a. Flame spread rating: 75 maximum
 - b. Smoke density rating: 200 maximum
3. Samples
 - a. The Contractor shall submit s sample (12 in X 12 in minimum) and other necessary technical information concerning the cushion to the Owner for review.

B. Carpet

1. Construction
 - a. Type: Tufted, One-level, or Textured Loop
 - b. Face fiber: Nylon (3 ply)
 - c. Dyeing method: Continuous or Kuster
 - d. Guage: 1/8-inch maximum
 - e. Stitches per inch: 8 maximum
 - f. Pile height: 6/32 inch +/- 1/32 inch
 - g. Face weight: 20 oz./yd² minimum
 - h. Primary backing: Polypropylene
 - i. Secondary backing: Jute
 - j. Total weight: 50 oz./yd² minimum
 - k. Minimum width: 12 feet
2. Sound Absorption
 - a. Noise reduction coefficient (ASTM C423): 0.30 minimum
3. Static Electricity Control
 - a. American Association of Textile Chemist and Colorists (Test Method 134): 3.0 kilovolts maximum (at 70°F and 20% relative humidity).
4. Colorfastness
 - a. American Association of Textile Chemist and Colorists (Test Method 16E): No more than slight change after 60 "AATCC Fading Units."
5. Flammability (ASTM E 84)
 - a. Flame spread rating: 75 maximum
 - b. Smoke density rating: 200 maximum
6. Coloration
 - a. The proposed carpet shall be available in at least 3 patterns with a minimum of 10 colorations per pattern. Bold contrasting patterns (stripes, checks, flowers, etc.) shall not be used. The Contractor shall submit samples (3"x3" minimum) or color cards accurately representing each available coloration to the Owner for pattern and color selection. Carpet from different dye lots shall not be used.
7. Installation Materials

- a. All materials and accessories used in the installation of materials furnished for installation under this section shall be acceptable to and approved by the carpet manufacturer. These materials include, but are not limited to:
 - 1) Tackless strips
 - 2) Adhesives
 - 3) Tapes
 - 4) Edge strips

3 EXECUTION

3.1 PREPARATORY WORK

- A. The Contractor shall inspect the subflooring before commencing carpet installation and notify the Engineer of any condition which would prevent proper installation of cushioning and carpeting. Floors shall be swept clean and shall be dry and suitable for installation of cushioning and carpeting. Ensure that doors swinging out over carpeted areas have sufficient clearance. The initiation of installation will signal that conditions are proper to proceed and to expect satisfactory work. No claim to the contrary will be acceptable by the Engineer after installation work.

3.2 INSTALLATION

A. Cushion

1. The underlay cushion shall be cemented to the floor with an approved adhesive to prevent shifting or buckling. The seams shall be taped with industrial tape, minimum width 2 inches. The underlay cushion shall be knee-kicked to allow for slight stretch. The underlay cushion and carpet seams shall not coincide.

B. Carpet

1. The carpet shall be installed by approved methods by the manufacturer and industry standard, the carpet shall run in the same direction unless specifically directed otherwise. The carpet shall have a minimum of seams as shown on the seaming diagram. Stretch carpet drum-tight in both directions by use of knee-kickers and power stretches. Where carpet edges are adjacent to raised floor surfaces, ensure that surfaces are flush with carpet subfloor shall be bound with metal gripper bars and the carpet tacked under the bar. Seams shall be sewn using No. 18 waxed linen thread or taped. If tape is used, the tape is expected to provide both mechanical sealing with pins and adhesive sealing. Seaming method is to conform to the tape manufacturer's written instruction. No seams are to occur at doorways and entries perpendicular to door or entries. Seam occurring at door parallel to door shall be centered directly under the door. Seams occurring at change of direction in corridors shall follow the wall line parallel to the carpet direction.

3.3 CLEANING AND PROTECTION

- A. After completion of carpet installation, remove all waste and excess materials, tools and equipment. Usable carpet pieces which remain shall be left at the job site, placed where directed by the Engineer. Vacuum carpet with a commercial machine, with rotation agitator or beater in the nozzle. Remove soiled spots. Shampoo if necessary to clean carpet. Protect carpeted areas during remainder of construction period, so that carpet will be in undamaged and unsoiled condition at the time of acceptance.

** END OF SECTION **



SECTION 09900

PAINTING

1 GENERAL

1.1 DESCRIPTION

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to accomplish all painting as specified herein and shown on the Drawings.

1.2 SCOPE OF WORK

- A. In general, work included under this section shall include the surface preparation, shop priming, field priming, and/or field painting of all exposed items and surfaces throughout the project, unless otherwise indicated.
- B. All exposed items and surfaces shall be painted using the appropriate coating system as specified herein. Coating system schedules and finish schedules may be provided herein and/or on the Drawings, which identify specific paint systems and paint colors to be used on specific items and surfaces. However, these schedules do not necessarily cover all items to be painted. Where the selection of a specific painting system for a particular application is not clear, it shall be the responsibility of the Contractor to request clarification from the Engineer.
- C. Surface preparation, priming, and coats of paint specified are in addition to shop priming and surface pretreatment specified in other sections, unless otherwise indicated.
- D. All exposed surfaces shall be painted except where the natural finish of the material is obviously intended to be the finished surface or if the surface is specifically noted not to be painted.
- E. In general, items to be painted include:
1. All exposed exterior surfaces including:
 - a. Concrete block.
 - b. Equipment supports.
 - c. Pipe, valves, fittings, hydrants, and appurtenances.
 - d. Ductwork and appurtenances.
 - e. Non-galvanized conduit and appurtenances.
 - f. Ferrous metals.
 - g. All factory primed steel doors and equipment.
 - h. Exposed untreated wood.
 - i. All other surfaces subject to corrosion.
 2. All exposed interior surfaces including:
 - a. All wall surfaces in all spaces unless specifically noted not to be painted.
 - b. All columns, equipment pads, pipe supports, and appurtenances.
 - c. Pipe, valves, fittings, hydrants, and appurtenances.
 - d. Ductwork and appurtenances.
 - e. All electrical conduit unless specifically noted not to be painted.
 - f. All hangers and supports for overhead items.
 - g. Ferrous metals.
 - h. All factory primed steel doors and equipment.
 - i. Exposed untreated wood.

- j. All other surfaces subject to corrosion.
 - 3. The interior of the existing influent pump station (all concrete, piping, ferrous metals, etc.)
 - 4. The interior of the influent pump station electrical building. The entire room shall be painted after modifications are made to the building.
 - 5. The interior of the new influent screen discharge box.
 - 6. The below grade exterior basement walls of the MBR Process Building.
 - 7. All new buildings in accordance with the Room Finish Schedule in the Drawings.
 - 8. The interior of the Chlorine Building. The entire room shall be painted after modifications are made to the building.
 - 9. Equipment that does not have an approved final coat or does not have the appropriate finished color as directed by the Engineer.
 - 10. Touch up all equipment that has been damaged by the existing construction as directed by the Engineer.
 - 11. Touch up all existing or new items and surfaces damaged by construction as directed by the Engineer.
- F. In general, items NOT to be painted include:
- 1. Items with Engineer approved factory finish.
 - 2. Electrical equipment unless specifically noted.
 - 3. Surfaces hidden from view including piping, conduit, ducts, and insulation. Note, the manufacturer's standard coatings, if any, may remain.
 - 4. Stainless steel surfaces except piping or tubing.
 - 5. Aluminum surfaces except:
 - a. Where specifically noted to be painted.
 - b. Where embedded in or in contact with concrete.
 - c. Where in contact with dissimilar metals.
 - d. Piping or tubing.
 - 6. Fiberglass surfaces except piping and piping appurtenances.
 - 7. Interior of pipe, ductwork, and conduits.
 - 8. Moving parts of mechanical and electrical units where painting would interfere with the operation of the unit.
 - 9. Code labels and equipment identification and rating plates.
 - 10. Exterior concrete or pre-cast concrete surfaces.
 - 11. Galvanized metal surfaces except interior conduit.
 - 12. Face brick, ceramic tile, plastic laminate.
 - 13. Concealed deck except where specifically specified to be painted.
 - 14. Pre-finished metal.
 - 15. Interior and exterior of concrete basins, vaults, and tanks unless noted otherwise.

1.3 DEFINITIONS

- A. Definitions of Painting Terms: ASTM D16, unless otherwise specified.
- B. Dry Film Thickness (DFT): Thickness of a coat of paint in fully cured state measured in mils (1/1000 inch).

1.4 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of the section titled "Submittals" of these specifications.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications:
 - 1. Product Data
 - a. Submit Manufacturer's product data for each coating, including generic description, complete technical data, surface preparation, and application instructions.
 - 2. Color Samples
 - a. Submit Manufacturer's color samples showing full range of standard colors.
- C. Manufacturer's Quality Assurance
 - 1. Submit Manufacturer's certification that coatings comply with specified requirements and are suitable for intended application.
- D. Warranty
 - a. Submit a complete description of the warranty to be provided.
- E. Painting Schedule
 - 1. Contractor shall submit a schedule of all items (structures, equipment, pipe, etc.) to be painted prior to beginning painting operations. Schedule shall include, but not be limited to, items to be painted, surface preparation, paint system, and color. The schedule shall be submitted to the Engineer for approval at which time the Engineer will select the colors to be used that are not specified herein or on the Drawings.

1.5 QUALITY ASSURANCE

- A. Manufacturer's Qualifications
 - 1. Specialize in manufacture of coatings with a minimum of 10 years successful experience.
 - 2. Able to demonstrate successful performance on comparable projects.
 - 3. Single Source Responsibility
 - a. Coatings and coating application accessories shall be products of a single manufacturer.
- B. Applicator's Qualifications
 - 1. Experienced in application of specified coatings for a minimum of 5 years on projects of similar size and complexity to this work.
 - 2. Applicator's Personnel
 - a. Employ persons trained for application of specified coatings.
- C. Pre-application Meeting
 - 1. Convene a pre-application meeting two weeks before start of application of coating systems. Attendance of parties directly affecting work of this section, including Contractor, Engineer, Applicator, and Manufacturer's representative, is required. The meeting shall cover, but not be limited to, the following:
 - a. Environmental requirements.
 - b. Protection of surfaces not scheduled to be coated.
 - c. Surface preparation.
 - d. Application.
 - e. Repair.
 - f. Field quality control.

- g. Cleaning.
- h. Protection of coating systems.
- i. One-year inspection.
- j. Coordination with other work.

D. Manufacturer's Representative During Painting Operations

- 1. An authorized Manufacturer's representative shall be present at the start-up and weekly during painting operations. Such representative shall instruct and observe the Contractor's and Applicator's work and shall, at the completion of work, certify in writing to the Engineer that the Manufacturer's application recommendations have been adhered to. The cost of this work shall be borne by the Contractor.

1.6 DELIVERY, STORAGE, AND HANDLING

A. Delivery

- 1. Deliver materials to site in manufacturer's original, unopened containers and packaging, with labels clearly identifying:
 - a. Coating or material name.
 - b. Manufacturer.
 - c. Color name and number.
 - d. Batch or lot number.
 - e. Date of manufacture.
 - f. Mixing and thinning instructions.

B. Storage

- 1. Store materials in a clean dry area and within temperature range in accordance with Manufacturer's instructions.
- 2. Keep containers sealed until ready for use.
- 3. Do not use materials beyond Manufacturer's shelf life limits.

C. Handling

- 1. Protect materials during handling and application to prevent damage or contamination.

1.7 ENVIRONMENTAL REQUIREMENTS

A. Weather

- 1. Air and Surface Temperatures
 - a. Prepare surfaces and apply and cure coatings within air and surface temperature range in accordance with Manufacturer's instructions.
- 2. Surface Temperature
 - a. Minimum of 5 °F (3 °C) above dew point.
- 3. Relative Humidity
 - a. Prepare surfaces and apply and cure coatings within relative humidity range in accordance with Manufacturer's instructions.
- 4. Precipitation
 - a. Do not prepare surfaces or apply coatings in rain, snow, fog, or mist.
- 5. Wind
 - a. Do not spray coatings if wind velocity is above manufacturer's limit.

B. Ventilation

1. Provide ventilation during coating evaporation stage in confined or enclosed areas in accordance with AWWA D 102.

C. Dust and Contaminants

1. Schedule coating work to avoid excessive dust and airborne contaminants.
2. Protect work areas from excessive dust and airborne contaminants during coating application and curing.

1.8 TESTING EQUIPMENT

- A. The Contractor shall furnish and make available to the Engineer the following items of testing equipment for use in determining if requirements of this section are being satisfied. Specified items of equipment shall be available for the Engineer's use at all times when field painting or surface preparation is in progress.

- a. Wet film gauge.
- b. Surface thermometer.
- c. Keane-Tator surface profile comparator.
- d. Set of National Association of Corrosion Engineers (NACE) visual standards.
- e. Holiday (pin hole) detector (low voltage).
- f. Sling-psychrometer.
- g. Magnetic dry film gauge.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:

1. Tnemec.
2. Induron.
3. Carboline.

- B. Unless otherwise indicated, product names and numbers specified herein are manufactured by Tnemec. Equivalent materials produced by approved Manufacturer's shall be acceptable subject to prior review by the Engineer.

2.2 COATING SYSTEMS

A. General

1. Tnemec product names and numbers are specified herein. Equivalent materials produced by approved manufacturers shall be acceptable.
2. Exposure terms refer to the environmental conditions to which different surfaces may be exposed. A surface may exist in more than one exposure, e.g. an exterior wall can be categorized not only as "Exposed", but also as "Buried", where the exposure is below the grade line.

B. Coating Systems

1. Structural Steel – Interior Exposed
 - a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: SSPC-SP6/NACE 3
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - e. Total DFT: 6 to 10 mils

2. Structural Steel – Exterior Exposed
 - a. System Type: Epoxy/Polyurethane
 - b. Surface Preparation: SSPC-SP6/NACE 3
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - d. Intermediate Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
 - e. Finish Coat: TNEMEC Series 1074 Endura-Shield, 2 to 5 mils DFT
 - f. Total DFT: 7 to 13 mils
3. Structural Steel – Below Grade (Buried) and Immersed
 - a. System Type: Epoxy/Coal Tar Epoxy
 - b. Surface Preparation: SSPC-SP10/NACE 2
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - d. Finish Coat: TNEMEC Series 46H-413 Hi-Build Tneme-Tar, 14 to 20 mils DFT
 - e. Total DFT: 17 to 25 mils
4. Structural Steel – Interior/Immersion Severe H₂S Exposure (Inside Pump Station Wet Wells)
 - a. System Type: Modified Polyamine Epoxy
 - b. Surface Preparation: SSPC-SP5/NACE 1
 - c. Prime Coat: TNEMEC Series 435 Perma-Glaze, 15 to 20 mils DFT
 - d. Finish Coat: TNEMEC Series 435 Perma-Glaze, 15 to 20 mils DFT
 - e. Total DFT: 30 to 40 mils
5. Factory Primed Steel Doors, Frames, and Equipment – Interior Exposed
 - a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: Clean and Dry
 - c. Prime Coat: Factory Primed
 - d. Intermediate Coat: TNEMEC Series 27 F.C. Typoxy, 2 to 3 mils DFT
 - e. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
 - f. Total DFT: 4 to 6 mils
6. Factory Primed Steel Doors, Frames, and Equipment – Exterior Exposed
 - a. System Type: Epoxy/Polyurethane
 - b. Surface Preparation: Clean and Dry
 - c. Prime Coat: Factory Primed
 - d. Intermediate Coat: TNEMEC Series 27 F.C. Typoxy, 2 to 3 mils DFT
 - e. Finish Coat: TNEMEC Series 1075 Endura-Shield II, 2 to 3 mils DFT
 - f. Total DFT: 4 to 6 mils
7. Galvanized Steel Pipe and Non-Ferrous Metal Pipe – Interior Exposed
 - a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
 - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
 - e. Total DFT: 4 to 6 mils
8. Galvanized Steel Pipe and Non-Ferrous Metal Pipe – Exterior Exposed

- a. System Type: Epoxy/Polyurethane
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
 - d. Finish Coat: TNEMEC Series 1075 Endura-Shield II, 2 to 3 mils DFT
 - e. Total DFT: 4 to 6 mils
9. Galvanized Steel Pipe and Non-Ferrous Metal Pipe – Immersed
 - a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
 - e. Total DFT: 7 to 11 mils
 10. Ductile Iron Pipe, Pumps, and Valves – Interior Exposed
 - a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
 - e. Total DFT: 7 to 11 mils
 11. Ductile Iron Pipe, Pumps, and Valves – Exterior Exposed
 - a. System Type: Epoxy/Epoxy/Polyurethane
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - d. Intermediate Coat: TNEMEC Series 69 Hi-Build Epoxoline II, 4 to 6 mils DFT
 - e. Finish Coat: TNEMEC Series 1075 Endura-Shield II, 2 to 3 mils DFT
 - f. Total DFT: 9 to 14 mils
 12. Ductile Iron Pipe, Pumps, and Valves – Below Grade (Buried) and Immersed
 - a. System Type: Epoxy/Coal Tar Epoxy
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 3 to 5 mils DFT
 - d. Finish Coat: TNEMEC Series 46H-413 Hi-Build Tneme-Tar, 14 to 20 mils DFT
 - e. Total DFT: 17 to 25 mils
 13. Ductile Iron Pipe, Pumps, and Valves – Interior/Immersion Severe H₂S Exposure (Inside Pump Station Wet Wells)
 - a. System Type: Ceramic-Filled Epoxy
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N140 Pota-Pox Plus, 3 to 5 mils DFT
 - d. Finish Coat: TNEMEC Series 431 Perma-Shield PL, 30 to 40 mils DFT
 - e. Total DFT: 33 to 45 mils
 14. Polyvinyl Chloride – Interior Exposed
 - a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: Scarify
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT

- d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
 - e. Total DFT: 4 to 6 mils
15. Polyvinyl Chloride – Exterior Exposed
- a. System Type: Epoxy/Polyurethane
 - b. Surface Preparation: Per manufacturer's recommendation
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 2 to 3 mils DFT
 - d. Finish Coat: TNEMEC Series 1075 Endura-Shield II, 2 to 3 mils DFT
 - e. Total DFT: 4 to 6 mils
16. Insulated Pipe – Interior/Exterior Exposed
- a. System Type: Acrylic/Acrylic
 - b. Surface Preparation: Clean and Dry
 - c. Prime Coat: TNEMEC Series 1029 Enduratone (semi-gloss), 2 to 3 mils DFT
 - d. Finish Coat: TNEMEC Series 1029 Enduratone (semi-gloss), 2 to 3 mils DFT
 - e. Total DFT: 4 to 6 mils
17. Cast-In-Place and Precast Concrete – Interior Exposed
- a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 2-4, concrete cured a minimum of 28 days
 - c. Prime Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
 - d. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
 - e. Total DFT: 8 to 12 mils
18. Cast-In-Place and Precast Concrete – Exterior Exposed
- a. System Type: Waterborne Acrylate/Waterborne Acrylate
 - b. Surface Preparation: SSPC-SP13/NACE 6, clean and dry, concrete cured a minimum of 28 days
 - c. Prime Coat: TNEMEC Series 156 Enviro-Crete, 4 to 8 mils DFT
 - d. Finish Coat: TNEMEC Series 156 Enviro-Crete, 4 to 8 mils DFT
 - e. Total DFT: 8 to 16 mils
19. Cast-In-Place and Precast Concrete – Below Grade
- a. System Type: Coal Tar Epoxy
 - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 3, concrete cured a minimum of 28 days
 - c. Finish Coat: TNEMEC Series 46H-413 Hi-Build Tneme-Tar, 14 to 20 mils DFT
 - d. Total DFT: 14 to 20 mils
20. Cast-In-Place and Precast Concrete – Interior/Immersion Severe H₂S Exposure (Inside Pump Station Wet Wells)
- a. System Type: Modified Polyamine Epoxy
 - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 5, concrete cured a minimum of 28 days
 - c. Filler: TNEMEC Series 217 MortarCrete, fill voids
 - d. Prime Coat: TNEMEC Series 434 Perma-Shield H₂S, 125 mils DFT
 - e. Finish Coat: TNEMEC Series 435 Perma-Glaze, 15 to 20 mils DFT

- f. Total DFT: Nominal 125 mils
- 21. Concrete Floors – Light Traffic, Low Impact
 - a. System Type: Waterborne Epoxy/Waterborne Acrylic
 - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 1-3
 - c. Prime Coat: TNEMEC Series 287 Enviro-Pox, 3 to 4 mils DFT
 - d. Finish Coat: TNEMEC Series 287 Enviro-Pox, 3 to 4 mils DFT
 - e. Total DFT: 6 to 8 mils
- 22. Concrete – Secondary Containment
 - a. System Type: Epoxy/Epoxy/Epoxy
 - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 3-9
 - c. Prime Coat: TNEMEC Series 201 Epoxoprime, 6 to 8 mils DFT
 - d. Intermediate Coat: TNEMEC Series 239SC ChemTread, 68 to 92 mils DFT
 - e. Finish Coat: TNEMEC Series 282 Tneme-Glaze, 6 to 8 mils DFT
 - f. Total DFT: Nominal 125 mils
- 23. Concrete Masonry Unit (CMU) – Interior Exposed
 - a. System Type: Epoxy/Epoxy
 - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 2-4, CMU clean and dry
 - c. Prime Coat: TNEMEC Series 130 Envirofill, 60 to 80 square feet per gallon
 - d. Intermediate Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
 - e. Finish Coat: TNEMEC Series N69 Hi-Build Epoxoline II, 4 to 6 mils DFT
 - f. Total DFT: 8 to 12 mils
- 24. Concrete Masonry Unit (CMU) – Exterior Exposed
 - a. System Type: Acrylate/Acrylate
 - b. Surface Preparation: SSPC-SP13/NACE 6, ICRI CSP 2-4, CMU clean and dry
 - c. Prime Coat: TNEMEC Series 130 Envirofill, 60 to 80 square feet per gallon
 - d. Intermediate Coat: TNEMEC Series 156 Enviro-Crete, 4 to 8 mils DFT
 - e. Finish Coat: TNEMEC Series 156 Enviro-Crete, 4 to 8 mils DFT
 - f. Total DFT: 8 to 16 mils
- 25. Plaster and Gypsum Wallboard
 - a. System Type: Waterborne Epoxy/Waterborne Acrylic
 - b. Surface Preparation: Clean and Dry
 - c. Prime Coat: TNEMEC Series 151-1051 Elasto-Grip FC, 1 to 2 mils DFT
 - d. Finish Coat: TNEMEC Series 113 H.B. Tneme-Tufcoat, 4 to 6 mils DFT
 - e. Total DFT: 5 to 8 mils
- 26. Wood – Interior or Exterior Exposed
 - a. System Type: Alkyd/Acrylic
 - b. Surface Preparation: Sand, Clean and Dry
 - c. Prime Coat: TNEMEC Series 10-99W Tnemec Primer, 2 to 3.5 mils DFT
 - d. Finish Coat: TNEMEC Series 1029 Enduratone (semi-gloss), 2 to 3 mils DFT
 - e. Total DFT: 4 to 6.5 mils

2.3 INFLUENT SCREEN TANK COATING

- A. All interior surfaces of the discharge tank located underneath the influent screens shall be coated with a polyurethane lining system to protect the concrete from corrosion. Coating shall extend to the interface of the screen so that no concrete is exposed beneath the screen
- B. Polyurethane lining system shall be Sprayroq, Inc. Spraywall, or equal.
- C. Coating shall be applied per the manufacturer's instructions.

2.4 MBR PROCESS BUILDING BASEMENT COATING

- A. The exterior surface of the MBR Process Building basement walls shall be coated with a cementitious crystalline material.
- B. Cementitious crystalline material shall be Xypex Modified.
- C. Coating shall be applied per the manufacturer's instructions.

2.5 ACCESSORIES

- A. Coating Application Accessories
 - 1. Accessories required for application of specified coatings in accordance with manufacturer's instructions, including thinners.
 - 2. Products of coating manufacturer.

3 EXECUTION

3.1 EXAMINATION

- A. Examine areas and conditions under which coating systems are to be applied. Notify Engineer of areas or conditions not acceptable. Do not begin surface preparation or application until unacceptable areas or conditions have been corrected.

3.2 PROTECTION OF SURFACES NOT SCHEDULED TO BE COATED

- A. Protect surrounding areas and surfaces not scheduled to be coated from damage during surface preparation and application of coatings.
- B. Immediately remove coatings that fall on surrounding areas and surfaces not scheduled to be coated.

3.3 SURFACE PREPARATION OF STEEL

- A. Prepare steel surfaces in accordance with Manufacturer's instructions.
- B. Fabrication Defects
 - 1. Correct steel and fabrication defects revealed by surface preparation.
 - 2. Remove weld spatter and slag.
 - 3. Round sharp edges and corners of welds to a smooth contour.
 - 4. Smooth weld undercuts and recesses.
 - 5. Grind down porous welds to pinhole-free metal.
 - 6. Remove weld flux from surface.
- C. Ensure surfaces are dry.
- D. Immersed or Below Grade Surfaces
 - 1. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 10/NACE 2.
- E. Exterior Exposed or Interior Exposed Surfaces
 - 1. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 6/NACE 3.

- F. Interior or Immersed Surfaces, Severe Atmospheres
 - 1. Remove visible oil, grease, dirt, dust, mill scale, rust, paint, oxides, corrosion products, and other foreign matter in accordance with SSPC-SP 5/NACE 1.
- G. Abrasive Blast-Cleaned Surfaces
 - 1. Coat abrasive blast-cleaned surfaces with primer before visible rust forms on surface. Do not leave blast-cleaned surfaces uncoated for more than 8 hours.
- H. Shop Primer
 - 1. Prepare shop primer to receive field coat in accordance with manufacturer's instructions.
- 3.4 SURFACE PREPARATION OF GALVANIZED STEEL AND NONFERROUS METAL
 - A. Prepare galvanized steel and nonferrous metal surfaces in accordance with Manufacturer's instructions.
 - B. Ensure surfaces are dry.
 - C. Remove visible oil, grease, dirt, dust, protective mill coatings, and other soluble contaminants in accordance with SSPC-SP 1 or Manufacturer's instructions as specified for coating system.
 - D. Immersed Service
 - 1. Clean surfaces by abrasive blasting.
 - E. Remove Rust From Galvanized Steel
 - 1. Remove white rust from galvanized steel by hand or power brushing.
 - 2. Remove rust from old galvanized steel in accordance with SSPC-SP 2 or SP 3.
 - 3. Do not damage or remove galvanizing.
 - F. Increase mechanical adhesion under moderate to severe conditions, such as exterior exposure or chemical environments, by abrasive blast and/or chemical cleaning.
- 3.5 SURFACE PREPARATION OF DUCTILE OR CAST IRON
 - A. Prepare ductile or cast iron surfaces in accordance with Manufacturer's instructions.
 - B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- 3.6 SURFACE PREPARATION OF PVC
 - A. Prepare PVC surfaces in accordance with Manufacturer's instructions.
 - B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
 - C. Scarify PVC surfaces.
- 3.7 SURFACE PREPARATION OF INSULATED PIPE
 - A. Prepare insulated pipe surfaces in accordance with Manufacturer's instructions.
 - B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- 3.8 SURFACE PREPARATION OF CONCRETE
 - A. Interior, Exposed
 - 1. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
 - 2. Allow concrete to cure for a minimum of 28 days.
 - 3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
 - 4. Abrasive blast surface to remove laitance and solid contaminants and to provide clean, sound substrate with uniform anchor profile.
 - 5. Fill holes, pits, voids, and cracks with Tnemec 63-1500 Filler and Surfacer.

6. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

B. Exterior

1. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
2. Allow concrete to cure for a minimum of 14 days.
3. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.
4. Level concrete protrusions and mortar spatter.
5. Fill hairline cracks less than 1/64 inch (0.4 mm) in accordance with Manufacturer's instructions.
6. Prepare cracks wider than 1/64 inch (0.4 mm), moving cracks, gaps, and expansion joints in accordance with Manufacturer's instructions.
7. Ensure surfaces are clean, dry, and free of oil, grease, chalk, form release agents, and other contaminants.

3.9 SURFACE PREPARATION OF CONCRETE FLOORS

- A. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow concrete to cure for a minimum of 28 days before coating.
- D. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.

3.10 SURFACE PREPARATION OF SECONDARY CONTAINMENT

- A. Prepare secondary containment surfaces in accordance with Manufacturer's instructions.
- B. Prepare concrete surfaces in accordance with Manufacturer's instructions, SSPC-SP 13/NACE 6, and ICRI 03732.
- C. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- D. Allow concrete to cure for a minimum of 28 days before coating.
- E. Test concrete for moisture in accordance with ASTM D 4263 and F 1869.

3.11 SURFACE PREPARATION OF POROUS CONCRETE MASONRY UNITS

- A. Prepare porous concrete masonry unit surfaces in accordance with Manufacturer's instructions and SSPC-SP 13/NACE 6.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow mortar to cure for a minimum of 28 days before coating.
- D. Level protrusions and mortar spatter.

3.12 SURFACE PREPARATION OF PLASTER

- A. Prepare plaster surfaces in accordance with Manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.
- C. Allow plaster to cure and dry out for a minimum of 28 days before coating.
- D. Do not coat over plaster containing free water, lime, or other soluble alkaline salts.
- E. Remove plaster nibs and other protrusions.
- F. Patch voids and cracks with approved materials and after dry, sand flush with surface.

3.13 SURFACE PREPARATION OF GYPSUM BOARD

- A. Prepare gypsum board surfaces in accordance with Manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, and other contaminants.

- C. Sand joint compound smooth and feather edge.
- D. Avoid heavy sanding of adjacent gypsum board surfaces, which will raise nap of paper covering.
- E. Do not apply putty, patching pencils, caulking, or masking tape to drywall surfaces to be painted.
- F. Lightly scuff-sand tape joints after priming to remove raised paper nap. Do not sand through primer.

3.14 SURFACE PREPARATION OF WOOD

- A. Prepare wood surfaces in accordance with Manufacturer's instructions.
- B. Ensure surfaces are clean, dry, and free of oil, grease, dirt, dust, surface deposits of sap or pitch, and other contaminants.
- C. Seal knots and pitch pockets.
- D. Sand rough spots with the grain.
- E. Fill cracks and holes with approved materials after primer is dry. Sand flush with surface when filler is hard.
- F. Lightly sand between coats.

3.15 APPLICATION

- A. Apply coatings in accordance with Manufacturer's instructions.
- B. Mix and thin coatings, including multi-component materials, in accordance with manufacturer's instructions.
- C. Keep containers closed when not in use to avoid contamination.
- D. Do not use mixed coatings beyond pot life limits.
- E. Use application equipment, tools, pressure settings, and techniques in accordance with Manufacturer's instructions.
- F. Uniformly apply coatings at spreading rate required to achieve specified DFT.
- G. Apply coatings to be free of film characteristics or defects that would adversely affect performance or appearance of coating systems.
- H. Stripe paint with brush critical locations on steel such as welds, corners, and edges using specified primer.

3.16 REPAIR

- A. Materials and Surfaces Not Scheduled to Be Coated
 - 1. Repair or replace damaged materials and surfaces not scheduled to be coated.
- B. Damaged Coatings
 - 1. Touch-up or repair damaged coatings. Touch-up of minor damage shall be acceptable where result is not visibly different from adjacent surfaces. Recoat entire surface where touch-up result is visibly different, either in sheen, texture, or color.
- C. Coating Defects
 - 1. Repair in accordance with manufacturer's instructions coatings that exhibit film characteristics or defects that would adversely affect performance or appearance of coating systems.

3.17 FIELD QUALITY CONTROL

- A. Applicator's Services
 - 1. Verify coatings and other materials are as specified.
 - 2. Verify surface preparation and application are as specified.

3. Verify DFT of each coat and total DFT of each coating system are as specified using wet film and dry film gauges.
4. Coating Defects
 - a. Check coatings for film characteristics or defects that would adversely affect performance or appearance of coating systems.
 - b. Check for holidays on interior steel immersion surfaces using holiday detector.
5. Report
 - a. Submit daily written reports describing work performed, inspections made, and actions taken to correct nonconforming work. Daily reports shall contain, but not be limited to, the following information:
 - 1) Start date and time of work in each area.
 - 2) Weather conditions.
 - 3) Date and time of application for each following coat.
 - 4) Moisture content of substrate prior to each coat.
 - 5) Provisions utilized to maintain temperature and humidity of work area with Manufacturer's recommended ranges.
 - b. Report nonconforming work not corrected.
 - c. Submit copies of report to Engineer and Contractor.

B. Manufacturer's Field Services

1. Manufacturer's representative shall provide technical assistance and guidance for surface preparation and application of coating systems and shall be available per paragraph 1.5.E.

3.18 CLEANING

- A. Remove temporary coverings and protection of surrounding areas and surfaces.

3.19 PROTECTION OF COATING SYSTEMS

- A. Protect surfaces of coating systems from damage during construction.

3.20 ONE-YEAR INSPECTION

- A. Owner will set date for one-year inspection of coating systems.
- B. Inspection shall be attended by Owner, Contractor, Engineer, and Manufacturer's representative.
- C. Repair deficiencies in coating systems as determined by Engineer in accordance with Manufacturer's instructions.

3.21 PIPE CODING

- A. All process piping shall be color-coded. Pipe color and band color, when required, shall be in accordance with the Color Schedule of this section.
- B. Bands shall be spaced at maximum 6 feet on center. On pipe runs less than 6 feet in length, one band shall be located at the center of the run.
 1. Place bands:
 - a. Along continuous lines.
 - b. At changes in direction.
 - c. At changes in elevation.
 - d. On both sides of an obstruction.
 2. Band width shall be as follows:
 - a. For pipes up to 8" in diameter: 2" minimum.

- b. For pipes 10" to 24" in diameter: 4" minimum.
- c. For pipes 30" to 48" in diameter: 6" minimum.
- d. For pipes greater than 48" in diameter: 8" minimum.

C. Pipe Labels

1. After painting of pipe work is completed, all pipe work shall have stenciled labels indicating the contents of the pipe (i.e. "RAW WASTEWATER").
2. Labels shall be placed on each side of the pipe (180 degrees from each other) and spaced at maximum 20 feet on center. Labels shall be placed such that they are in direct line of site. For pipe runs less than 20 feet, label shall be placed at the center of the run or the most visible location. Label may be omitted from one side of pipe if view is obstructed from that side.
3. When the flow in a pipe is in one direction at all times, flow direction arrows shall be placed in front of each label on the pipe.
4. The width of each letter shall be 80% of the height of each letter. The height of each letter shall be as follows:
 - a. For pipes ¾" to 1½" in diameter: ½" in height.
 - b. For pipes 2" in diameter: ¾" in height.
 - c. For pipes 2½" to 6" in diameter: 1¼" in height.
 - d. For pipes 6" to 10" in diameter: 2½" in height.
 - e. For pipes greater than 10" in diameter: 3½" in height.
5. For pipes smaller than ¾" in outside diameter, use a laminated plastic or aluminum tag with the lettering etched or stamped and filled in with black or contrasting enamel.
6. Labels shall be black or white in color such that it is contrasting with the primary pipe color.

D. Equipment Labels

1. Where specified or directed by the Engineer, the Contractor shall label, in the same manner as the pipe, the individual units of equipment such as blowers, pumps, collector drives, compressors, silencers, etc. All push buttons, starters, switches, etc., when remote from the equipment, shall have labels of the engraved plastic type affixed to or adjacent to the remote switch, push button, starter, etc.

3.22 COLOR SCHEDULE

- A. Colors shall be coordinated with the Owner's standard/existing color scheme. If the Owner does not have a standard color scheme, the following schedules shall be used.

B. Piping

Service	Pipe Color	Band Color
Raw Wastewater	Gray	None
Mixed Liquor Suspended Solids	Brown	None
Return Activated Sludge	Brown	Black
Waste Activated Sludge	Brown	Orange
Sludge Re-circulation (Discharge)	Brown	None
Reuse Water	Purple	None
Potable Water	Blue	None
Compressed Air	Green	None

C. OSHA Safety Colors

Service	Color
Fire Protection Equipment, Fire Boxes, Fire Extinguishers, Exit Signs, Fire Sprinkler Piping, Portable Containers of Flammable Liquid, Emergency Stop Bars.	Safety Red

Exposed Box Housings, Exposed Edges of Pulleys, Gears, Etc., Safety Starting Buttons.	Safety Orange
Unguarded Edges of Platforms, Elevated Door Edges, Bollards, Pulley Blocks, Material Handling Equipment.	Safety Yellow
First Aid Kits, First Aid Signs, First Aid Dispensaries, Drinking Water Stations	Safety Green

** END OF SECTION **

SECTION 10400
SIGNAGE

1 GENERAL

1.1 SCOPE

- A. Work covered by this section includes furnishing all materials, labor, and equipment required to install signage and accessories as specified herein and/or shown on the Drawings.

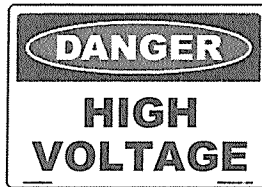
1.2 SUBMITTALS

- A. Submit complete shop drawings and engineering data in accordance with the requirements of Section 01300, Submittals.
- B. Submit a sample of the signage.

2 PRODUCTS

2.1 WARNING SIGNS

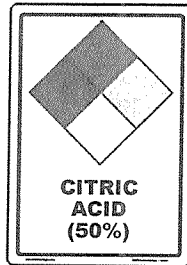
- A. Warning signs shall be 7-inches high by 10-inches wide.
- B. Sign shall be made of medium weight 0.040 aluminum with a long lasting finish.
- C. Suitable mounting holes shall be provided.
- D. Provide all mounting hardware. Hardware shall be type 316 stainless steel.
- E. The following sign (or a similar sign) shall be affixed to the outside of all new electrical room doors.



- F. The following signs (or similar signs) shall be affixed to the outside of all doors entering the blower room area in the new MBR Process Building and on the outside doors of the relocated generators.



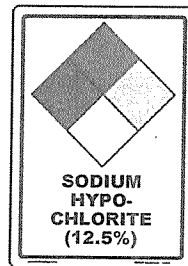
- G.
- H. The following signs (or similar signs) shall be affixed to the outside of the door entering the citric acid storage room in the new MBR Process Building.



Note: coordinate appropriate NFPA rating with chemical supplier.



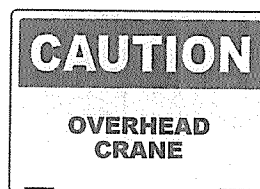
- I. The following signs (or similar signs) shall be affixed to the outside of the door entering the sodium hydroxide storage room in the new MBR Process Building.



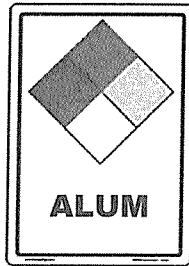
Note: coordinate appropriate NFPA rating with chemical supplier.



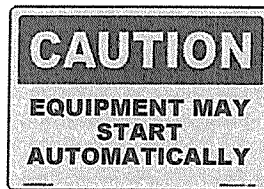
- J. The following sign (or a similar sign) shall be displayed on each side of the overhead bridge crane over the new membrane tanks and near the new monorail hoist inside the new MBR Process Building.



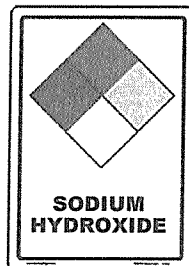
- K. The following signs (or similar signs) shall be affixed to the outside of the door of the alum chemical shelter. An NFPA sign shall also be located on the chemical storage tank.



Note: coordinate appropriate NFPA rating with chemical supplier.



- L. The following signs (or similar signs) shall be affixed to the outside of the door of the sodium hydroxide chemical shelter. An NFPA sign shall also be located on the chemical storage tank.



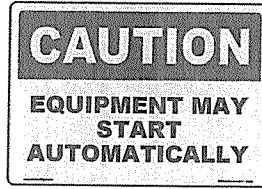
Note: coordinate appropriate NFPA rating with chemical supplier.



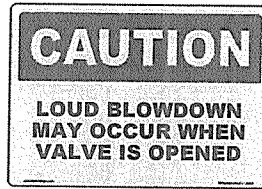
- M. The following sign (or a similar sign) shall be displayed on each side of the ultraviolet disinfection system area.



- N. The following sign (or a similar sign) shall be displayed by the new influent screens, new headworks equipment, and new plant water pump station.



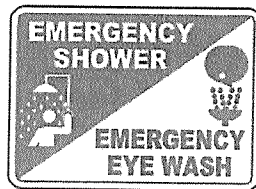
- O. The following sign (or a similar sign) shall be displayed at the new blow-off valve adjacent to the aerobic digester.



- P. The following sign (or similar sign) shall be displayed above all fire extinguishers. This sign is a 3-way sign with 180° visibility.



- Q. The following sign (or similar sign) shall be displayed at all new safety showers/eye wash stations.



2.2 WARNING LABELS

- A. Warning labels shall be adhesive type labels.
- B. The following label (or similar type label) shall be displayed on all electrical panels.



2.3 RESTROOM SIGNS

- A. Restroom signs shall be provided for each bathroom.
- B. Handicap accessibility shall be indicated where applicable.
- C. Signs shall be plastic with raised lettering.

2.4 EXIT SIGNS

- A. Exit signs shall be provided at all doors that exit to the exterior of the building and/or lead to the exterior of the building.

3 EXECUTION

3.1 INSTALLATION

- A. Signage shall be mounted straight, level, and plumb and shall be securely anchored.

** END OF SECTION **



SECTION 10522
FIRE EXTINGUISHERS AND ACCESSORIES

1 GENERAL

1.1 SCOPE OF WORK

- A. Furnish all labor, materials, equipment and incidentals required and install fire extinguishers with brackets and accessories as shown on the Drawings and as specified herein.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawing and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.

1.3 OPERATION AND MAINTENANCE DATA

- A. The contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with Section 01620, Storage and Protection.

1.5 QUALITY CONTROL

- A. Fire extinguishers shall be Underwriters Laboratories (UL) approved.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers include:
 - 1. J.L. Industries
 - 2. Kidde
 - 3. Or equal

2.2 GENERAL

- A. Fire extinguishers shall be tri-class chemical fire extinguishers with drawn aluminum or steel cylinder, squeeze handle with locking pin, nozzle assembly with pressure gauge, and heavy duty corrosion resistant wall bracket suitable for use in a vibrating environment.
- B. Fire extinguishers shall be suitable for operation over a temperature range of -40°C to +120°C.

2.3 FIRE EXTINGUISHERS

- A. Fire extinguishers located in the administration building shall be rated minimum 2A, 20B:C and shall be charged with 6 pounds of ammonium phosphate.
- B. All other fire extinguishers shall be rated minimum 4A, 60B:C and shall be charged with 10 pounds of ammonium phosphate.

2.4 IDENTIFYING SIGNS

- A. See Section 10400, Signage.

3 EXECUTION

3.1 INSTALLATION

- A. Fire extinguishers and brackets shall be installed at the locations shown and as directed.
- B. Mount brackets 4'-6" above finished floor with expansion bolts into masonry.

C. All fire extinguishers shall be inspected and certified within 30 days of start-up.

** END OF SECTION **

SECTION 10650
BATHROOM ACCESSORIES

1 GENERAL

1.1 SCOPE

- A. Work covered by this section includes furnishing all materials, labor, and equipment required to furnish and install restroom accessories as specified herein and/or shown on the Drawings.

1.2 SUBMITTALS

- A. Submit complete shop drawings and engineering data in accordance with the requirements of Section 01300, Submittals.

1.3 PRODUCT DELIVERY AND STORAGE

- A. Accessories shall be stored and protected in accordance with the requirements of Section 01620, Storage and Protection.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Bradley Corporation
 - 2. Bobrick Washroom Equipment, Inc.
 - 3. Or equal

2.2 TOWEL DISPENSER/WASTE RECEPTACLE

- A. Towel dispenser/waste receptacle shall be semi-recessed type, Bradley Model 2017-10, or equal.
- B. Install one (1) towel dispenser/waste receptacle in each bathroom.

2.3 MIRROR

- A. Mirror shall be 24-inch wide by 36-inch high fixed tilt frame mirror, Bradley Model 740, or equal.
- B. Install one (1) mirror over each sink.

2.4 SHELF

- A. Six-inch deep surface mounted shelf shall be Bradley Model 756, or equal.
- B. Install one (1) shelf over each sink.

2.5 SOAP DISPENSER

- A. Surface mounted liquid soap dispenser shall be Bradley Model 6562, or equal.
- B. Install one (1) soap dispenser at each sink. Adjacent sinks can have one dispenser located in between the sinks.

2.6 TOILET TISSUE DISPENSER

- A. Toilet tissue dispenser shall be surface-mounted, hinged hood, single roll toilet tissue dispenser, Bradley Model 5106, or equal.
- B. Install one (1) toilet tissue dispenser at each toilet.

2.7 GRAB BARS

- A. Grab bars with standard finish shall be Bradley Model 812, or equal.

- B. Install two (2) at each ADA toilet.

2.8 RESTROOM PARTITIONS

- A. Floor-braced restroom partitions.
- B. One-inch thick 22-gauge powder coated steel panels, color to be selected from manufacturers standard colors.
- C. Chrome plated brackets and door hardware (latch, coat hook, door pull, bumpers, etc.).
- D. Thirty-two inch, outward opening doors.
- E. Eighteen-inch deep, wall hung urinal screen.
- F. Bradley Series 500, or equal.

3 EXECUTION

3.1 INSTALLATION

- A. Contractor shall install bathroom accessories in accordance with manufacturer's written instructions.
- B. Dented materials shall be replaced.

** END OF SECTION **

SECTION 11100
GENERAL EQUIPMENT STIPULATIONS

1 GENERAL

1.1 SCOPE

- A. These General Equipment Stipulations apply, in general, to all equipment and piping as explained herein.

1.2 COORDINATION

- A. The Contractor shall assume full responsibility for the coordination of the installation of all equipment, materials and products furnished under these Contract Documents. The Contractor shall be completely responsible for verification that all structures, piping and equipment components furnished by him and/or his Subcontractors and Suppliers are compatible. The Contractor shall start up each equipment system and shall make all necessary adjustments to place each system in proper operating condition.

1.3 ADAPTATION AND LOCATION OF EQUIPMENT

- A. Equipment shall be readily adaptable for installation and operation in the structures to be constructed under other Contracts. No responsibility for alteration of a planned structure to accommodate other types of equipment will be assumed by the Owner. Equipment which requires alteration of the structures will be considered only if the Contractor assumes all responsibility for making and coordinating all necessary alterations. All such alterations shall be made at the Contractor's expense.
- B. The Contractor shall install the work in such manner that the equipment, piping, vents, conduit, panels, ductwork, etc., be as neatly installed and out-of-the-way as physically possible. All equipment, piping, ductwork, conduit, etc., shall be installed to provide needed maintenance and passage space.

1.4 PATENT ROYALTIES

- A. All royalties and fees for patents covering materials, articles, apparatus, devices, or equipment shall be included in prices bid by the Contractor.

1.5 EQUIPMENT GUARANTEE

- A. The Contractor and equipment manufacturer shall guarantee all equipment against faulty or inadequate design, improper assembly or erection, defective materials, breakage or other failure. Manufacturers of equipment included in these specifications shall warrant the units being supplied to the Owner against defects in workmanship and material under normal use, operation and service for a period of 1 year from the date of final acceptance of the work by the Owner unless an extended warranty is otherwise specified under individual equipment sections.
- B. The Contractor shall furnish and replace, without cost to the Owner, all equipment parts that are defective or show undue wear within the warranty period.
- C. The Warranty shall be in a printed form and apply to all components of the unit supplied by the Manufacturer.

1.6 WORKMANSHIP AND MATERIALS

- A. All equipment shall be designed, fabricated, and assembled in accordance with the best modern engineering and shop practice. Individual parts shall be manufactured to standard sizes and gauges so that repair parts, furnished at any time, can be installed in the field. Like parts of duplicate units shall be interchangeable. Equipment shall be new and shall not have been in service at any time prior to delivery, except as required by tests. All bolts, nuts, fastenings, pipe and fittings shall be manufactured in conformance with the United States system of measurement.
- B. Materials shall be suitable for service conditions. Iron castings shall be tough, close grained, gray iron free from blowholes, flaws, or excessive shrinkage and shall conform to

ASTM A 48, Class 30 minimum. Plugging of defective castings shall not be permitted. Castings shall be annealed to remove internal stresses prior to machining and shall have the mark number and heat number cast on them.

- C. Except where otherwise specified, structural and miscellaneous fabricated steel used in items of equipment shall conform to the Standards of the American Institute of Steel Construction. All structural members shall be considered as subject to shock or vibratory loads.
- D. All replaceable or expendable elements such as filters, screens, drive belts, fuses, indicator lamps, etc., shall be easily accessible and replaceable without need of dismantling equipment or piping. All such items shall be of a standard type that is readily available from multiple suppliers.
- E. Threaded openings for drains or vents in pump volutes, compressor or fan scrolls, air receivers, and heat exchangers which are plugged during normal operation shall be provided with stainless steel plugs.

1.7 LUBRICATION AND LUBRICATION FITTINGS

- A. Equipment shall be adequately lubricated by systems which require attention no more frequently than weekly during continuous operation. Lubrication systems shall not require attention during start up or shut down and shall not waste lubricants.
- B. Lubricants of the type recommended by the equipment manufacturer shall be provided in sufficient quantity by the Contractor to fill all lubricant reservoirs and to replace all lubricants consumed during testing, start up, and initial operation. The Contractor shall provide sufficient quantities of lubricants to lubricate all equipment for one year of normal service before final acceptance of the equipment will be made by the Owner.
- C. Where special run-in oil or storage lubricants are used, they shall be flushed out and replaced with the required service lubricant by the Contractor.
- D. Tag each piece of equipment with cloth tag showing proper type lubricant, period between lubrications, date of lubrication, and worker's initials. Have space for ten lubrication notations.
- E. Except for rotating shaft couplings, all lubrication fittings shall be brought to the outside of all equipment so that they are readily accessible from the outside without the necessity of removing covers, plates, housings, or guards. Fittings shall be accessible from safe, permanent platforms or walk areas. Fittings shall be of the bull-neck, check type for use with a portable high pressure grease gun. Connection from a remote fitting to the point of use shall be with minimum 3/16-inch stainless steel tubing, securely mounted parallel to equipment lines and protected where exposed to damage.

1.8 ELECTRIC MOTORS

- A. Unless otherwise required by the detailed equipment specifications, motors furnished with equipment shall comply with the following:
 - 1. Motors shall be designed and applied in compliance with NEMA, ANSI, IEEE, and AFBMA standards and the NEC for the specific duty imposed by the driven equipment.
 - 2. Where frequent starting occurs, motors shall be designed for frequent starting duty equivalent to the duty service required by the driven equipment.
 - 3. All motors shall be rated for continuous duty at 40°C ambient. Motor temperature rise above 40°C ambient on continuous operation at nameplate horsepower shall not exceed the NEMA limit for 1.0 service factor and Class B insulation.
 - 4. Motors shall be designed for full voltage starting. Motors shall operate under a ±10 percent voltage variation and ±5 percent frequency variation.
 - 5. Motor-bearing life shall be based upon the actual operating load conditions imposed by the driven equipment.
 - 6. Motors shall be sized for the altitude at the location where the equipment is to be installed.

7. Motors shall be sized so that, under maximum continuous load imposed by the driven equipment, the motor nameplate horsepower for continuous operation in 40°C ambient is at least 15 percent more than the driven load. Continuous equipment load shall not exceed 87 percent of motor nameplate horsepower, whether motor service factor is 1.0 or higher.
 8. Where the detailed specifications call for encapsulated motor windings, the motor shall have a sealed insulation system designed for a more severe environment than usual varnish treatments can withstand. The insulation system shall be General Electric "Polyseal", Allis-Chalmers "Poxeal", U. S. Motors "Everseal", or equal. Motors in this case may be single voltage rated.
 9. Motors shall have a clamp-type grounding terminal inside the motor conduit box.
 10. Motors with external conduit boxes shall have oversized conduit boxes.
 11. Motors in occupied areas shall be quiet rated and so marked.
- B. It is the intent of this general specification to allow the manufacturer's standard motor on integrally-constructed, motor-driven equipment such as appliances, hand tools, etc., that is specified by model number in which a redesign of the complete unit would be required for a motor with other features as may be specified herein.
 - C. Unless otherwise required by the detailed equipment specifications, motors within the horsepower ranges indicated below shall be rated and constructed as follows:
 1. Below 3/4 horsepower:
 - a. 115-volt, 60-hertz, single phase
 - b. Totally enclosed, fan-cooled
 - c. Permanently lubricated, sealed bearings
 - d. Built-in manual-reset thermal protector; or furnished with integrally mounted stainless steel enclosed manual motor-overload switch
 2. 3/4 to 1 horsepower:
 - a. 230/460-volt, 60-hertz, 3-phase
 - b. Totally enclosed, fan cooled
 - c. Specially insulated for use in damp locations below 20°C
 - d. Grease-lubricated, antifriction bearings.
 3. 1½ horsepower and above:
 - a. 230/460-volt, 60-hertz, 3-phase
 - b. Totally enclosed, fan-cooled
 - c. Specially insulated for use in damp locations below 20°C
 - d. Grease-lubricated antifriction bearings or oil-lubricated sleeve bearings
 - e. Vertical motors shall have 15-year average-life thrust bearings.
 - D. Any motor, installed in a wet-well, in an area which is physically connected to a wet-well, or in an area that is classified Class 1, Division 1 shall be explosion proof.
 - E. Any motor installed in a classified area shall be designed to operate in the specific classified environment.

1.9 DRIVE UNITS

- A. Except when specified otherwise in the detailed equipment specifications, 87 percent of the nameplate horsepower rating of each drive motor shall be at least equal to the theoretical brake horsepower required to drive the equipment under full load, including all losses in speed reducers and power transmission.

- B. The nominal input horsepower rating of each gear or speed reducer shall be at least equal to the nameplate horsepower of the drive motor.
- C. Drive units shall be designed for 24-hour continuous service and shall be constructed so that oil leakage around shafts is precluded.
- D. Gear Motors
 - 1. Gear motors shall be rated AGMA Class II and shall bear an AGMA nameplate.
- E. Gear Reducers
 - 1. Each gear reducer shall be totally enclosed, oil lubricated, with antifriction bearings throughout. Worm gear reducers shall have a service factor of at least 1.25. Shaft-mounted gear reducers shall be rated AGMA Class II. Other helical, spiral bevel, and combination bevel-helical gear reducers shall have a service factor of at least 1.40. Each gear reducer shall bear an AGMA nameplate or the manufacturer shall certify that the gear reducer is designed and rated in accordance with AGMA standards.
- F. Chain Drives
 - 1. Chain drives shall utilize roller chain having an ultimate strength of not less than 10 times the maximum working load.
- G. V-Belt Drives
 - 1. Each V-belt drive shall include a sliding base or other suitable tension adjustment. Fixed ratio V-belt drives shall have a service factor of at least 1.5 based on motor nameplate horsepower.
- H. Couplings
 - 1. Couplings between motors and drives or between drives and the driven equipment shall have a service factor of not less than 1.25 based on motor nameplate horsepower. Couplings between drives and the driven equipment shall have a service factor not less than that of the drive based on motor nameplate horsepower. All couplings rotating at speeds less than 900 rpm shall be of all steel construction. In general, couplings shall be of the tapered grid steel spring type or the crowned gear type.
- I. Overtorque Protection
 - 1. All low speed, high torque drives for equipment such as mechanical screens, conveyors, and clarifier and thickener mechanisms shall be protected against excessive torque by means of a suitable overtorque protection device. Acceptable devices shall include torque switches, shear pins, shear keys, and full-release torque couplings. Torque limiting couplings using sliding surfaces or friction to limit torque shall not be used.

1.10 SAFETY GUARDS

- A. All belt or chain drives, fan blades, couplings, and other moving or rotating parts shall be covered on all sides by a safety guard. Safety guards shall be fabricated from 16 USS gauge or heavier galvanized or aluminum-clad sheet steel or ½-inch mesh galvanized expanded metal. Each guard shall be designed for easy installation and removal. All necessary supports and accessories shall be provided for each guard. Supports and accessories, including bolts, shall be galvanized. All safety guards in outdoor locations shall be designed to prevent the entrance of rain and dripping water. All safety guards shall comply with OSHA General Industry Standards, Part 1910, Subpart O, Machinery and Machine Guarding. Provide tachometer access on shaft ends.

1.11 ANCHOR BOLTS

- A. Equipment suppliers shall furnish suitable anchor bolts for each item of equipment. Anchor bolts, together with templates or setting drawings, shall be delivered sufficiently early to permit setting the anchor bolts when the structural concrete is placed. Two nuts and two washers shall be furnished for each bolt. Anchor bolts to be embedded in concrete shall be provided with sufficient threads to permit a nut and washer to be installed on the concrete

side of the concrete form or supporting template, but in no case shall bolts be threaded less than 2 inches. Anchor bolts used in anchoring rotating or vibrating equipment shall be provided with suitable lock washers.

- B. Unless otherwise shown or specified, anchor bolts for items of equipment mounted on baseplates shall be long enough to permit a minimum of one inch of grout beneath the baseplate and to provide adequate anchorage into structural concrete. Individual, embedded anchor bolts for heavy equipment shall be centered in a steel pipe sleeve having an inside diameter approximately two times the bolt diameter and an embedded length approximately 8 times the bolt diameter.
- C. Bolts specified to be bent shall be bent cold. Bend radius shall not be less than twice the bolt diameter. Unless otherwise shown or specified, anchor bolts shall be embedded in concrete a minimum distance of 15 times the bolt diameter. Unless otherwise shown or specified, all anchor bolts shall be at least ½-inch in diameter.
- D. All embedded anchor bolts or anchor bolt materials shall be ASTM A 276, Type 316 stainless steel threaded per ANSI B1.1. Nuts shall be heavy hex nuts, ANSI B18.2, semifinished pattern, and shall be ASTM A194 Grade 316 stainless steel. Flat washers shall be Type 316 stainless steel.
- E. Adhesive anchors shall be used to anchor equipment to existing concrete. Anchors shall be stainless steel, Type 316. Installation methods shall be in conformance with the manufacturer's recommendations for maximum pullout and shear strength, but in no case shall the depth of the hole be less than 8 bolt diameters or 3 inches, whichever is greater. The minimum distance between the center of any expansion anchor and an edge or exterior corner of concrete shall not be less than 5 times the diameter of the hole in which it is installed. The minimum distance between adjacent anchors shall not be less than 10 times the diameter of the hole in which it is installed.

1.12 EQUIPMENT BASES

- A. All equipment shall be installed on a raised reinforced concrete base. The base shall be a minimum of 4 inches in height and shall extend a minimum of 2 inches beyond the equipment baseplate on all sides.
- B. The electrical contractor shall be instructed concerning electrical conduit locations prior to pouring the concrete base.
- C. Unless otherwise specified, a cast iron or welded steel baseplate shall be provided for each pump, compressor, and any other item of equipment which is to be installed on a concrete base. Each unit and its drive assembly shall be supported on a single baseplate of neat design. Baseplates shall have pads for anchoring all components and adequate grout holes. Baseplates for pumps shall have a raised lip all around and a threaded drain connection. Baseplates shall be anchored to the concrete base with suitable anchor bolts and the space beneath filled with epoxy or non-shrink grout as specified in the grouting section.
- D. On direct coupled equipment, motor and driven equipment shall be doweled to a common base with a minimum of two dowels each.

1.13 ALIGNMENT OF MOTORS AND EQUIPMENT

- A. In every case where a drive motor is connected to a driven piece of equipment by a flexible coupling, the coupling halves shall be disconnected and the alignment between the motor and the equipment checked and corrected. Machinery shall first be properly aligned and leveled by means of steel wedges and shims or jacking screws near anchor bolts. Anchor bolts shall be tightened against the shims, wedges, or jacking screws and the equipment shall again be checked for level and alignment before placing grout. Wedges shall not be placed between machined surfaces.
- B. In general, checking and correcting the alignment shall follow the procedures set up in the Standards of the Hydraulic Institute, Instructions for Installation, Operation, and Maintenance of Centrifugal Pumps. Equipment shall be properly leveled and brought into angular and parallel alignment.

- C. Equipment shall be installed in such a way that no strain is transmitted to the equipment by piping systems or adjacent equipment.

1.14 GROUTING

- A. A special epoxy, non-shrink grout shall be used in the placement of all pump, motor, and equipment baseplates or bedplates, column baseplates, other miscellaneous baseplates, and other grouting applications as shown on the Drawings. Grouting materials and installation shall be as specified in Section 03600, Grout.

1.15 WELDING AND BRAZING

- A. All welds shall be sound and free from embedded scale and slag. All butt welds shall be continuous and where exposed to view shall be ground smooth. All continuous welds shall be gas and liquid-tight. Welds in piping shall have full penetration and shall be smooth on the inside of the pipe. Intermittent welds shall have an effective length of at least 2 inches and shall be spaced not more than 6 inches apart.
- B. All welding of steel and aluminum, including materials, welding techniques, general safety practices, appearance and quality of welds, and methods of correcting defective work, shall conform to the latest requirements of AWS Specifications. Structural steel welding shall conform to the requirements of the AWS Structural Welding Code. The general recommendations and requirements of the AWS Structural Welding Code shall also apply to welded aluminum structures. The welding process and welding operators shall meet qualification tests and welding performance tests in accordance with the latest provisions of ASME Boiler and Pressure Vessel Code, Section IX, Welding and Brazing Qualifications. Welding process and qualification procedures for welding of pipe shall conform to the latest requirements of ANSI B31.1, Section 327, Welding, and Section 328, Brazing and Soldering. All welding qualification tests shall be witnessed by the Engineer, except as provided herein. All costs associated with the qualification or testing of welders and welding operators shall be borne by the Contractor.
- C. Actual welding procedures to be used in field assembly and installation of equipment furnished under this Contract shall be submitted to the Engineer for approval prior to beginning the work. Reports certifying that the welding procedures, welders, and welding operators that the Contractor intends to use are qualified as specified above shall also be submitted to the Engineer prior to beginning the work. In the case of welder qualifications for shop welding and for carbon steel field welding, welders presenting certified qualification papers validated within the preceding 6-month period and acceptable to the Engineer will not be required to take the qualification tests. In the case of field welding of stainless steel or aluminum, all welders shall be required to take the qualification tests regardless of past experience or availability of certified qualification papers.
- D. Field welding practices shall conform to OSHA construction standards, Part 1926, Subpart J, Welding and Cutting. Shop welding practices shall conform to OSHA General Industry Standards, Part 1910, Subpart Q, Welding, Cutting, and Brazing.
- E. Welding electrodes for structural steel shall conform to the standard recommendations of the AISC. Welding electrodes for stainless steel shall conform to applicable AWS Specifications and shall be as recommended by "Welded Austenitic Chromium-Nickel Stainless Steels, Techniques and Properties", published by the International Nickel Company, New York, New York. Welding electrodes for aluminum shall conform to applicable AWS Specifications.
- F. Each welder and welding operator must identify his welds with his assigned symbol.
- G. Welders performing unsatisfactory work shall be removed from the welding process.
- H. The Owner may inspect any weld by radiographic or other means. Welds not in accordance with the requirements specified herein shall be repaired or replaced at the Contractor's expense. Excessive porosity, nonmetallic inclusions, lack of fusion, incomplete penetration, and cracking shall constitute grounds for rejection of welds.

1.16 ERECTION AND SETTING

- A. In the erection and setting of all fabricated equipment, the Contractor shall exercise care to ensure that each item of equipment is adequately supported so as not to bend or distort under its own weight until adequate foundation support and anchorage are provided. Where lifting lugs, angles or clips are provided on equipment, they shall be used in erecting and setting the equipment. Erection and setting of equipment and structural steel shall conform to the requirements of OSHA Construction Standards, Part 1926, Subpart R, Steel Erection, Subpart H, Material Handling, Storage, Use, and Disposal, and Subpart N, Cranes, Derricks, Hoists, and Conveyors. Erection of structural steel shall conform to the latest requirements of the AISC Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings.
- B. During placement and prior to any grouting or connection of adjacent piping the equipment shall be leveled and aligned true to level, plumb, alignment, and grade with all parts bearing or fitting the structure or equipment accurately and securely. It shall not be permitted to cock out of alignment, redrill, reshape, or force fit any fabricated items.
- C. The Contractor shall take all measurements necessary to properly fit his work in the field, and he shall be governed by and responsible for these measurements and the proper working out of all details. The Contractor shall be responsible for the correct fitting of all work in the field and the accurate placement of all anchor bolts installed by him.
- D. The Contractor shall bring all parts to be erected or assembled into close contact. Before assembly, all surfaces to be in contact with each other shall be thoroughly cleaned. Drift pins may be used only for bringing members into position, never to enlarge or distort holes. Torching or burning of holes or cutting of fabricated items to correct misalignment or shop errors shall not be permitted. Enlargement of holes necessary to make field connections shall be done only with the Engineer's approval by reaming with twist drills and in a manner acceptable to the Engineer.
- E. All equipment shall be furnished with suitable eyebolt lifting lugs or lifting angles to facilitate handling.

1.17 SPECIAL TOOLS AND ACCESSORIES

- A. Equipment requiring periodic repair and adjustment shall be furnished complete with all special tools, instruments, and accessories required for proper maintenance. Special tools and accessories shall include those tools and accessories not normally available in an industrial hardware or mill supply house. Equipment requiring special devices for lifting or handling shall be furnished complete with those devices.

1.18 SHOP PRIMING AND PAINTING

- A. All equipment shop priming and painting, including surface preparation, workmanship and materials, shall be as specified in Section 09900, Painting.

1.19 FIELD PRIMING

- A. All iron and carbon steel surfaces not specified to be galvanized or shop primed and all ferrous or nonferrous surfaces specified to be field primed and painted shall be coated in the field with one or more coats of primer in accordance with the requirements of Section 09900, Painting.

1.20 FIELD PAINTING

- A. Except for interior surfaces of vessels and enclosed equipment not specified to be field painted, all ferrous and nonferrous surfaces of equipment which have received one or more coats of shop or field applied primer shall be field painted after installation in accordance with the requirements of Section 09900, Painting.

1.21 GALVANIZING

- A. All galvanizing shall be done by the hot-dip process after fabrication in conformity with requirements of ASTM A123, A153, A384, and A385. Articles to be galvanized shall be pickled before galvanizing.

- B. Where galvanized bolts are specified or required by the Drawings, cadmium or zinc plated bolts will be acceptable provided cadmium plating conforms to ASTM A165, Type NS, and zinc plating conforms to ASTM A164, Type GS.
- C. Areas of galvanizing damaged by welding or burning or otherwise damaged shall be thoroughly stripped and cleared and recoated with zinc to the required thickness by the hot dip process.
- D. Galvanized articles shall be free from uncoated spots, blisters, flux, black spots, dross, projections, and other defects not consistent with acceptable galvanizing practice.
- E. Zinc and cadmium plating shall be subject to visual examination to determine uniformity of coating. The Engineer may require that the coating uniformity be tested in accordance with ASTM A 239.

1.22 PROTECTION AND STORAGE

- A. All equipment shall be boxed, crated, or otherwise completely enclosed and protected during shipment, handling, and storage. All equipment shall be protected from exposure to the elements and shall be kept thoroughly dry at all times. Compressors, blowers, pumps, motors, valves, control panels, instrumentation, electrical equipment, and other equipment having antifriction or sleeve bearings shall be stored in weathertight warehouses which are maintained at a temperature of at least 60°F. Other equipment may be stored outside under cover. All equipment shall be stored above ground level and adequately supported on wood blocking or other approved support material. Printed storage instructions of the manufacturers shall be strictly adhered to.
- B. Painted, anodized, or otherwise coated surfaces shall be protected against impact, abrasion, discoloration, and other damage. All coated surfaces which are damaged prior to acceptance of equipment shall be cleaned and coated to the satisfaction of the Engineer with the same or equivalent coating used in the original application.
- C. Electrical equipment, motors, controls, and insulation shall be protected against moisture or water damage. All space heaters provided in the equipment shall be kept connected and operating at all times until equipment is placed in service. Electrical equipment stored without space heaters shall be provided with desiccants to protect against moisture damage. Desiccant shall be silica gel in porous bags at not less than one ounce per cubic foot of volume. Desiccant shall be replaced periodically.
- D. Electrical equipment and instrumentation shall be stored in a location that is free from excessive or injurious amounts of vibration.
- E. Rotating equipment such as pumps, motors, fans, and compressors shall be rotated periodically. In the absence of specific exercising instructions by the equipment manufacturer, each item of rotating equipment shall be rotated a minimum of 10 revolutions at intervals not to exceed 20 days. When shafts are too difficult to rotate by hand, nonmetallic grips shall be used to turn the shafts.
- F. Vehicles such as trucks, forklifts, tractors, lawn mowers, and other engine-powered equipment shall be started up and operated at intervals not to exceed 15 days. Equipment shall be run until engine temperatures and pressures are in normal operating ranges. All lifting, lowering, tilting, loading, and unloading accessories shall be operated at least once during the exercise period. Equipment shall be moved under power from the parked position and run a sufficient distance so as to ensure proper lubrication of drive train and suspension components. All operators employed to exercise the vehicles shall be qualified and thoroughly familiar with the proper operation of the equipment. Forklifts, tractors, lawn mowers, and other small engine-powered equipment shall be stored indoors in garages or other suitable structures. Trucks stored outdoors shall be washed using approved materials at intervals not to exceed 15 days. All exercising and storage of vehicular equipment shall be conducted in a manner acceptable to the Engineer.
- G. Interiors of gear and bearing cases housing oil-lubricated gears and bearings shall be filled with a rust inhibiting oil prior to storage or, if extended storage is anticipated, coated periodically with a rust inhibiting oil mist at intervals of time acceptable to the Engineer.

Interiors of large pumps and compressors shall be protected using vapor phase inhibitor paper or porous bags of rust inhibiting, vapor emitting crystals. Exposed shafts shall be coated with rust preventative compound then wrapped with oil-impregnated paper and polyethylene film and sealed with waterproof tape prior to shipment.

- H. Individually packaged, unpainted steel parts shall be protected by a wrapping of vapor phase inhibiting or oil-impregnated paper and polyethylene film prior to shipment.
- I. Parts and equipment not requiring periodic inspection or maintenance shall be stored unopened in their original packaging until used.
- J. Parts, instruments, controls, and small items of equipment shall be stored above ground or floor level on suitable shelves or racks in a heated, watertight warehouse.
- K. Flanged openings on equipment shall be covered with suitable solid wooden or metal blanks securely bolted to the flange using a minimum of four bolts and a suitable rubber gasket. Ends of threaded pipe and fittings shall be sealed watertight with metal or plastic caps. Threaded openings shall be sealed watertight with metal or plastic plugs. Other openings shall be sealed with two layers of 6-mil polyethylene securely taped in place with waterproof tape.
- L. A maintenance log on each item of mechanical and electrical equipment requiring periodic attention in storage shall be maintained by the Contractor. Oil and grease changes, exercising, desiccant replacement, nitrogen purge checks, heater checks, insulation checks, and other periodic maintenance shall be entered in the log. The maintenance log shall be made available to the Engineer on request.
- M. A resistance test shall be performed on all motor windings and heater elements following storage and prior to installation as a check for insulation deterioration or moisture damage during storage.
- N. Immediately prior to installation, equipment shall be cleaned of any protective coatings used during storage and any rust, dirt, grit, or other foreign material shall be removed.
- O. After installation and prior to start-up, all grease-lubricated joints, shaft couplings, and bearings shall be flushed out and re-greased. All oil reservoirs and sumps shall be completely drained and flushed and refilled with the proper lubricant. Screens and filters shall be checked for contamination and replaced if necessary. The equipment shall then be tagged, signed, and dated, indicating that the equipment has been properly lubricated for start-up.
- P. After storage, rubber parts such as valve seats, diaphragms, expansion joints, gaskets, hoses, and shaft couplings shall be checked for hardening or cracking. Deteriorated parts shall be replaced prior to start-up by the Contractor at his own expense.

1.23 VIBRATION TESTING

- A. Unless specified otherwise in the detailed equipment specifications, each pump, blower, compressor, motor, or similar item of stationary rotating equipment having a rated power in excess of 50 hp or an operating speed in excess of 1,800 rpm shall be tested in the field for acceptable vibration levels. Vibration testing shall be performed by an experienced, factory-trained and authorized vibration analysis expert (not a sales representative) retained by the Contractor for this work. Each unit or pump system shall be tested separately without duplicate equipment running. All field testing shall be done in the presence of the Engineer. The Engineer shall be furnished with four (4) certified copies of vibration test data for each test performed.

1.24 PRESSURE AND TEMPERATURE GAUGES

- A. The Contractor shall furnish a compound liquid-filled pressure/vacuum gauge on the suction and a liquid-filled pressure gauge on the discharge of each pump, compressor, and blower. Gauges shall be 4 to 5 inches in diameter with phenolic cases and clear shatter-proof lenses. Gauges shall have a white background and black pointers and characters. Maximum scale reading shall be approximately twice the maximum operating pressure of the fluid being measured. Accuracy shall be ± 2 percent. The operating mechanism shall

be of the Bourdon type with positive protection against any solids contamination of the operating mechanism provided. Pressure gauges shall be provided with NPT connections and shall be isolated from the liquid inside the piping with isolating diaphragm seals and gauge cocks. Pressure gauges on rotary or reciprocating equipment shall be provided with pressure snubbers.

- B. Unless otherwise specified, the Contractor shall furnish a bi-metallic temperature gauge on the discharge of each air compressor or blower. Temperature gauges shall be approximately 5 inches in diameter with stainless steel case and white background and black pointers and characters. All temperature gauges shall have a range of 0-250°F unless otherwise required for process conditions. Accuracy shall be ± 1 percent. Temperature gauges shall be furnished with stainless steel thermowells and NPT connections.
- C. Pressure gauges for steam service shall have stainless steel case and shall be equipped with pigtail siphon.

1.25 LIMIT SWITCHES AND SENSORS

- A. Unless otherwise specified, limit switches on equipment shall be of the heavy-duty, precision type with NEMA 4 steel enclosure and standard pretravel lever or plunger operator as required. Limit switches shall have SPDT or DPDT contacts rated not less than 5 amps inductive, 10 amps resistance at 120 volts AC. Limit switches in hazardous locations shall be enclosed in a cast aluminum, explosion-proof enclosure.
- B. Unless otherwise specified, pressure switches shall be of the snap-acting type with internal adjustment and shock-resistant, cast, waterproof enclosure. Contacts shall be SPDT or DPDT rated minimum 15 amps at 125 volts AC. Switch operation shall be by means of a teflon diaphragm or a Type 316 stainless steel bellows, depending on pressure range. All wetted parts shall be of brass or stainless steel. Switch shall have a repeatability of ± 1 percent of range or better. Switch shall be UL listed.
- C. Unless otherwise specified, temperature switches shall be of the non-indicating, snap-acting type with internal adjustment, oil-filled stainless steel sensing bulb, and shock resistant, cast watertight enclosure. Contacts shall be SPDT or DPDT rated minimum 15 amps at 125 volts AC. Switch shall be furnished with a separable stainless steel well. Switch shall be UL listed.

1.26 INSTALLATION CHECK

- A. An experienced, competent, and authorized service representative of the manufacturer of each item of equipment or other person acceptable to the Engineer shall visit the site of the work and inspect, check, adjust if necessary, and approve the equipment installation. In each case, the equipment manufacturer's representative or other person authorized by the Engineer to perform the installation check shall be present when the equipment is placed in operation and shall revisit the jobsite as often as necessary until all trouble is corrected and the equipment installation and operation are satisfactory in the opinion of the Engineer.
- B. Each equipment manufacturer's representative or other person authorized by the Engineer to perform the installation check shall furnish to the Owner, through the Engineer, a written report certifying that the equipment (1) has been properly installed and lubricated; (2) is in accurate alignment; (3) is free from any undue stress imposed by connecting piping or anchor bolts; and (4) has been operated under full load conditions and that it operated satisfactorily. The work described under these Contract Documents will not be accepted as complete until satisfactory installation certifications have been submitted in accordance with the requirements of this section.
- C. The Contractor shall properly coordinate the visits by the manufacturer's representatives, particularly where the operation of an item of equipment is dependent on the operation of other equipment. Prior to calling the manufacturer's representative, the Contractor shall ensure that all necessary related equipment, structures, piping, and electrical work is complete. The Contractor shall pay for any revisits to the site by the manufacturer's representative made necessary due to the Contractor's failure to properly coordinate the visits.

- D. The Contractor shall inform the Engineer of any impending visits of manufacturer's representatives at least 72 hours before the visits so that the Engineer can make arrangements to have his representative at the site to witness the installation check of the manufacturer's representative.
- E. The Contractor shall secure the services of the manufacturer's representative at the site of the work for as long as is necessary to check the installation and place the equipment in satisfactory operation.
- F. Electrical connections to equipment shall be made only upon approval of the manufacturer's representative.
- G. All costs for this work shall be included in the Contract Prices(s) and no separate payment will be made.

1.27 FIELD TESTING

- A. After installation and checkout, all equipment shall be field tested. During the field tests, the equipment shall be subjected to various full load and partial load conditions and emergency operating and shutdown conditions. The ability of the equipment to operate in the prescribed manner without overheating, jamming, excessive noise or vibration, or evidence of excessive wear shall be demonstrated to the satisfaction of the Engineer.
- B. All equipment shall be tested before it is covered or insulated. All accessory equipment which may be damaged by conditions during the test shall be isolated or otherwise protected.
- C. Should results of the tests indicate that the equipment has failed to perform in accordance with requirements of the applicable detailed equipment specification, in the opinion of the Engineer, the Contractor shall make at his own expense such modifications or adjustments as required for satisfactory operation, including replacement of any or all components, if necessary. Following the modifications or adjustments, the Contractor shall repeat the field tests as specified herein. This procedure shall be repeated until results of the field tests indicate that the equipment has satisfied the requirements of the applicable specification section.
- D. The cost of all field testing shall be included in the Contract Price(s) and no separate payment will be made.

1.28 IDENTIFICATION OF PIPING AND EQUIPMENT

- A. All piping and equipment shall be identified as follows:
 - 1. All equipment and piping specified to be painted shall be color coded. The colors shall be as specified in Section 09900, Painting. Insulated piping shall be identified using plastic bands, arrows, and letters, colored and sized in accordance with Section 09900, Painting.
 - 2. All major items of equipment shall have an identification nameplate. The Contractor shall submit a suitable list of all items of major equipment to the Engineer, who will furnish the Contractor with an identification numbering system. The nameplates shall be of Type 304 stainless steel, No. 6 finish, and not less than No. 16 gauge with indented stamped lettering. Nameplates shall be attached to equipment bases in easily visible and accessible locations. Nameplates shall be fastened in a permanent manner, arranged not to damage the equipment, with not less than four stainless steel fasteners. All nameplates shall contain as a minimum the following information, where applicable:
 - a. Name of equipment (from equipment specifications)
 - b. Manufacturer
 - c. Model designation
 - d. Rated horsepower
 - e. Service factor

- f. Electrical and insulation specifications
- g. Speed (rpm)
- h. Capacity and head (discharge pressure)
- i. Net weight
 - 1) Lettering shall be upper case, block style in size and spacing to suit the nameplate. A sample nameplate including fastenings shall be submitted to the Engineer for approval prior to manufacture of any of the nameplates. The identification nameplates shall not be painted.
- 3. All valves shall be identified with a round brass disc, approximately 1½ inches in diameter and not less than No. 14 gauge, coated with a clear lacquer. Discs shall be fastened to valves in a permanent manner; however, attachment by chain to handwheels or other operators shall not be acceptable. Discs shall be stamped using indented numerals and/or letters with a valve number corresponding to its identification number in the valve schedule to be included in the Operation and Maintenance Manual.
- 4. All pushbutton stations, switches, motor controllers, transmitters, and other control equipment shall have identification nameplates of the engraved, laminated plastic type affixed to or adjacent to the switch, pushbutton station, etc.
- 5. All manufacturer's nameplates, identification nameplates, and ASME code plates located on areas of equipment to be insulated shall be removed and reattached on uninsulated areas in a manner acceptable to the Engineer and in his presence.

1.29 WARNING SIGNS

- A. Permanent warning signs shall be furnished and installed on all mechanical and electrical equipment where a hazard exists as specified herein. Signs shall be made in accordance with OSHA requirements and shall be suitable for exterior use. Mounting details shall be in accordance with manufacturer's recommendations; location as approved by the Engineer. Fasteners shall be stainless steel.
- B. Warning signs shall be approximately 10 inches high by 14 inches wide, colored yellow and black, on minimum 0.080-inch aluminum stock.

** END OF SECTION **

SECTION 11202
FABRICATED GATES

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation fabricated stainless steel slide gates, sluice gates, weir gates, and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, as appropriate, to support the design of the equipment being provided.
 - 3. Calculations that provide a basis of design for each piece of equipment. Calculations shall justify the size and type of operator provided and shall be sealed by a registered professional engineer.
 - 4. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Fontaine
 - 2. Waterman
 - 3. Whipps, Inc.

2.2 DESIGN CRITERIA

A. Provide fabricated stainless steel slide gates as follows.

Tag Number	Gate Type	Size (WxH)	Oper. Floor Elev.	Invert Elev.	Head Elev. (Seating/ Unseating)	Mounting	Operator
SG-701	Self-Cont'd	48"x36"	801.00	794.25	797.25/ 794.75	Concrete Surface	Motorized
SG-702	Self-Cont'd	48"x36"	801.00	794.25	797.25/ 794.75	Concrete Surface	Motorized
SG-703	Self-Cont'd	48"x36"	801.00	794.25	797.25/ 794.75	Concrete Surface	Motorized
SG-704	Self-Cont'd	48"x36"	801.00	794.25	797.25/ 794.75	Concrete Surface	Motorized
SG-711	Self-Cont'd	48"x36"	801.00	793.58	796.58/ 794.08	Concrete Surface	Motorized
SG-712	Self-Cont'd	48"x36"	801.00	793.58	796.58/ 794.08	Concrete Surface	Motorized
SG-713	Self-Cont'd	48"x36"	801.00	793.58	796.58/ 794.08	Concrete Surface	Motorized
SG-714	Self-Cont'd	48"x36"	801.00	793.58	796.58/ 794.08	Concrete Surface	Motorized
20-FV-209-1	Self-Cont'd	48"x30"	793.50	789.92	796.00/ 790.42	Concrete Surface	Motorized
20-FV-209-2	Self-Cont'd	48"x30"	793.50	789.92	796.00/ 790.42	Concrete Surface	Motorized
20-FV-209-3	Self-Cont'd	48"x30"	793.50	789.92	796.00/ 790.42	Concrete Surface	Motorized
20-FV-209-4	Self-Cont'd	48"x30"	793.50	789.92	796.00/ 790.42	Concrete Surface	Motorized

B. Provide downward opening fabricated stainless steel slide gates as follows.

Tag Number	Gate Type	Size (WxH)	Oper. Floor Elev.	Invert Elev.	Head Elev. (Seating/ Unseating)	Mounting	Operator
SG-40-1	Self-Cont'd	24"x24"	792.43	787.10	789.10/ 787.10	Concrete Surface	Hand Crank

C. Provide fabricated stainless steel sluice gates as follows.

Tag Number	Gate Type	Size (WxH)	Oper. Floor Elev.	Invert Elev.	Head Elev. (Seating/ Unseating)	Mounting	Operator
SLG-75-1	Non Self-Cont'd	36"x36"	817.00	801.60	815.00/ 815.00	Concrete Surface	Hand Crank
SLG-75-2	Non Self-Cont'd	36"x36"	817.00	801.60	815.00/ 815.00	Concrete Surface	Hand Crank
SLG-75-3	Non Self-Cont'd	36"x36"	817.00	801.60	815.00/ 815.00	Concrete Surface	Hand Crank

D. Performance

1. Fabricated gates shall be substantially watertight under the design head conditions.
2. Leakage around fabricated gates and weir gates shall not exceed 0.05 gallons per minute per foot of seal periphery under the design seating and unseating head.

2.3 CONSTRUCTION

A. Fabricated Slide Gates and Weir Gates

1. General

- a. Fabricated slide gates and downward opening weir gates shall be manufactured in accordance with AWWA C513, latest edition.
- b. Fabricated full aperture sluice gates shall be manufactured in accordance with AWWA C561, latest edition.
- c. Gates and operators shall be manufactured out of the Type 316 stainless steel. All welded stainless steel shall be Type 316L.
- d. Gates shall be of the rising stem type.

2. Disc

- a. The disc shall consist of a flat plate reinforced with formed plates or structural members.
- b. The maximum deflection of the disc shall be $1/720$ th of its span under design head conditions.

3. Frame

- a. The gate frame shall be constructed of structural members or formed plates welded together to form a rigid frame.

4. Yoke

- a. Self contained gates shall have a yoke constructed of structural members or formed plates.
- b. The maximum deflection of the yoke shall be $1/360$ th of the gates span.

5. Seals

- a. Bottom and side seals shall be made of ultra high molecular weight polyethylene or specially molded neoprene.
- b. The sealing system shall maintain the specified leakage rate in both seating and unseating conditions.

6. Stems

- a. The operating stem shall be stainless steel designed to permit operation of the gate, under full operating head, with a maximum effort of 40 pounds on the crank or handwheel.
- b. The stem shall have a maximum slenderness ratio (L/r) of 200.
- c. Gates having a width equal to or greater than 2 times their height shall be provided with two lifting mechanisms connected by a tandem shaft.
- d. Gate stems shall have a gate stop that threads onto the stem and can be fixed in place with a set screw.

7. Stem Guides

- a. Stem guides shall be provided as required for gates.
- b. Stem guides shall be fabricated from Type 316 stainless steel with ultra-high molecular weight polyethylene bushings.

- c. Guides shall be adjustable and shall be spaced in accordance with the manufacturer's recommendation. The L/r ratio shall not be greater than 200.
8. Floor Stands
- a. Gates shall be provided with floor stands and wall mounting brackets as required to support the gate operator.
 - b. Floor stands and wall brackets shall be manufactured from Type 316 stainless steel.
9. Stem Covers
- a. Gates shall be provided with a clear polycarbonate stem cover with end cap and condensation vents.
10. Lifting Mechanisms
- a. Motorized Actuator
 - 1) Motorized actuator shall conform to AWWA C540 except, speed of operation shall be sufficient to open gates at 10 to 14 inches per minute.
 - 2) Motorized actuator shall operate with 480V, 3 phase, 60 hertz power.
 - 3) Control
 - a) Provide LOCAL/OFF/REMOTE (L/O/R) switch and OPEN/CLOSE/STOP pushbuttons.
 - (1) In the LOCAL position, the actuator shall open the gate when the OPEN pushbutton is pressed, close the gate when the CLOSE pushbutton is pressed, and stop when the STOP pushbutton is pressed.
 - (2) In the OFF position, the gate actuator shall stop and not operate.
 - (3) In the REMOTE position, the gate actuator shall open, close, and stop based on open and close commands from the plant SCADA system.
 - b) Provide OPEN/CLOSE limit switches.
 - c) Actuator shall be provided with the following minimum I/O contacts
 - (1) Provide output contacts for the following:
 - (a) Actuator OPEN status
 - (b) Actuator CLOSED status
 - (c) Common fault
 - (2) Provide input contacts for the following:
 - (a) Actuator OPEN command
 - (b) Actuator CLOSE command
 - 4) Motorized actuator shall be AUMA, or equal.
 - b. Hand Crank
 - 1) Hand crank shall be designed to open gate under maximum head conditions with a maximum effort of 40-pounds force on the crank.
 - 2) Crank shall be removable and fitted with a corrosion resistant rotating handle.
 - 3) The maximum crank radius shall be 15-inches.

3 EXECUTION

3.1 INSTALLATION

- A. Fabricated gates shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Fabricated gates shall be field tested after installation to demonstrate proper operation and checked for leakage. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

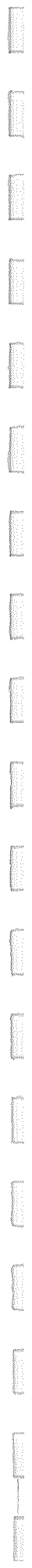
3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11207
PARSHALL FLUME

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section include furnishing all labor, materials, and equipment required to install fiberglass Parshall flume and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for two (2) years from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Tracom, Inc.
 - 2. Warminster Fiberglass Company
 - 3. Engineer Approved Equal

2.2 DESIGN CRITERIA

- A. General
 - 1. Provide one (1) 24-inch, one-piece, fiberglass reinforced plastic Parshall flume designed to measure flow from 0 to 21 MGD.
- B. Construction
 - 1. Parshall flume shall be manufactured out of fiberglass reinforced plastic.
 - 2. Parshall flume dimensions shall be in accordance with the United States Department of Interior, Water Measurement Manual, latest edition.

3. Laminate Properties
 - a. Minimum Glass Content: 25-percent
 - b. Minimum Tensile Strength (ASTM D638): 14,000 PSI
 - c. Minimum Flexural Strength (ASTM D790): 25,000 PSI
 - d. Minimum Flexural Modulus (ASTM D790): 1,000,000 PSI
 - e. Minimum Barcol Hardness (ASTM D2583): 40
4. Minimum 3/16" wall thickness.
5. Minimum 15 mil gel coat free from fiber pattern, roughness, and other irregularities.
6. Fiberglass shall have a UV inhibitor to prevent degradation of the fiberglass reinforced plastic.
7. Parshall flume color shall be white. Color shall be uniform through the entire thickness of the fiberglass reinforced plastic.
8. Parshall flume shall have integral stiffening ribs/flanges to make the flume self-supporting.
9. Parshall flume shall be provided with radius type inlet wing-walls.
10. Parshall flume shall be provided with a laminated, high-visibility staff gauge graduated in 1/10-foot, 1/100-foot, and MGD increments.

3 EXECUTION

3.1 INSTALLATION

- A. Parshall flume shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.

** END OF SECTION **

SECTION 11245
SUBMERSIBLE PUMPS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation submersible pumps and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, pump performance curves, mass moment of inertia calculations for the impeller, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Recommended locations of pump guide rail supports.
 - 4. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 5. Pump performance curves shall, at a minimum, depict the following.
 - a. Head vs. Capacity
 - b. RPM
 - c. Combined weight of pump and motor
 - d. Impeller diameter
 - e. Largest spherical solid that can be passed
 - f. Area of the eye of the impeller in square inches
 - g. Clearly marked operation points
 - h. Horsepower
 - i. NPSHR
 - j. Shut-off head
 - k. Kilowatt usage at design conditions
 - l. Efficiency at design conditions
 - 6. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for five (5) years from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Flygt (Xylem)
 - 2. Ebara

2.2 DESIGN CRITERIA

- A. Provide three (3) variable speed submersible pumps (P-101, P-102, and P-103) for the existing influent pump station that meet the following design criteria:

Design Flow	4,167 GPM @ 154' TDH
Number of Duty Pumps Operating in Parallel	2
Primary Duty Point per Pump	2,083 GPM @ 154' TDH
Secondary Duty Point per Pump	3,550 GPM @ 123' TDH
Maximum Pump Speed	1,800 RPM
Maximum Motor HP	215 HP
Minimum Shut-Off Head at Maximum Speed	195-Feet
Minimum Efficiency at Primary Duty Point	75%
Minimum Sphere Diameter	3-Inches
Minimum Discharge Diameter	8-Inches

- B. It shall be the responsibility of the Contractor and pump Manufacturer to closely inspect the Drawings and coordinate the exact location of the pump guide rails, base elbow, and all other appurtenances related to the proper installation of the pumping system being provided. Any changes from the Drawings shall be submitted to the Engineer for approval.

2.3 CONSTRUCTION

- A. General
 - 1. Pump(s) shall be heavy-duty, electric submersible, centrifugal non-clog units capable of handling raw, unscreened sewage and wastewater and shall be fully guaranteed for this use.
 - 2. Pump(s) shall be designed for easy removal and reinstallation without the need for the removal of bolts, nuts, or other fasteners. The pump(s) shall automatically and firmly connect to the discharge connection, guided by no less than two parallel, non-load bearing, guide rails extending from the top of the pump station to the wet well mounted discharge connection. There shall be no need for personnel to enter the wet well.
 - 3. Sealing of the pumping unit to the discharge connection shall be accomplished by a machined metal-to-metal watertight contact.

4. The entire weight of the pump/motor unit shall be borne by the pump discharge elbow. No portion of the pump/motor unit shall bear on the sump floor directly or on a sump floor mounted stand.
5. Power and pilot cable supports shall be provided and consist of a stainless steel wire braid sleeve with attachment loops or tails to connect to cable holders on the under side of the access frame.

B. Pump

1. Major pump components (pump casing, impeller, intermediate housing, motor housing) shall be ASTM A-48, Class 35B, cast iron with smooth surfaces devoid of blow holes or other casting irregularities.
2. All exposed nuts or bolts shall be Type 316 stainless steel.
3. All metal surfaces coming into contact with the pumped media shall be protected by manufacturers standard factory applied spray coating which shall be guaranteed to protect the pump from the pumped media.
4. Pump/motor unit mating surfaces where watertight sealing is required shall be machined and fitted with Viton rubber O-rings.

C. Motor Cooling System (if Required)

1. The motor cooling jacket shall encircle the stator housing and shall provide heat dissipation for the motor regardless of whether the motor unit is submerged in the pumped media or surrounded by air.
2. An impeller that is integral to the cooling system and driven by the pump shaft shall provide the necessary circulation of the cooling liquid through the jacket.
3. The cooling jacket shall have one fill port and one drain port.
4. The cooling system shall provide for continuous pump operation in liquid or ambient temperatures up to 40 °C (104 °F). Restrictions below this temperature are not acceptable.

D. Cable and Cable Entry Seal

1. The power cable shall be suitable for the submersible pump applications and sized according to NEC and ICEA standards.
2. The power cable shall be of sufficient length to reach from the pump to the dedicated junction box terminal block without splicing. The cable shall have enough slack such that it can be routed and secured out of the way of any equipment in the wet well. It shall be the Contractor's responsibility to coordinate the cable length.
3. The outer jacket of the power cable shall be oil resistant.
4. The cable seal design shall preclude specific torque requirements to insure a watertight and submersible seal.

E. Motor

1. Motor and pump shall be produced by the same manufacturer.
2. The motor shall be 480V, 60 Hz, three-phase, inverter duty rated.
3. The pump motor shall be a NEMA B design, induction type with a squirrel cage rotor, shell type design, housed in an air filled, watertight chamber. The stator windings and stator leads shall be insulated with moisture resistant minimum Class H insulation rated for 180°C (356°F). The motor shall be specifically designed for submersible pump usage and designed for continuous duty pumping media of up to 40°C (104°F) with an 80°C temperature rise and capable of 15 starts per hour. The rotor bars and short circuit rings shall be made of cast aluminum. Thermal switches shall be embedded in the stator end coils to monitor the temperature of each phase winding. These thermal switches shall be used in conjunction and supplemental to external motor overload protection and shall be connected to the control panel. The junction chamber shall be

sealed off from the stator housing for connection of power and pilot sensor cables. The use of wire nuts or crimping type connectors is not acceptable.

4. Motor shall have a minimum service factor of 1.15. The motor shall have a voltage tolerance of plus or minus 10%. A performance chart shall be provided in the submittal showing curves for torque, current, power factor, input/output kW and efficiency and data on starting and no-load characteristics.
5. The motor shall be suitable for Class 1, Division 1 environments.
6. Motors shall be suitable for variable frequency drive applications.
7. The motor and cable shall be capable of continuous submergence underwater without loss of watertight integrity to a depth of 65 feet.
8. The motor horsepower shall be adequate so that the pump is non-overloading throughout the entire pump performance curve from shut-off through run-out.

F. Bearings

1. Motor bearings shall be sealed and permanently grease lubricated with high temperature grease.
2. The minimum L10 bearing life shall be 100,000 hours at any point along the usable portion of the pump curve at maximum product speed.

G. Mechanical Seals

1. Pumps shall be provided with a tandem mechanical shaft seal system consisting of two totally independent seal assemblies.
2. Each seal shall contain one stationary and one positively driven rotating corrosion resistant tungsten-carbide or silicon-carbide ring.
3. Seals shall operate in an oil lubricant reservoir that hydrodynamically lubricates the lapped seal faces at a constant rate.
4. Each seal interface shall be held in contact by its own spring system. The seals shall require neither maintenance nor adjustment and shall be capable of operating in either clockwise or counterclockwise direction of rotation without damage or loss of seal.
5. Should both seals fail and allow fluid to enter the stator housing, a port shall be provided to direct that fluid immediately to the stator float switch to shut down the pump and activate an alarm. Any intrusion of fluid shall not come in contact with the lower bearings.
6. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The lubricant chamber shall be designed to prevent overfilling and to provide lubricant expansion capacity. The seal lubricant chamber shall have drain and inspection plugs that are both accessible from the outside of the pump unit. The seal system shall not rely upon the pumped media for lubrication. The motor shall be able to operate continuously while non-submerged without damage while pumping under load.
7. Seal lubricant shall be nontoxic.

H. Pump Shaft

1. The pump shaft shall be made of 400 series stainless steel and shall be completely isolated from the pumped liquid.
2. Pump and motor shaft shall be a solid and continuous shaft. The pump shaft is an extension of the motor shaft. Couplings shall not be acceptable.

I. Impeller

1. Impeller(s) shall be ASTM A-48, Class 35B cast iron, dynamically balanced, multi-vane, semi-open or enclosed, non-clogging design having long throughlets without acute turns.

2. Impeller(s) shall be capable of handling solids, fibrous materials, heavy sludge and other matter found in wastewater.
3. Impeller(s) shall be keyed to the shaft, retained with an expansion ring and shall be capable of passing the minimum diameter solid indicated in the design criteria.

J. Wear Rings/Suction Covers

1. A wear ring system shall be used to provide efficient sealing between the volute and suction inlet of the impeller.
2. Volute shall have a replaceable bronze wear ring.
3. Impeller shall have a stainless steel impeller wear ring.

K. Volute

1. Volute(s) shall be made of ASTM A-48, Class 35B cast iron, non-concentric design with smooth passages large enough to pass any size solid that may enter the impeller.
2. Minimum discharge size shall be as specified in the design criteria.

L. Protection

1. All stators shall incorporate thermal switches in series to monitor the temperature of each phase winding. Should high temperature occur, the thermal switches shall open, stop the motor and activate an alarm.
2. Float switches shall be installed in all chambers where leakage may occur and cause damage to the pump. When a float switch is activated, the motor shall stop and an alarm shall be activated.
3. A monitoring unit shall be provided for installation in the pump control panel to monitor the thermal switches and seal leakage float switches.
4. The wires for the thermal switches and moisture sensor may be a part of a composite motor cable. If separate cables are provided, they shall be of adequate length to reach the dedicated junction box without splicing.

M. Hazard Classification

1. Provide motors, control switches, and devices that meet the NEC requirements for Class I, Division 1 hazardous classification for the equipment in the pump station.

2.4 INSTRUMENTATION AND CONTROLS

A. General Requirements for Pump Control Panels

1. Pump control panel shall be supplied by the pump manufacturer to control and monitor the Influent pumps. The pump control panel shall contain all of the necessary components for system operation including, but not limited to, the following.
 - a. Control Panel Enclosure
 - 1) Control panel shall be NEMA 1 painted steel.
 - b. Safety Interlocks
 - 1) Provide safety interlocks to stop the pumps or prevent them from starting upon motor fail or low-level alarm conditions.
 - 2) Provide circuitry required to interface with the thermal protection and leakage protection systems specified in this section.
 - 3) Provide intrinsically safe barriers in the pump control panel for all control and signal circuits coming from Class 1, Division 1 area.
 - c. Alarms
 - 1) Provide alarm lights for alarm conditions. See Electrical and Instrumentation Drawings for details.
 - d. Indicator Lights

- 1) Provide local indicator lights for each pump that indicate pump ON, OFF, or FAIL status.
- 2) Provide local indicator lights for Low and High level alarms.
- 3) Provide an indicator light that indicates power is supplied to the control panel.
- e. Alternator
 - 1) Alternate pumps after each pump down cycle.
- f. Run Time Meter
 - 1) Provide a run time meter for each pump.
- g. Duplex Receptacle
 - 1) Provide one 120V duplex receptacle in the control panel.
- h. Terminal Block
 - 1) Provide 25-percent spare terminals.
- i. Ground Bus
 - 1) Provide an internal copper ground bus for grounding connections.
- j. Panel Nameplate
 - 1) Provide nameplates for all items on the control panel.
- k. Phase Monitor
 - 1) Provide a phase monitor for control panel power monitoring. Include a dry 5 Amp, 120VAC rated contact for "Power Fail" alarm to SCADA system.
- l. Surge Suppression Unit
 - 1) Provide a 120VAC surge suppressor in the control panel to protect against lightning and other surges. Connect surge suppressor to the incoming feeder terminals
- m. Level Signal
 - 1) Provide a 4-20 mA level signal output for connection to the Owner's SCADA system.
 - 2) Provide a surge suppressor, Phoenix Contact Plugtrab PT, inside the panel at the termination of signal cables.
2. Panel shall be a triplex pump controller.
 - a. Panel shall contain "MPE" SC-2000 triplex pump controller to control the pumps in "Automatic" mode.
3. Pump Controls
 - a. Provide a LOCAL/OFF/REMOTE (L/O/R) selector switch.
 - 1) In the LOCAL position, the pump shall be controlled from the H/O/A switch.
 - 2) In the OFF position, the pump shall stop.
 - 3) In the REMOTE position, the pump shall start and stop based on the SCADA system contacts. The pump speed shall be pre-set at the VFD. See Electrical Drawings for details.
 - b. HAND/OFF/AUTO (H/O/A) switch for each pump.
 - 1) In the HAND position, the pump shall start and run.
 - 2) In the OFF position, the pump shall stop.

- 3) In the AUTO position, the pump shall start and stop based on wet well level. The pump shall speed up on rising wet well level and slow down on declining wet well level. The maximum allowable flow output of two pumps operating in parallel shall be 4,167 gallons per minute.
 4. The High Wet Well Level alarm shall activate when the wet well level reaches the elevation shown on the plans.
 5. The Low Wet Well Level alarm shall activate when the wet well level reaches the elevation shown on the plans.
 6. Provide an adjustable 0-300 second time on delay timing relay to insure that the pump(s) start after a preset time when power is restored after power interruption.
 7. Output Contacts for Remote Indication
 - a. Provide dry output contacts for remote indication of pump REMOTE and AUTO mode, ON/OFF/VFD Fault/Pump Fault status, LOW and HIGH level alarms, and Power Fail.
 8. Variable Frequency Drive (VFD)
 - a. VFD for each pump shall be provided by Electrical Contractor. See Section 16489 for VFD specification.
- B. Level Instrument
1. Submersible pressure transducer
 - a. Existing Submersible pressure transducer shall be reused and reconnected to the new pump control panel.
- C. Float Switches
1. One High Level float and one Low Level float shall be provided in the wet well.
 2. Floats switches shall be non-mercury tilt type switches with dry contacts rated at 5 Amps at 120 VAC.
 3. Float switches shall be suitable for Class 1, Division 1 environments.
 4. Float switches shall be provided with a sufficient amount of cable to reach the dedicated junction box.
 - a. The Contractor shall be responsible for determining the exact length of cable required.
- 2.5 ACCESSORIES
- A. Guide Rails
1. Guide rails shall be Type 316 stainless steel provided by the Contractor. Diameter shall be as specified by the pump manufacturer.
- B. Guide Rail Supports
1. Upper and intermediate guide rail supports shall be Type 316 stainless steel provided by the pump manufacturer. The pump manufacturer shall submit the recommended locations of the guide rail supports to the Engineer.
- C. Cable Holder
1. Cable holder shall be Type 316 stainless steel provided by the pump manufacturer.
 2. Provide cable holders as needed for the supplied pump motor and sensor cables.
- D. Pump Lifting System
1. Each submersible pump shall be supplied with one (1) complete pump lifting system.
 2. Lifting system shall be capable of automatically attaching to and detaching from pump without the need for personnel to enter the wet well.

3. The system shall be appropriately sized for the weight of the pump to be lifted and the distance that the pump needs to be lifted.

2.6 SPARE PARTS

- A. Provide the following spare parts.
 1. Provide one (1) spare impeller.
 2. Provide one (1) set of O-rings.
 3. Provide one (1) set of stationary and rotating wear rings for each pump provided. Three (3) total sets required.
 4. Provide one (1) set of all special tools (including tool box) required for working on the pumps.
- B. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for.
- C. Spare parts shall be of the same type and quality as the parts provided in the original equipment package.

2.7 PAINTING

- A. Pump(s) shall be shop painted and field painted in accordance with the Manufacturer's standard.

2.8 SHOP TESTING

- A. Certification tests shall be performed on the actual assembled pumps to be supplied. Pumps shall be tested in the Manufacturers facility and in accordance with the latest test code of the Hydraulic Institute Grade 1U to determine head vs. capacity and kilowatt draw required. Tests shall cover a range from shut-off to runout. Certification tests shall be conducted on each pump being supplied. A pump curve shall be generated showing actual flow, head, BHP, and hydraulic efficiency for each pump being supplied. A registered Professional Engineer shall certify each pump curve. Certified pump curves shall be submitted to the Engineer and approved by the Engineer prior to shipping the pump(s).

3 EXECUTION

3.1 INSTALLATION

- A. Pump(s) shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Pump(s) shall be field tested after installation to demonstrate operation without excessive noise, vibration, cavitation or over heating to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. Field test shall include, but not be limited to, checking for correct rotation, correct operation at design point(s), maximum motor amperage draws within the nameplate specifications, balanced voltages on each power leg with the pump operating to within Manufacturers tolerances, ability of the pump to be raised from the wet well and lowered back into the seated position, and demonstrated compatibility of the pump/motor with the controls supplied. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11246
SELF-PRIMING CENTRIFUGAL PUMPS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation self-priming centrifugal pumps and appurtenances as specified herein and as shown on the drawings.
- B. Self-priming centrifugal pump will be used to feed sludge to the belt filter press.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, pump performance curves, mass moment of inertia calculations for the impeller, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 4. Pump performance curves shall, at a minimum, depict the following.
 - a. Head vs. Capacity
 - b. RPM
 - c. Weight of pump and motor
 - d. Impeller diameter
 - e. Largest spherical solid that can be passed
 - f. Area of the eye of the impeller in square inches
 - g. Clearly marked operation points
 - h. Horsepower
 - i. NPSHR
 - j. Shut-off head
 - k. Kilowatt usage at design conditions
 - l. Efficiency at design conditions
 - 5. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Gorman-Rupp T Series

2.2 DESIGN CRITERIA

- A. Provide one (1) variable speed self-priming centrifugal pump that meets the following design criteria:

Maximum Design Flow Duty Point	160 GPM @ 34' TDH
Minimum Design Flow Duty Point	80 GPM @ 10' TDH
Maximum Static Suction Lift	6-Feet
Pumped Media	1% to 2% Aerobically Digested Sludge
Maximum Pump Speed at Max Design Flow	1,800 RPM
Maximum Motor HP	7.5 HP
Minimum Shut-Off Head at Maximum Speed	45-Feet
Minimum Efficiency at Primary Duty Point	35%
Minimum Sphere Diameter	2.5-Inches
Minimum Discharge Diameter	3-Inches

- B. Self-priming centrifugal pump will be used to feed digested sludge to the belt filter press.

2.3 CONSTRUCTION

A. General

- 1. Pump shall be horizontal, V-belt driven, self-priming centrifugal pump.
- 2. Pump shall be capable of pumping digested sludge.
- 3. Pumps shall have pulleys and V-belts appropriately sized to operate the pump at the required maximum speed to meet the maximum duty point. A variable frequency drive will be used to reduce pump speed for operation at the minimum duty point.

B. Pump

- 1. Pump casing shall be manufactured from Class 30 gray cast iron with smooth surfaces devoid of blow holes or other casting irregularities.
- 2. Impeller shall be two-vane, semi-open type manufactured from ductile iron (65-45-12).
- 3. Impeller shaft shall be AISI 4150 alloy steel.
- 4. Shaft sleeve shall be AISI 4130 alloy steel.

5. Replaceable wear plate shall be AISI 1015 carbon steel.
6. Removable wear plate and seal plate shall be Class 30 gray cast iron.
7. Flap valve shall be neoprene with steel reinforcing.
8. Bearing housing shall be Class 30 gray cast iron.
9. Suction and discharge connections shall be Class 125 flanges.
10. Bearing shall be open, single-row ball bearings.
11. Seals shall be cartridge type mechanical seals, oil-lubricated, double floating, and self-aligning. Seals shall have tungsten titanium carbide rotating and stationary faces, Type 316 stainless steel stationary seat, fluorocarbon elastomers, stainless steel cage and spring.
12. Pump shall be provided with safety guards around all rotating parts.
13. Pump base shall be manufactured from steel shapes and shall support the pump and motor.

C. Motor

1. Motor shall be TEFC, 480V, 60 Hz, three-phase, inverter duty rated with minimum 1.15 service factor. Motor shall be equipped with three (3) motor winding temperature switches (one for each winding) prewired in series for High temperature alarm and trip.

2.4 INSTRUMENTATION AND CONTROLS

A. General Requirements for Control Panels

1. Control panels shall contain all of the necessary components for system operation including, but not limited to, the following.
 - a. Control Panel Enclosure
 - 1) Control panel shall be Type 304 stainless steel and rated NEMA 4X.
 - b. Main Circuit Breaker
 - 1) The circuit breaker shall have a minimum interrupting capacity of 42,000 A RMS symmetrical.
 - 2) The main circuit breaker shall be interlocked with a lockable control panel door opening mechanism.
 - c. Alarms
 - 1) Provide an alarm light for alarm conditions.
 - d. Indicator Lights
 - 1) Provide local indicator lights that indicate pump ON, OFF, or FAIL status.
 - 2) Provide an indicator light that indicates power is supplied to the control panel.
 - e. Run Time Meter
 - 1) Provide a run time meter.
 - f. Terminal Block
 - 1) Provide 25-percent spare terminals.
 - g. Ground Bus
 - 1) Provide an internal copper ground bus for grounding connections.
 - h. Panel Nameplate
 - 1) Provide nameplates for all items on the control panel.
 - i. Control Power Transformer
 - 1) Provide a control power transformer for control voltage as required.

- j. Current Monitor
 - 1) Provide a current monitor for overload protection for each pump.
 - k. Surge Suppression Unit
 - 1) Provide a surge suppressor in the control panel to protect against lightning and other surges. Connect surge suppressor to the incoming feeder terminals
 - l. Variable Frequency Drive
 - 1) Provide a variable frequency drive in the control panel for each pump.
 - 2) Provide a circuit breaker for each variable frequency drive. Circuit breakers shall have a minimum interrupting capacity of 42,000 RMS symmetrical amperes.
 - 3) Include 3% input line reactor.
 - 4) See Specification 16489, Low Voltage Variable Frequency Drives for VFD requirements.
2. Pump Controls
- a. Provide a HAND/OFF/AUTO (H/O/A) switch and START/STOP pushbuttons for the pump.
 - 1) In the HAND position, the pump shall start and run when the START pushbutton is pressed and stop when the STOP pushbutton is pressed.
 - 2) In the OFF position, the pump shall stop.
 - 3) In the AUTO position, the pump shall start and stop based a start command from the belt filter press control panel. Pump shall also receive a 4-20 mA speed signal from the belt filter press control panel.
 - b. Provide dry output contacts rated for 5 Amp, 120VAC for remote indication of pump ON/OFF/VFD Fault status and High Motor Winding Temperature alarm.

2.5 SPARE PARTS

- A. Provide the following spare parts.
 - 1. One (1) set of belts and sheaves.
 - 2. One (1) mechanical seal.
- B. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for.
- C. Spare parts shall be of the same type and quality as the parts provided in the original equipment package.

2.6 PAINTING

- A. Pump(s) shall be shop painted and field painted in accordance with the Manufacturer's standard.

2.7 SHOP TESTING

- A. Certification tests shall be performed on the actual assembled pumps to be supplied. Pumps shall be tested in the Manufacturers facility and in accordance with the latest test code of the Hydraulic Institute Grade 1U to determine head vs. capacity and kilowatt draw required. Tests shall cover a range from shut-off to runout. Certification tests shall be conducted on each pump being supplied. A pump curve shall be generated showing actual flow, head, BHP, and hydraulic efficiency for each pump being supplied. A registered Professional Engineer shall certify each pump curve. Certified pump curves shall be submitted to the Engineer and approved by the Engineer prior to shipping the pump(s).

3 EXECUTION

3.1 INSTALLATION

- A. Pump(s) shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Integrate pumps into the belt filter press system.
- C. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Pump(s) shall be field tested after installation to demonstrate operation without excessive noise, vibration, cavitation or over heating to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. Field test shall include, but not be limited to, checking for correct rotation, correct operation at design point(s), maximum motor amperage draws within the nameplate specifications, balanced voltages on each power leg with the pump operating to within Manufacturers tolerances, and demonstrated compatibility of the pump/motor with the controls supplied. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11251
PACKAGED WATER BOOSTER SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation a packaged non-potable plant water booster system including pumps, bladder tank, flow meter, strainers, controls, and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, pump performance curves, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 4. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Flo-Pac Aqua-Pac
 - 2. Flowtronex
 - 3. Engineer Approved Equal

2.2 DESIGN CRITERIA

- A. Provide one (1) skid mounted triplex non-potable plant water booster system that meets the following design criteria:

Design Flow Rate with 2 Pumps Running	500 GPM
Minimum Flow Rate with 1 Pump Running	40 GPM
Maximum System Pressure (Pump Off)	116 PSI
Minimum System Pressure (Pump On)	106 PSI
Maximum Operating Speed	
Minimum Efficiency	
Maximum Motor HP	30 HP
Minimum Bladder Tank Size	660 Gallons
Maximum Ambient Temperature	100°F
Minimum Ambient Temperature	0°F

- B. Hydro-pneumatic bladder tank shall be sized to deliver 35 GPM for 10 minutes to the system.

2.3 CONSTRUCTION

A. General

1. Furnish and install a skid mounted horizontal, triplex pump, water booster system.
2. System shall meet the design flow rate with two pumps running.
3. System shall consist of pumps, valves, bladder tank, pressure switches, temperature switches, a flow meter, a strainer, controls, and all other appurtenances for a complete and operable system.

B. Base

1. Water booster system shall be built on a structural steel base that is capable of spanning the existing 5-foot wide chlorine contact chamber channel(s) and sitting on the existing 12-inch wide walls as shown on the drawings.
2. Steel base shall be covered with a solid checker plate deck covering the open channel below. Deck shall be designed for a live load of 300 pounds per square foot with a maximum deflection of ¼-inch.

C. Pumps

1. Pumps shall be variable speed, close coupled, multi-stage vertical turbine pumps.
2. Design Criteria
 - a. Pumps shall meet the following design criteria:

Number of Pumps	3
Design Flow per Pump	250 GPM
Design TDH per Pump	268 ft
Maximum Operating Speed	1,800 RPM
Minimum Efficiency at Design Flow	73%
Maximum Motor HP	30 HP

3. Pump head shall have an above ground discharge and shall be manufactured from ATM A48, Class 30 cast iron or fabricated steel. The connection to the pump head shall be an ANSI Class 150 flange.
4. Pump seals shall be mechanical seals with a carbon rotating seal face and a silicon carbon rotating face. Seals shall be replaceable without removing the motor.
5. Column shall be ASTM A53, Grade B steel pipe.
6. Lineshafts and bowl shafts shall be Type 416 stainless steel.
7. Pump bowls shall be close grained, ASTM A48, Class 30 cast iron. Intermediate bowls shall be provided with bronze bearings and replaceable bronze wear rings.
8. Impellers shall be enclosed and shall be manufactured from cast bronze. Impellers shall be attached to shaft with Type 416 stainless steel key.
9. Motor
 - a. Motors shall be squirrel cage induction type, NEMA design B, inverter duty rated.
 - b. Motors shall be premium efficiency, 460 V, 3 phase, 60 Hz with a 1.15 service factor and shall be equipped with 115VAC, 1 Phase motor space heater.
 - c. Motors shall have WP-1 enclosure.
 - d. Motors shall be non-overloading over the entire pump curve.

D. Pipe

1. System headers shall be Schedule 10, Type 304 stainless steel.
2. The connection point to the pump skid shall have an ANSI Class 150 flange.

E. Valves

1. Butterfly Valves
 - a. Butterfly valves 2" and larger shall be rated for 250 PSI working pressure. Valve body shall be lug style. Valves shall be of the resilient seat type. The stem shall be one piece. The body shall be cast iron, with a nylon coated, ductile iron disc, stainless steel stem, and EPDM seat. Valves shall be equipped with lever operator and 10-degree increment throttling plate.
2. Ball Valves
 - a. Ball valves shall be two-piece, full port design. The valve body, ball and stem manufactured from 316 stainless steel. The valve must have a blowout proof stem and adjustable packing nut. Valve must be rated to a minimum of 1000psi WOG non-shock.
3. Pump Control Valves
 - a. A solenoid operated pump control valve shall be provided on each pump for flow isolation and to assist filling hydro-pneumatic tank.
4. Check Valves
 - a. Check valves 2" and smaller shall be threaded, spring actuated, in-line lift type. The valve body shall be bronze with a PTFE resilient disc and stainless steel stem. Valve dimensions and workmanship shall conform to MSS SP-80.
 - b. Check valves 2 1/2" and larger shall be wafer or globe style and of the silent operating type that begins to close as the forward flow diminishes and fully closes at zero velocity preventing flow reversal and resultant water hammer.

F. Pressure Regulating Valves

1. A combination pressure regulating and check shall be provided on each pump.

2. Valves shall be single seated, diaphragm operated, pilot controlled globe valves with speed control.
- G. Pressure Relief and Surge Valve
1. The water booster system shall be equipped with pressure relief and surge valves, as required, to protect the system from over pressure and water hammer.
- H. Pressure Reducing Valve
1. Pressure reducing valves shall be provided to control system pressure.
- I. Isolation Valves and Check Valves
1. The water booster system shall be provided with isolation valves and check valves as required to protect the pumps and isolate the pumps and system.
 2. Valves 2-inches and smaller shall be ball valves and valves 2-1/2-inches and larger shall be lug pattern butterfly valves.
- J. Bladder Tank
1. A vertical ASME bladder-type tank shall be provided for periods of low water usage.
 2. Bladder tank shall be steel and shall have a minimum pressure rating of 200 psi.
 3. The bladder shall be constructed of butyl rubber and shall be removable.
 4. The inside of the tank shall be painted with an epoxy paint that is compatible with potable water.
- K. Duplex Basket Strainer
1. Provide a duplex strainer on the discharge of the pumping system. Strainer shall be cast iron with 125 lb. connections. Strainer shall utilize a three-way plug design to allow continuous operation while the strainer is being serviced.
 2. Basket shall be fabricated from Type 316 stainless steel and shall have 1/8" diameter perforations.
 3. Strainer shall be Eaton, Model 50, Plug Type Duplex Basket Strainer, or equal.
- L. Flow Meter
1. Provide a magnetic flow meter to measure discharge flow rate.
- M. Pressure Gauges
1. Provide a pressure gauge on the discharge header to measure system pressure.
 2. Provide a differential pressure gauge across the duplex basket strainer to measure pressure differential.
 3. Pressure gauges shall turret style, liquid filled gauges with stainless steel body and 4-inch diameter face.
- N. Pressure Transmitter
1. Provide a 2-wire, 4 to 20 mA DC analog output pressure transmitter to measure system pressure.
 2. Pressure transmitter shall be provided with direct connect pressure seals.
 3. Accuracy of pressure transmitter shall be +/-0.2% of calibrated span.
 4. Pressure transmitter housing shall be Type 316 stainless steel and rated NEMA 4X.
- O. Low Level Float
1. Provide low level float switch to protect pumps from low suction condition.
 2. Float switch shall be UL listed and mercury free.
- P. Freeze Protection

1. All discharge piping and instruments shall be configured so that it can be readily heat traced and insulated to protect from freezing. Assume insulation will be 2-inches thick.

2.4 INSTRUMENTATION AND CONTROL

A. Control Panel

1. Control Panel Enclosure
 - a. Control panel shall be a Type 304 stainless steel, NEMA 4X enclosure mounted on the pump skid.
 - b. All components (disconnects, transformers, variable frequency drives, control devices, etc.) shall be installed in the control panel. All skid mounted components shall be prewired to the Control Panel by Manufacturer.
2. Main Circuit Breaker
 - a. The main circuit breaker shall have a minimum interrupting capacity of 42,000 RMS symmetrical amperes.
 - b. The main circuit breaker shall be interlocked with a lockable control panel door opening mechanism.
3. Indicator Lights
 - a. Provide local indicator lights for each pump that indicate pump ON, OFF, and FAIL status.
4. Alternator
 - a. Alternate pumps after each pump down cycle.
5. Run Time Meter
 - a. Provide a run time meter for each pump.
6. Ground Bus
 - a. Provide an internal copper ground bus for grounding connections.
7. Panel Nameplate
 - a. Provide nameplates for all items on the control panel.
8. Control Power Transformer
 - a. Provide a 480/120V control power transformer for control power, flow meter power, motor space heaters, and all other skid mounted components requiring 120VAC power.
9. Current Monitor
 - a. Provide a current monitor for overload protection for each pump.
10. Provide a HAND/OFF/AUTO (H/O/A) switch for each pump.
 - a. In the HAND position, the pump shall start and run.
 - b. In the OFF position, the pump shall stop.
 - c. In the AUTO position, the pump shall start and stop based on system pressure.
11. Alarm
 - a. Provide an alarm light for alarm conditions.
 - b. Alarm conditions shall include, but not be limited to, Low Suction Pressure, Low System Pressure, High System Pressure, Pump Fail, etc.
12. Variable Frequency Drives
 - a. Provide a variable frequency drive for each pump.
13. Programmable Logic Controller

- a. Provide a panel door mounted programmable logic controller for operation of the system.
 - b. All system parameters shall be adjustable from the controller.
 - c. Display discharge pressure and discharge flow rate on the control panel.
14. Output Contacts for Remote Indication (2 Amp, 120VAC rated)
- a. Provide dry output contacts for remote indication of pump ON and OFF Status, HAND Mode, Pump Station Common Fault and Low Level Alarm.
 - b. Provide an analog output for remote flow rate and Discharge pressure indication.
15. Surge Suppression Unit
- a. Provide a surge suppressor in the control panel to protect against lightning and other surges. Connect surge suppressor to the incoming feeder terminals.
16. Air Conditioning Unit
- a. Provide an air conditioning unit to control air temperature within the control panel and protect the variable frequency drives and other components from excessive heat. Control panel will be located outdoors.

3 EXECUTION

3.1 INSTALLATION

- A. Packaged water booster system shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Packaged water booster system shall be field tested after installation to demonstrate satisfactory operation to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.

- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11256
POLYMER FEED SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section include furnishing all labor, materials, and equipment required to install polymer dilution blending feed systems and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, pump performance curves, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 4. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Neptune Polymaster
 - 2. Fluid Dynamics DynaBlend
 - 3. Velodyne Velocity Dynamics, Inc.
 - 4. Engineer Approved Equal

2.2 DESIGN CRITERIA

- A. Provide two (2) polymer dilution blending and feeding systems that meet the following design criteria:

Neat Polymer Flow Range	0 to 4.5 GPH
Dilution Water Flow Range	0 to 600 GPH

- B. Polymer feed pumps will replace the existing polymer feed systems for the existing belt filter press system and the relocated belt filter press system.

2.3 CONSTRUCTION

A. General

1. Polymer dilution blending and feeding system shall be an integrated equipment package that will automatically meter dilute, activate, and feed emulsion, solution, or dispersion polymers.
2. Polymer feed systems shall be integrated into the belt filter press system and shall be provided with all equipment and appurtenances required for a complete and operational system.
3. All wetted parts of the polymer feed system shall be constructed of materials that are non-corrosive.

B. Frame

1. Polymer system shall be provided with a Type 304 stainless steel frame. If required, a Type 304 stainless steel support stand shall be provided so that the polymer system components will be located at a convenient working height.

C. Pump

1. Pump shall be an electronic solenoid-driven diaphragm type pump with a manual stroke length adjustment and electronic stroke speed control.
2. Pump shall be capable of receiving a 4-20 mA pacing signal to automatically adjust the polymer feed rate.
3. Pumps shall be LMI chemical metering pumps, or equal.

D. Rotameter

1. Rotameter(s) shall be provided, as required, to meter and control the dilution water flow rate.
2. Rotameter shall be guided float type with acrylic metering tube and Type 316 stainless steel and brass control valve.

E. Pressure Sensor

1. Polymer system shall be provided with a pressure sensor to monitor dilution water pressure. In the event there is insufficient dilution water pressure, the polymer system shall stop and a low dilution water pressure alarm shall be generated.

F. Solenoid Valve

1. Polymer system shall be provided with a solenoid valve for on/off control of the dilution water.

G. Mixing Chamber

1. Polymer system shall be provided with the appropriate mixing chamber(s) required to activate the neat polymer and then blend the active polymer with the dilution water.
2. A clear mixing chamber or clear section of pipe after the mixing chamber discharge shall be provided to allow viewing of the mixed polymer and water solution.

H. Power

1. Polymer system shall operate on 120V, 60 Hz, single phase power.

I. Instrumentation and Control

1. Polymer feed system shall be provided with all necessary controls, pre-wired, for a complete and operational system.
2. All electrical controls and wiring shall be NEMA 4X construction.
3. Controls
 - a. Provide and LOCAL/OFF/REMOTE (L/O/R) switch and START/STOP pushbuttons.
 - 1) In the LOCAL position, the polymer feed system shall start when the START pushbutton is pressed and stop when the STOP pushbutton is pressed.
 - 2) In the OFF position, the polymer system shall stop.
 - 3) In the REMOTE position, the polymer feed system shall start and stop based on a start and stop command from the belt filter press panel. The speed of the polymer feed pump shall also be controlled with a 4-20 mA input signal from the belt filter press.
 - b. Provide a FLUSH MODE switch to allow automatic flushing of the polymer feed system.
 - c. Polymer feed system shall be provided with the following minimum I/O Contacts (5 Amp, 120VAC rated):
 - 1) Provide output contacts for the following:
 - a) LOCAL/REMOTE status
 - b) Pump ON/OFF status
 - c) Common alarm
 - 2) Provide input contacts for the following:
 - a) Pump START/STOP command
 - b) Analog 4-20 mA speed control

J. Accessories

1. Drum Suction Pipe
 - a. Provide two (2) drum suction pipes with threaded bung attachment and strainer on end of suction pipe.
2. Drum Mixer
 - a. Provide two (2) 0.33 HP drum mixing units with three pair of mixing blades. Unit shall be designed to fit in a 2-inch drum bung hole. Mixer shall plug into a 120V outlet.
3. Desiccant Dryer
 - a. Provide two (2) desiccant dryers for controlling moisture in the polymer drum.

2.4 SPARE PARTS

- A. Provide the following spare parts.
 1. Provide two (2) sets of diaphragms, check valves, and seals for the chemical metering pumps.
- B. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for.
- C. Spare parts shall be of the same type and quality as the parts provided in the original equipment package.

3 EXECUTION

3.1 INSTALLATION

- A. Polymer feed system shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Integrate polymer feed system into the belt filter press system.
- C. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Polymer feed system shall be field tested after installation to demonstrate satisfactory operation to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **

SECTION 11259
PERISTALTIC CHEMICAL FEED PUMPS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section include furnishing all labor, materials, and equipment required to install peristaltic chemical feed pump systems and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, pump performance curves, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 4. Pump performance curves shall, at a minimum, depict the following.
 - a. Head vs. Capacity
 - b. RPM
 - c. Clearly marked operation points
 - 5. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers include:

1. Watson-Marlow, Inc.
2. Verderflex
3. Engineer Approved Equal

2.2 DESIGN CRITERIA

A. Provide one (1) triplex peristaltic chemical feed pump system that meets the following design criteria:

Number of Pumps	
Duty	2
Standby	1
Total	3
Pump Flow Rate	0 to 24 GPH
Operating Pressure	30 PSI
Duty	Continuous
Pumped Media	Alum

B. Provide one (1) duplex peristaltic chemical feed pump system that meets the following design criteria:

Number of Pumps	
Duty	1
Standby	1
Total	2
Pump Flow Rate	0 to 37 GPH
Operating Pressure	30 PSI
Duty	Continuous
Pumped Media	Sodium Hydroxide

2.3 CONSTRUCTION

A. General

1. Pumps shall be skid mounted on a polypropylene skid and plumbed with all valves, fittings, piping, and appurtenances as required for a complete and operational system. Contractor shall only be required to connect suction pipe, discharge pipe, and power to the skid.
2. The triplex pump skid shall be plumbed with two (2) discharge points so that with two pumps operating, they can each pump to two different locations.
3. Peristaltic pump tubing shall be suitable for the chemical being pumped.
4. Tubing shall be provided with quick disconnects.

B. Pump

1. General

- a. Pumps shall be positive displacement peristaltic type complete with spring-loaded pump head, self-contained variable speed drive, and flexible extruded tube.

2. Pump Head

- a. Pump head shall consist of a fixed track, a hinged, guard door, spring-loaded tube clamp mechanisms, spring-loaded roller rotor assembly.
- b. Guard door shall be transparent.
- c. Pump head materials shall be corrosion resistant to the chemicals being pumped.

3. Drive

- a. Pump drive shall be rated for continuous 24-hour operation.
- b. Power Supply: 120V, 60 Hz, 1-phase
- c. Enclosure Rating: NEMA 4X Stainless Steel
- d. Speed Control Range: 2200:1 from 0.1 to 220 RPM +/-0.1 RPM throughout range

4. Leak Detection

- a. Pump shall have a leak detection system that senses hose/tubing failure.

5. Controls

- a. Pump shall have an integral control panel capable of local and remote operation.
- b. I/O Contacts (5 Amp, 120VAC rated)
 - 1) Provide output contacts for the following:
 - a) LOCAL/REMOTE status
 - b) Pump ON/OFF status
 - c) Common alarm
 - 2) Provide input contacts for the following:
 - a) Pump START/STOP command
 - b) Analog 4-20 mA speed control

6. Electrical Panel

- a. Provide a NEMA 4X Stainless Steel electrical panel that will be mounted on the pump skid.
- b. Control panel shall be provided with a door mounted main circuit breaker. Circuit breaker shall have a minimum interrupting capacity of 42,000 RMS symmetrical amperes.
- c. All pump electrical and control wiring shall terminate in this panel on terminal blocks.

C. Skid

- 1. Skid shall be manufactured from polypropylene shapes or similar chemical resistant material.

D. Accessories

- 1. Provide each pump with the following accessories.
 - a. Calibration cylinder
 - b. Pressure relief valve
 - c. Backpressure valve
 - d. Pressure gauge

2. Calibration Cylinder
 - a. Clear PVC with easy to read graduation marks in milliliters and gallons per hour.
 - b. Size: 2,000 ml
 - c. Griffco Valve, Inc. PVC Calibration Cylinder, or equal.
3. Pressure Relief Valve
 - a. Diaphragm pressure relief valve with 3-port socket connections.
 - b. Size: ½-inch
 - c. Wetted Part Materials: PVC
 - d. Diaphragm Material: EPDM
 - e. Griffco Valve, Inc. G-Series Pressure Relief Valve, or equal
4. Back Pressure Valve
 - a. Diaphragm back pressure valve with 2-port socket connections.
 - b. Size: As specified on drawings.
 - c. Wetted Part Materials: PVC
 - d. Diaphragm Material: EPDM
 - e. Griffco Valve, Inc. G-Series Back Pressure Valve, or equal
5. Pressure Gauge
 - a. Pressure gauge shall be liquid filled with 2-inch diameter face and black lettering. Range shall be 0 to 100 psig. Gauge shall be stainless steel and sealed to prevent entrance of moisture. Bourdon tube shall be phosphor bronze with forged brass socket. Connections shall be 1/4-in male NPT. Furnish cartridge type pressure snubbers to reduce gauge pointer pulsations.
6. Diaphragm Isolator
 - a. Diaphragm isolators shall protect gauges, switches and other instruments from the chemicals being pumped.
 - b. Wetted and Non-Wetted Part Material: PVC
 - c. Diaphragm Material: Teflon (PTFE)
7. Valves
 - a. Valves shall be PVC true-union ball valves.

2.4 SPARE PARTS

- A. Provide the following spare parts.
 1. Provide two (2) spare pump heads for each type of pump.
 2. Provide 15-meters of tubing for each pump provided.
- B. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for.
- C. Spare parts shall be of the same type and quality as the parts provided in the original equipment package.

3 EXECUTION

3.1 INSTALLATION

- A. Peristaltic chemical feed pumps shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.

- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Peristaltic chemical feed pumps shall be field tested after installation to demonstrate satisfactory operation to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11290
INTERNALLY FED DRUM SCREENS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation an internally fed drum screen system which is comprised of internally fed drum screens, screenings washers/compactors, and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Calculations that provide a basis of design for each piece of equipment. Calculations shall justify the capacity and the horsepower requirements for each type of equipment provided and shall be sealed by a registered professional engineer.
 - 4. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 5. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Parkson Corporation
 - 2. WesTech Engineering, Inc.

2.2 DESIGN CRITERIA

- A. Provide two (2) internally fed drum screens (SCRN-301 and SCRN-302), one duty and one standby, that meet the following design criteria.

Peak Flow Rate	6 MGD
Maximum Influent Total Suspended Solids	475 mg/l
Average Influent Total Suspended Solids	237 mg/l
Maximum Screen Opening Size	2-mm
Screen Type	Perforated Plate

- B. Provide two (2) screenings washers/compactors (COMP-301 and COMP-302) that will wash and compact the screenings prior to discharging into a dumpster.

Minimum Loading Rate	50 cubic feet per hour
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2.3 CONSTRUCTION

A. General

1. The internally fed drum screen shall be suitable for screening raw wastewater.
2. The internally fed drum screens and screenings washers/compactors shall be a complete system provided by the internally fed drum screen manufacturer. Each drum screen/washer/compactor combination shall have its own individual control panel.
3. Internally fed drum screens and washers/compactors shall be all type 316 stainless steel construction.
4. Internally fed drum screens and washers/compactors will be installed outdoors in a Class 1, Division 2, Group D area.

B. Internally Fed Drum Screen

1. Screen Cylinder
 - a. The screen element shall be a perforated cylinder constructed out of minimum 20-gauge type 316 stainless steel.
 - b. Perforations shall be maximum 2-millimeters in diameter.
 - c. Screen cylinder shall be equipped with type 316 stainless steel flights designed to transport the screened solids to the discharge end of the screen cylinder.
2. Base Frame
 - a. The base frame shall be constructed out of type 316 stainless steel.
 - b. The base frame shall be designed to withstand all loads imposed by the screen components and the wastewater passing through the unit.
 - c. The base frame shall be designed for maximum 4-point support at each corner.
3. Trunnion Wheels
 - a. A minimum of four (4) trunnion wheels shall be used to support the screen cylinder.
 - b. Trunnion wheels shall be constructed of polyamide plastic, polyethylene, or phenolic resin.
 - c. Trunnion wheel bearing assemblies shall be anti-friction ball bearings with inner race. If bearing assemblies require lubrication, grease fittings shall be provided. Grease fittings shall be accessible from the outside of the screen and shall not require any disassembly of the screen.

- d. Trunnion wheels shall be shaft supported. Shafts and support brackets shall be constructed out of type 316 stainless steel.
4. Inlet Pipe
 - a. The inlet pipe shall be constructed out of type 316 stainless steel.
 - b. The inlet connection shall be a 24-inch diameter ANSI B16.1, Class 125 flange.
 5. Headbox
 - a. The headbox shall be constructed out of type 316 stainless steel.
 - b. The headbox shall be designed to reduce forward velocity, provide momentary flow equalization, and evenly distribute flow over side weirs.
 - c. The headbox shall be provided with a minimum 3-inch diameter drain port for maintenance. Drain port shall be fitted with a type 316 stainless steel ball valve.
 6. Splash Guards
 - a. Splash guards shall be constructed out of type 316 stainless steel.
 - b. Splash guards shall be designed to contain and direct the flow to the screen discharge opening.
 - c. Splash guards shall be self-supporting throughout their entire length and shall be easily removed for maintenance purposes.
 7. Covers
 - a. Covers shall be constructed out of type 316 stainless steel.
 - b. Covers shall consist of panels and support members that completely enclose the screen assembly. Panel sections shall be capable of being opened and locked in the open position.
 - c. Panel sections shall be sized such that a maximum of two (2) people are required to remove the panel.
 8. Discharge End Section
 - a. The discharge end section shall be constructed out of type 316 stainless steel.
 - b. The discharge end section shall capture the screenings and direct them downward into a screenings washer/compactor.
 - c. The discharge end section shall be flanged such that a removable transition piece can be installed between the screen and the screenings washer/compactor.
 - d. The discharge end section shall have removable panels or doors that allow access to the interior of the screen.
 9. Screen Cleaning System
 - a. The screen cleaning system shall be constructed out of type 316 stainless steel.
 - b. The screen cleaning system shall consist of spray headers, spray nozzles, and spray deflectors.
 - c. The screen cleaning system shall be designed to keep screen openings clear.
 - d. The screen cleaning system shall be provided with NEMA 7 solenoid valves and a spray timer, as required, for automatic operation of the spray system. The spray timer shall be located in the screen control panel and shall open the solenoid valve at preset intervals.
 10. Screen Drive
 - a. The screen drive assembly shall consist of a drive motor and gear reducer.
 - b. Motor shall be TEFC, 460 V, 3-phase, 60 Hz, 1.15 service factor. Motor shall also be suitable for Class 1, Division 2, Group D conditions.

- c. Motor horsepower shall be as required for the design conditions presented above.
11. Emergency Stop Switch
- a. The internally fed drum screen shall be equipped with a NEMA 7 emergency stop switch mounted to the unit. When the emergency stop switch is depressed, the internally fed drum screen shall immediately shut down.
12. Hazard Classification
- a. Internally fed drum screens shall be provided with motors, control switches, and devices that meet the NEC requirements for Class I, Division 2, Group D hazardous classification.
- C. Screenings Washer/Compactor
1. General
- a. The screenings washer/compactor shall be designed to wash and compress screenings from the internally fed drum screens.
 - b. Screenings washer/compactor will be installed outdoors in a Class 1, Division 2, Group D area.
2. Construction
- a. All components of the screenings washer/compactor, except for the washer auger, shall be constructed out of type 316 stainless steel.
 - b. The washer auger shall be constructed out of high strength carbon steel and shall have a protective primer coating applied to it.
 - c. Inlet connection shall be flanged to interconnect with the internally fed drum screen.
 - d. Manufacturer shall coordinate with the contractor to determine the exact configuration of the discharge chute.
3. Spray Header
- a. The spray headers and nozzles shall be constructed out of type 316 stainless steel.
 - b. The spray headers shall provide a high intensity spray to clean the screenings and wash debris from the screens washer/compactor.
 - c. Electrically actuated NEMA 7 solenoid valves and flow and pressure control valves shall be provided on the spray headers.
4. Discharge Pipe
- a. Each screenings washer/compactor shall be provided with a discharge pipe constructed out of type 316 stainless steel.
 - b. The discharge pipe shall direct screenings to a dumpster as shown on the drawings. The exact location and discharge elevation of the discharge shall be coordinated with the contractor.
5. Screenings Washer/Compactor Drive
- a. The screenings washer/compactor drive shall consist of a direct coupled, constant-speed, integral helical gear reducer and motor unit.
 - b. Motor shall be TEFC, 460 V, 3-phase, 60 Hz, with a 1.15 service factor. Motor shall also be suitable for Class 1, Division 2, Group D conditions.
 - c. Motor horsepower shall be as required for the design conditions presented above. Calculations justifying the capacity and motor horsepower of the screenings washer/compactor shall be submitted in the shop drawing submittals. Calculations shall be sealed by a professional engineer.
6. Controls

- a. Controls for the screenings washer/compactor shall be incorporated into the internally fed drum screen control panel.
- 7. Emergency Stop Switch
 - a. The screenings washer/compactor shall be equipped with a NEMA 7 emergency stop switch mounted to the unit. When the emergency stop switch is depressed, the screenings compactor shall immediately shut down.
- 8. Hazard Classification
 - a. Screenings washers/compactors shall be provided with motors, control switches, and devices that meet the NEC requirements for Class I, Division 2, Group D hazardous classification.

D. Transition Pieces

- 1. Transition pieces that connect the internally fed drum screen to the screenings washer/compactor shall be provided.
- 2. Transition pieces shall be constructed out of type 316 stainless steel.
- 3. Transition pieces shall bolt to flanges on each piece of equipment and shall have access doors that will allow access to clear debris or the transition pieces shall be capable of being removed without having to move either piece of equipment that they are attached to.

2.4 INSTRUMENTATION AND CONTROL

A. Control Panel

- 1. Two (2) control panels shall be provided, one (1) for each internally fed drum screen and screenings washer/compactor combination.
- 2. The control panel shall meet the following general requirements.
 - a. Control Panel Enclosure
 - 1) Control panel enclosure shall be constructed out of type 304 stainless steel and shall be rated NEMA 4X.
 - 2) Control panels will be located outside. Provide air conditioning units if required for the equipment being provided.
 - b. Main Circuit Breaker
 - 1) The main circuit breaker shall have a minimum interrupting capacity of 42,000 RMS symmetrical amperes.
 - 2) The main circuit breaker shall be interlocked with a lockable control panel door opening mechanism.
 - c. Control Power Transformer
 - 1) Provide a control power transformer for control voltage as required.
 - d. Safety Interlocks
 - 1) Provide safety interlocks to stop the screens and screenings washers/compactors or prevent them from starting upon motor fail or other alarm conditions.
 - e. Provide a HAND/OFF/AUTO (H/O/A) switch and START/STOP push-buttons for each screen.
 - 1) In the HAND position, the screen shall start and run when the START push-button is pressed and stop when the STOP push-button is pressed.
 - 2) In the OFF position, the screen shall stop.
 - 3) In the AUTO position, the screen shall start and stop based on a start command from the plant SCADA system.

- f. Provide a HAND/OFF/AUTO (H/O/A) switch and START/STOP push-buttons for each internal and external spray wash system.
 - 1) In the HAND position, the spray wash system shall turn on when the START push-button is pressed and stop when the STOP push-button is pressed.
 - 2) In the OFF position, the spray wash system shall turn off.
 - 3) In the AUTO position, the spray wash system shall turn on and off based on a signal from the spray wash timer.
- g. Provide a HAND/OFF/AUTO (H/O/A) switch and START/STOP push-buttons for each screenings washer/compactor.
 - 1) In the HAND position, the screenings washer/compactor shall start and run when the START push-button is pressed and stop when the STOP push-button is pressed.
 - 2) In the OFF position, the screenings washer/compactor shall stop.
 - 3) In the AUTO position, the screenings washer/compactor shall start and stop based on a signal from the screen.
- h. Screen Timers
 - 1) Provide a timer for each screen.
 - 2) Screen timer shall be adjustable and shall allow the screen to run for a set period of time after the flow signal has called for the screen to turn off.
- i. Spray Wash Timers
 - 1) Provide a spray wash timer for each screen.
 - 2) Timer(s) shall start and stop the spray wash system based on adjustable run time settings.
- j. Screenings Washer/Compactor Timers
 - 1) Provide a timer for each screenings washer/compactor.
 - 2) Screenings washer/compactor timer shall be adjustable and shall allow the screenings washer/compactor to run for a set period of time after the screen has turned off.
- k. Indicator Lights
 - 1) Provide local indicator lights for each screen and screenings washer/compactor that indicate ON, OFF, or FAIL status.
 - 2) Provide an indicator light that indicates power is supplied to the control panel.
- l. Emergency Stop Button
 - 1) Provide an emergency stop button on the control panel that will stop all pieces of equipment when depressed.
- m. Run Time Meter
 - 1) Provide run time meters for each screen and screenings washer/compactor.
- n. Terminal Block
 - 1) Provide 25-percent spare terminals.
- o. Ground Bus
 - 1) Provide an internal copper ground bus for grounding connections.
- p. Panel Nameplate
 - 1) Provide name plates for all items on the control panel.
- q. I/O Contacts
 - 1) Provide dry 5 Amp, 120VAC rated output contacts for the following:

- a) Remote indication of screen HAND/OFF/AUTO switch (AUTO Mode)
 - b) Screen ON/OFF status
 - c) Screen common alarm
 - d) Screenings washer/compactor ON/OFF status
 - e) Washer/compactor common alarm
 - f) Indication that an emergency stop button has been activated.
 - 2) Provide input contacts for the following
 - a) Screen START command.
 - r. Motor Starters
 - 1) Provide Combination Full-Voltage Motor Starters with circuit breakers in the control panel for each screen and screenings washer/compactor. Circuit breakers shall have a minimum interrupting capacity of 42,000 RMS symmetrical amperes.
 - s. Current Monitor
 - 1) Provide a current monitor for overload protection for each screen and screenings washer.
 - t. Surge Suppression Unit
 - 1) Provide a surge suppressor in the control panel to protect against lightning and other surges. Connect surge suppressor to the incoming feeder terminals.
 - B. Wash Water Solenoid Valves
 - 1. Provide 120 V, 60 Hz solenoid valves for each spray washer system header on the screens and screenings washer/compactors.
 - 2. Solenoid valves shall be rated for Class 1, Division 2, Group D hazardous environments.
 - C. Emergency Stop Buttons
 - 1. Provide a local emergency stop push button at each screen and each screenings washer/compactor.
 - 2. Emergency stop buttons shall be rated for Class 1, Division 2, Group D hazardous environments.
- 2.5 SPARE PARTS
- A. Provide the following spare parts.
 - 1. Four (4) complete trunnion wheel assemblies for each screen provided.
 - 2. Five (5) spray nozzles for each screen provided.
 - 3. Two (2) bearing assemblies for the screenings washer/compactor.
 - 4. Two (2) shaft seal sets for the screenings washer/compactor.
 - 5. All special tools (i.e. trunnion wheel replacement tool, etc.) required for working on the equipment provided. Provide one (1) set of all special tools (including tool box) required for working on the screens and screenings washer/compactor.
 - B. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for.
 - C. Spare parts shall be of the same type and quality as the parts provided in the original equipment package.

3 EXECUTION

3.1 INSTALLATION

- A. Internally fed drum screens, screenings washer/compactor, and appurtenances shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Internally fed drum screens, screenings washer/compactor, and appurtenances shall be field tested after installation to demonstrate proper operation to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **

SECTION 11320
GRIT REMOVAL SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation grit removal systems and appurtenances as specified herein and as shown on the drawings.
- B. The new grit removal systems will be installed in the existing 360-degree Smith and Loveless 4.0 vortex grit chambers.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 4. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Smith and Loveless
 - 2. WesTech Engineering, Inc.
 - 3. Lakeside Equipment Corporation

2.2 DESIGN CRITERIA

- A. Provide two (2) vortex type grit removal systems (GRIT-401 and GRIT-402) that will fit in the existing 360-degree Smith and Loveless 4.0 vortex grit chambers and meet the following design criteria.

Peak Design Flow Rate	4 MGD
Grit Chamber Inside Diameter	8-feet
Removal Efficiency at Peak Flow Rate:	
Grit Greater Than 50 Mesh in Size	95%
Grit Greater Than 70 Mesh in Size	85%
Grit Greater Than 100 Mesh in Size	65%

- B. Provide two (2) grit classifiers that meet the following design criteria.

Minimum Grit Slurry Feed Rate	60 GPM
Minimum Grit Conveying Capacity	14 cubic feet per hour

- C. Contractor and manufacturer shall verify the actual dimensions of the existing grit chambers and provide equipment that is designed to fit in the existing structures.

2.3 CONSTRUCTION

A. General

1. Each grit removal system shall include drive unit, drive tube, paddle assembly, grit pump, grit classifier, control panel, and appurtenances for two (2) complete and independent systems.
2. Grit systems shall be designed to fit in the existing grit chambers. One grit chamber has a counter-clockwise flow pattern and one grit chamber has a clockwise flow pattern.
3. All grit equipment shall be Type 316 stainless steel construction.

B. Grit Chamber

1. Drive Unit

- a. The drive unit shall consist of an electric motor and a helical gear reduction unit that turns the drive tube and paddle assembly.
- b. The drive unit housing shall be constructed out of cast iron or Type 316 stainless steel plate.
- c. The drive unit motor shall be TEFC, 460 V, 3-phase, 60 Hz, with a 1.15 service factor. Motor shall also be suitable for Class 1, Division 2, Group D conditions. Motor shall be non-overloading during all normal operating conditions.

2. Drive Tube

- a. The drive tube shall be constructed out of 10-inch diameter, Type 316 stainless steel pipe with a minimum thickness of ¼-inches.

3. Paddle Assembly

- a. The paddle assembly shall consist of four (4) fixed blades attached to the drive tube by means of a collar. The collar shall allow the blades to be adjusted up or down as required.

- b. The paddle assembly and collar shall be constructed out of Type 316 stainless steel.
 - 4. Floor Plate
 - a. The grit chamber shall have a steel floor plate to minimize organic capture.
 - b. The floor plate shall consist of two (2) removable sections and shall be constructed out of ½" thick, Type 316 stainless steel.
 - 5. Flow Control Baffles
 - a. If required to meet the performance requirements described above, the grit chamber shall be provided with inlet and/or outlet baffles.
 - b. The inlet/outlet baffles shall be constructed out of Type 316 stainless steel.
 - 6. Shop Painting
 - a. All cast iron components shall be solvent cleaned, near-white blast cleaned per SSPC-SP10, and primed with minimum 4-mil DFT Tnemec Series 66 Hi-Build Epoxoline Primer.
- C. Grit Pump
 - 1. Grit pumps shall be a vacuum-primed centrifugal pump or self-priming centrifugal pump (Gorman Rupp) designed to transfer grit from the grit chamber to the grit classifier.
 - 2. Grit pumps shall be sized by the grit system manufacturer and approved by the Engineer.
 - 3. Grit pump motor shall be TEFC, 460 V, 3-phase, 60 Hz, with a service factor of 1.15. Motor shall also be suitable for Class 1, Division 2, Group D conditions. Motor shall be non-overloading during all normal operating conditions.
- D. Grit Classifier
 - 1. Grit classifiers shall be provided to dewater the grit slurry removed from the grit chambers and discharge the dewatered grit into a dumpster as shown on the Drawings.
 - 2. The grit classifier settling tank, cover, dewatering trough, inlet and out flanges, etc. shall be constructed out of type 316 stainless steel.
 - 3. The grit classifier dewatering screw shall be constructed out of high strength carbon steel.
 - 4. The grit classifier shall have a 2-inch drain with fitted with a 2-inch stainless steel ball valve.
 - 5. Drive Unit
 - a. The drive unit shall consist of an electric motor and a helical gear reduction unit.
 - b. The drive unit motor shall be TEFC, 460 V, 3-phase, 60 Hz, with a 1.15 service factor. Motor shall also be suitable for Class 1, Division 2, Group D conditions. Motor shall be non-overloading during all normal operating conditions.

2.4 HAZARD CLASSIFICATION

- A. Grit systems and grit classifiers shall be provided with motors, control switches, and devices that meet the NEC requirements for Class I, Division 2, Group D hazardous classification.

2.5 INSTRUMENTATION AND CONTROL

- A. Control Panel
 - 1. Two (2) control panels shall be provided, one (1) for each grit system.
 - 2. Each control panel shall meet the following general requirements.
 - a. Control Panel Enclosure

- 1) Control panel enclosure shall be constructed out of type 304 stainless steel and shall be rated NEMA 4X.
- b. Main Circuit Breaker
 - 1) The main circuit breaker shall have a minimum interrupting capacity of 42,000 RMS symmetrical amperes.
 - 2) The main circuit breaker shall be interlocked with a lockable control panel door opening mechanism.
- c. Control Power Transformer
 - 1) Provide a control power transformer for control voltage as required.
- d. Safety Interlocks
 - 1) Provide safety interlocks to stop the grit system or prevent it from starting upon motor fail or other alarm conditions.
- e. Provide a LOCAL/OFF/REMOTE switch.
 - 1) In LOCAL, the grit system shall be controlled via the grit system control panel.
 - 2) In REMOTE, the grit system shall be controlled via the plant SCADA system.
- f. Provide START/STOP push-buttons for the grit chamber drive.
 - 1) The grit chamber drive shall start and run when the START push-button is pressed and stop when the STOP push-button is pressed.
- g. Provide a HAND/OFF/AUTO (H/O/A) switch and START/STOP push-buttons for the grit pump.
 - 1) In the HAND position, the grit pump shall start and run when the START push-button is pressed and stop when the STOP push-button is pressed.
 - 2) In the OFF position, the grit pump shall stop.
 - 3) In the AUTO position, the grit pump shall start and stop based on a 24-hour, 96-position time clock, 0-30 minute pump timer, and 0-30 minute priming timer.
- h. Provide a HAND/OFF/AUTO (H/O/A) switch and START/STOP push-buttons for grit classifier.
 - 1) In the HAND position, the grit classifier shall start and run when the START push-button is pressed and stop when the STOP push-button is pressed.
 - 2) In the OFF position, the grit classifier shall stop.
 - 3) In the AUTO position, the grit classifier shall start and stop when the grit pump starts and stops. A 0-30 minute "off delay" timer shall be provided to allow the grit classifier to run for a set period of time after the grit pump turns off.
- i. Timers
 - 1) Provide a 24-hour time clock to cycle grit system starts.
 - 2) Provide adjustable timers for grit pump and grit classifier.
- j. Indicator Lights
 - 1) Provide local indicator lights that indicate the ON, OFF, or FAIL status of the grit chamber drive, blower, and grit classifier.
 - 2) Provide an indicator light that indicates power is supplied to the control panel.
- k. Emergency Stop Button
 - 1) Provide an emergency stop button on the control panel that will stop all pieces of equipment when pressed.
- l. Run Time Meter
 - 1) Provide run time meters for grit chamber drive, grit pump, and grit classifier.

- m. Terminal Block
 - 1) Provide 25-percent spare terminals.
- n. Ground Bus
 - 1) Provide an internal copper ground bus for grounding connections.
- o. Panel Nameplate
 - 1) Provide name plates for all items on the control panel.
- p. I/O Contacts
 - 1) Provide 5 Amp, 120VAC rated output contacts for the following:
 - a) Remote indication of grit systems LOCAL/REMOTE status
 - b) Grit system paddle drive ON/OFF and Common Alarm status
 - c) Grit pump ON/OFF status and AUTO mode
 - d) Grit pump common alarm
 - e) Grit system prime failure
 - f) Grit classifier ON/OFF status and AUTO mode
 - g) Grit classifier common alarm.
 - 2) Provide input contacts for the following:
 - a) Grit system START command.
- q. Motor Starters
 - 1) Provide Combination Full-Voltage Motor Starters with circuit breakers in the control panel for grit system paddle drive, grit pump, and grit classifier.
 - 2) The circuit breakers shall have a minimum interrupting capacity of 42,000 RMS symmetrical amperes.
- r. Current Monitor
 - 1) Provide a current monitor for overload protection for grit system paddle drive, grit pump, and grit classifier.
- s. Surge Suppression Unit
 - 1) Provide a surge suppressor in the control panel to protect against lightning and other surges. Connect surge suppressor to the incoming feeder terminals.

3 EXECUTION

3.1 INSTALLATION

- A. Grit removal equipment and appurtenances shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Grit removal equipment and appurtenances shall be field tested after installation to demonstrate proper operation to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.

- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **

SECTION 11330
MEMBRANE BIOLOGICAL REACTOR SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation a membrane biological reactor systems and appurtenances as specified herein and as shown on the drawings.
- B. The membrane biological reactor system equipment and appurtenances will be provided by GE Water and Process Technologies, Inc.
- C. The cost for this equipment has been pre-negotiated.
- D. Contractor shall refer to GE Water and Process Technologies "As Sold Proposal" and "Contractor Package," provided in Appendix A and Appendix B, respectively, for a complete description of the equipment that will be supplied.

1.2 SUBMITTALS

- A. The contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings that show plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, piping diagrams, wiring diagrams, and electrical data, as appropriate, to support the design of the equipment being provided.
 - 3. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operation and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.

2 PRODUCTS

2.1 MANUFACTURERS

- A. GE Water and Process Technologies, Inc. ZENON Membrane Solutions

2.2 EQUIPMENT

- A. Contractor shall refer to the Bill of Materials in GE Water and Process Technologies "As Sold Proposal" for a complete list of equipment being provided.
- B. In general, the following equipment will be provided as part of the membrane biological reactor system.
 - 1. Membrane Biological Reactor Control Panel

2. Membrane Blowers
3. Process Blowers
4. Process Basin Mixers
5. Process Basin Fine Bubble Diffusers
6. Membranes
7. Process Pumps
8. Anaerobic Return Activated Sludge Pumps
9. Anoxic Return Activated Sludge Pumps
10. Waste Activated Sludge/Drain Pumps
11. Citric Acid Chemical Feed System
12. Sodium Hypochlorite Chemical Feed System
13. Air Compressors for Pneumatic Air System
14. Miscellaneous Flow Meters
15. Miscellaneous Process Monitoring Instruments
16. Miscellaneous Valves and Valve Operators

3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be installed in accordance with the manufacturer's requirements to produce a finished product that is clean and demonstrates true craftsmanship. The controls shall be easily accessed, moving components shall be adequately shielded, and walking areas shall be unobstructed.
- B. Half of the MBR system will be installed in the existing trains that do not currently have any equipment installed in them. This half of the MBR system shall be placed into service and made operational. Once it is operational, the second half of the MBR system will be constructed in the existing process trains that are in use. Contractor shall allow at least 8 weeks in the schedule to start up the biological process for Phase 1 prior to being able to begin Phase 2 construction.
- C. All seed sludge that is pumped into the new process basin must be screened with minimum 2-mm screen.
- D. Prior to installing membranes in the membrane tanks, it is critical that ALL construction debris be removed from the process basins, channels, pipes, etc. Membrane fibers can be easily damaged by the construction debris, especially metal shavings. Once membranes are installed, contractor shall prevent construction debris from being introduced into the process basins where it can end up in the membrane tanks. If membranes are damaged by construction debris, Contractor shall be responsible for replacing the membranes at no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. A manufacturer's certified representative shall be made available to the contractor during equipment installation.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certification shall be provided that states that the equipment is installed properly, is operating within the design parameters, and will be warranted as required by these specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11365
ULTRAVIOLET DISINFECTION SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation an open channel, gravity flow ultraviolet disinfection system and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings that show plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, piping diagrams, wiring diagrams, and electrical data, as appropriate, to support the design of the equipment being provided.
 - 3. Independent bioassay validation and dosage calculations verifying compliance with the specified dose requirements. Bioassay validation shall be signed and sealed by a registered professional engineer.
 - 4. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operation and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship, and materials under normal use, operation, and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and shall apply to all similar units.
- C. UV lamps shall be warranted for 12,000 hours of operation, provided there are no more than four (4) on/off cycles per 24-hour period. The warranty shall be prorated after 9,000 hours of operation. If a UV lamp fails within 9,000 hours of operation, it shall be replaced at no cost to the owner.
- D. Electronic ballasts shall be warranted for five (5) years. The warranty shall be prorated after one (1) year. If an electronic ballast fails within one (1) year, it shall be replaced at no additional cost to the Owner.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers
 1. Trojan, UV 3000 Plus
 2. WEDECO, TAK 55

2.2 DESIGN CRITERIA

- A. Provide an ultraviolet disinfection system that meets the following design criteria.

Design Criteria	Design Value
Peak Flow Rate	6.00 MGD
Number of Channels	1
Number of Banks per Channel	2 (1 duty, 1 standby)
Fecal Coliform Bacteria (Monthly Geometric Mean)	≤ 200/100 ml
Fecal Coliform Bacteria (Maximum per Sample)	100/100 ml
Minimum UV Dosage at End of Lamp Life *	30 mJ/cm ²
Minimum UV Transmittance at 253.7 nm	70%
End of Lamp Life Factor	0.80
Lamp Fouling Factor	0.90
Total Suspended Solids	≤ 5 mg/l
Turbidity	3 NTU
Maximum Head Loss @ Peak Flow	1.00 ft
Minimum Water Temperature	13 °C

* The UV dosage at the end of the lamp life shall be as required for the ultraviolet disinfection system manufacturer to guarantee that the system will meet the fecal coliform bacteria requirements; however, the UV dosage at the end of the lamp life shall be no less than the dose specified.

- B. One ultraviolet disinfection system bank will be duty and one will be standby.

2.3 CONSTRUCTION

A. General

1. The ultraviolet disinfection system shall be open channel type and shall utilize low-pressure, high-output amalgam ultraviolet lamps.
2. UV lamp array shall be configured so that all lamps are parallel to each other and parallel to the flow.
3. All metal components that come into contact with water shall be Type 316L stainless steel.
4. All metal components located above the top of channel and do not come in contact with water shall be Type 304L stainless steel.
5. All materials that are exposed to the ultraviolet light shall be UV resistant.
6. The entire ultraviolet disinfection system shall be designed for outdoor installation.

B. UV Module

1. UV modules will consist of UV lamps mounted on a Type 316L stainless steel frame.

C. UV Lamps

1. UV lamps shall be low-pressure, high-output amalgam lamps.
2. UV lamp life shall be guaranteed for 12,000 hours of operation.
3. UV lamps shall be capable of operating at variable power levels.

D. Quartz UV Lamp Sleeves

1. UV lamps shall be protected from direct contact with the water by high purity quartz sleeves.
2. Quartz sleeves shall have a minimum UV transmittance of 90-percent at 253.7 nm.
3. UV lamps shall be removable from the quartz sleeve.

E. UV Monitoring System

1. One (1) ultraviolet intensity sensor shall be provided in each UV bank to measure the ultraviolet intensity in each UV bank.
2. The ultraviolet intensity sensor shall produce a 4-20 mA control signal that shall be transmitted to the PLC.
3. The measured ultraviolet intensity shall be displayed on the operator interface as an absolute value in mW/cm^2 .

F. Mechanical Cleaning System

1. Each UV bank shall be equipped with a mechanical cleaning system.
2. The mechanical cleaning system shall be automatic.
3. The mechanical cleaning system shall operate on a timer. Wiping frequency and number of strokes per wiping cycle shall be adjustable.

G. Effluent Level Controller

1. Provide a Type 316 stainless steel labyrinth weir with a minimum 70-foot weir length to control water level in UV channel.

H. Low Water Level Sensor

1. Provide one (1) low water level sensor to monitor water level in the UV channel.

I. Davit Crane

1. Provide one (1) Type 304 stainless steel davit crane with base for UV module removal/handling.
2. Davit crane shall be capable of reaching each UV module in each UV bank from a single location.

2.4 ELECTRICAL

A. General

1. UV system supplier shall provide a complete UV power and control system package such that the operation of the UV system will be fully automatic.
2. UV system shall be suitable for 480V, 3 phase, 60 Hz service.
3. UV system power and control enclosure(s) shall be rated NEMA 4X with air conditioning unit(s), if required. Control enclosures will be located outdoors in a non-temperature controlled environment.
4. UV manufacturer shall provide conduits/cables of adequate length to connect the UV lamps to the control panel.

2.5 INSTRUMENTATION AND CONTROL

A. General

1. UV system supplier shall provide their standard control system package that allows the UV system to be fully automatic.

2. UV system control and interface shall be by an Allen Bradley PLC system and Allen Bradley Panel View HMI. HMI shall be mounted at eye level on the front of the control panel.
3. The UV system shall have the ability to adjust the power level of the UV lamps based on a 4-20 mA plant flow rate input.
4. The UV system shall have fiber optic cable Ethernet connection to connect to the plant SCADA system for remote monitoring. See Electrical and Instrumentation Drawings for details.

B. Isolation Transformers

1. Provide isolation transformers with 480 V, 3-phase input and 480/277 V, 3-phase, 4-wire output if the Trojan UV system is provided or provide isolation transformers with 480 V, 3-phase input and 400/230 V, 3-phase, 4-wire output if the WEDECO UV system is provided.
2. Isolation transformers shall be k-rated with supplier recommended kVA ratings.

C. Circuit Breakers

1. Each UV control panel shall be provided with a circuit breaker to accept the feeder from the isolation transformer.
2. The circuit breaker rating shall be as required for the application.

D. Surge Suppression Unit

1. Provide a surge suppressor in each control panel to protect against lightning and other surges. Connect a surge suppressor to the incoming feeder terminals.

2.6 SPARE PARTS AND TOOLS

A. Provide the following spare parts with each closed vessel ultraviolet disinfection system.

1. Ten (10) percent UV lamps (rounded up)
2. Ten (10) percent quartz sleeves (rounded up)
3. Five (5) percent electronic ballasts (rounded up)
4. Ten (10) percent wipers (rounded up)
5. One (1) UV intensity sensor

B. Provide the following tools and miscellaneous equipment.

1. One (1) set of all special tools (including tool box) required for working on the UV system
2. Two (2) face shields that block UV light

C. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for.

D. Spare parts shall be of the same type and quality as the parts provided in the original equipment package.

3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be installed in accordance with the manufacturer's requirements to produce a finished product that is clean and demonstrates true craftsmanship. The controls shall be easily accessed, moving components shall be adequately shielded, and walking areas shall be unobstructed.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. A manufacturer's certified representative shall be made available to the contractor during equipment installation.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certification shall be provided that states that the equipment is installed properly, is operating within the design parameters, and will be warranted as required by these specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11370
SLUDGE DEWATERING SYSTEM

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section include furnishing all labor, materials, and equipment required to relocate and install a sludge dewatering system as specified herein and as shown on the drawings.
- B. The Henry County Water Authority has an existing sludge dewatering system located at the Springdale Road Wastewater Treatment Plant which has been decommissioned. This sludge dewatering system shall be dismantled, transported to the Indian Creek Water Reclamation Facility, and reinstalled as a complete and operational system as specified herein and as shown on the drawings.
- C. Contractor shall provide all labor, materials, and equipment to dismantle, load, haul, unload, and install sludge dewatering equipment. Only major equipment will be relocated. Contractor shall be required to provide new piping, valves, fitting, and appurtenances, as required, to reinstall sludge dewatering system.
- D. Equipment that will be relocated includes the following:
 - 1. Belt filter press
 - 2. Sludge grinder
 - 3. Hydraulic power unit
 - 4. Wash water feed pump
- E. Contractor shall properly dispose of all materials that are dismantled but are not reused.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, pump performance curves, motor performance data, piping diagrams, and wiring diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Submit control panel schematics and layout drawings and submit manufacturer's catalog information for all components used.
 - 4. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.

- B. Equipment manufacturers that are providing new equipment or modifying existing equipment shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 SLUDGE FEED PUMP

- A. Provide new sludge feed pump in accordance with Section 11246, Self-Priming Centrifugal Pumps.

2.2 POLYMER FEED SYSTEM

- A. Provide a new polymer feed system in accordance with Section 11256, Polymer Feed System.

2.3 BELT CONVEYOR

- A. The existing belt conveyor was provided by Keystone Conveyor Corporation, 19992 Ferret Street N.W., Elk River, MN 55330 – (763) 712-1322.
- B. Existing belt conveyor shall be extended to serve the relocated belt filter press.
- C. Extended belt conveyor shall be capable of conveying 12 tons per hour of dewatered sludge weighing 60 to 65 pounds per cubic foot.
- D. At a minimum, belt conveyor extension shall include the following:
 - 1. Complete new belt. Belt is 18-inch wide, 2-ply, 220 P/W, cross rigid, MOR belting with 3-inch high corrugated sidewalls and stainless steel hinged mechanical splice.
 - 2. CEMA-C, 5-inch diameter corrosion resistant idlers with seal bearings.
 - 3. Twelve-gauge, hot-dip galvanized mild steel skirting at load area from relocated belt filter press.
 - 4. Hot-dip galvanized mild steel conveyor frame and supports. Supports on +/-10'-0" centers on the floor.
 - 5. Twelve-gauge, hot-dip galvanized steel deck plate and drip pans.
 - 6. Safety stop pull cord switch cable fittings for new conveyor length.

2.4 ACCESS PLATFORMS

- A. Contractor shall provide new access platforms for the relocated belt filter press. Access platforms shall be similar to the access platforms for the existing Indian Creek WRF belt filter press.
- B. Contractor shall be responsible for taking measurements of the relocated belt filter press after it is installed and submitting shop drawings for the new access platforms.
- C. Access platforms shall be manufactured from galvanized steel shapes and grating.

2.5 CONTROL PANEL

- A. New belt filter press control panel shall be supplied and installed by Electrical Contractor. See Electrical Drawings for panel details and for Sludge Dewatering System components wiring.

3 EXECUTION

3.1 GENERAL

- A. Contractor shall dismantle the existing sludge dewatering system at the Springdale Road WWTP and transport the major equipment specified to the Indian Creek WRF. The

Springdale Road WWTP is located near the intersection of East Lake Parkway and Springdale Road in Stockbridge, GA.

- B. Contactor shall install the relocated system integrating in new equipment as specified to produce a complete and operational system.
- C. The belt filter press that will be relocated is a Series-4WL (Model 2200) belt filter press manufactured by Enviroquip, Inc. (a.k.a. Ovivo USA, LLC), 2404 Rutland Drive, Suite 200, Austin, TX, 78758. Contractor shall contract with the belt press manufacturer to assist with the reinstallation of the relocated sludge dewatering system. Belt press manufacturer shall perform an inspection and startup of the belt filter press and identify any parts that may need replacement.

3.2 INSTALLATION

- A. Sludge dewatering system shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 STARTUP AND TESTING

- A. Sludge dewatering system shall be field tested after installation to demonstrate satisfactory operation to the satisfaction of the Engineer. Field tests shall be conducted by the Belt Press Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.4 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11377
FINE BUBBLE AERATION EQUIPMENT

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation fine bubble aeration equipment and appurtenances as shown on the Drawings and/or specified herein.
- B. The existing fine bubble aeration equipment in Aerobic Digesters No. 1 and No. 2 shall be removed and replaced with new fine bubble aeration equipment and new fine bubble aeration equipment shall be installed in Aerobic Digesters No. 3 and No. 4.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the equipment being provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, certified oxygen transfer performance curves, and piping diagrams, as appropriate, to support the design of the equipment being provided.
 - 3. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall end one (1) year from completion of the project or from date of engineer's acceptance of the equipment for permanent operation. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Sanitaire
 - 2. Environmental Dynamics, Inc.
 - 3. Aquarius Technologies, Inc.

2.2 DESIGN CRITERIA

- A. Provide a fine bubble aeration system for the aerobic digesters that meets the following design criteria.

Number of Tanks	4
Tank Width	30'-0"
Tank Length	80'-0"
Maximum Side Water Depth	15'-0"
Maximum Diffuser Submergence	13'-10"±
Number of Grids per Tank	2
Number of Drop Legs per Grid	1
Drop Leg Diameter	6"
Number of Air Distributors per Grid	14
Number of Diffusers per Air Distributor	26
Number of Diffusers per Grid	364
Number of Diffusers per Tank	728
Total Number of Diffusers	2,912
Average Air Flow Rate per Tank	1,092 SCFM
Average Air Flow Rate per Diffuser	1.5 SCFM
Maximum Air Flow Rate per Tank	2,912
Maximum Air Flow Rate per Diffuser	4 SCFM
Membrane Disc Diameter	9"

2.3 CONSTRUCTION

A. General

1. Diffuser design and configuration shall be identical to the existing diffuser configurations in Aerobic Digester Tanks No. 1 and No. 2 that are being replaced.

B. Materials, Fabrication, and Finishing

1. Stainless Steel

- a. Fabricate all welded parts and assemblies from sheets and plates of 304 stainless steel conforming to ASTM A240.
- b. Fabricate non-welded parts and pieces from sheets, plates or bars of 304 stainless steel conforming to ASTM A240 or ASTM A276.
- c. Provide drop legs of the diameter specified with dimensional tolerances conforming to ASTM A554.
- d. Piping shall have a minimum nominal wall thickness of 0.109-inches.
- e. All flanges shall be stainless steel.
- f. Nuts, bolts and washers including anchor bolts shall be Type 316 stainless steel.
- g. Fabricate all applicable products and fittings conforming to ASTM A774 and A778.
- h. Welds
 - 1) Welding shall be done in the factory. Field welding is not permitted.
 - 2) Clean all welded stainless steel surfaces and welds after fabrication.

2. Neoprene

- a. Furnish all gaskets of fiber reinforced neoprene – 45 to 50 durometer (Shore A).

3. Natural Rubber

- a. Furnish all fixed and expansion joint O-ring gaskets of natural rubber/SBR with a Shore A durometer of 45 ± 5.

4. Polyvinyl Chloride (PVC) Pipe and Fittings

- a. Produce all PVC pipe and fittings from PVC compound with a minimum tensile strength of 7000 psi.
 - b. Lower drop pipe, manifold and air distributors shall be SDR 33.5 per ASTM D3195.
 - c. Design air distributors and manifolds to withstand 125° F mean wall temperature.
 - d. Add two parts by weight of titanium dioxide per 100 parts of resin to PVC compounds for air distributors, joints and PVC diffuser assembly components to minimize ultraviolet light degradation.
 - e. Factory solvent weld all PVC joints and diffuser holders. Field solvent welding is not permitted.
5. EPDM – Membrane Diffusers and Gaskets
- a. Manufacture circular membrane diffuser discs with integral O-ring of EPDM synthetic rubber compound with precision die formed slits.
 - b. Add carbon black to the material for resistance to ultraviolet light.
 - c. Design diffuser as one-piece injection molded part with a minimum thickness of 0.080 inches for 9-inch diameter unit.
 - d. Limit the maximum tensile strength of the diffuser to 10 psi when operating at 2.4 SCFM/ft² of material. Furnish proportionately thicker material for larger diameter disc diffusers to limit the maximum tensile stress and to resist stretching.
 - e. Produce diffusers free of tears, voids, bubbles, creases or other structural defects.
 - f. Diffuser material shall meet the following criteria.

Item	Value/Units	ASTM
Base Polymer	EPDM	D573
UV Resistance	Carbon Black	
Specific Gravity	1.25 or less	
Durometer – Minimum	58% ± 5%	D2240
Modulus of Elasticity	500 psi	D412
Ozone Resistance (72 hrs: 40°C pphm)	No cracks @ 2X magnification	D1171 Test A
Tensile Strength	1,200 psi	D412
Elongation - % - Retained 70 hrs @ 100°C - minimum at break	75% Max 350%	D573 D412

C. Fine Bubble Aeration System Components

- 1. Drop Leg
 - a. Provide a 6-inch Type 316 stainless steel drop leg starting with a flange at the isolation butterfly valve at the top of the tank.
 - b. Provide a stainless steel band clamp coupling with gasket for the lower drop leg to manifold connection.
- 2. Manifolds
 - a. Provide PVC manifolds for connection to the air distribution headers.
 - b. Fabricate manifolds with fixed threaded union or flanged joints for connection to the air distributors.
 - c. Design manifold, distributor connections and supports to resist thrust generated by expansion/contraction of the air distributors over a temperature range of 125°F.
 - d. Connect manifolds with fixed threaded union or flanged joints to prevent rotation or blow apart.

3. Air Distributors and Diffuser Holders
 - a. Provide air distributors perpendicular to the air manifold
 - b. Fabricate distributors with single diffuser holders, solvent welded to the crown of the air distributor for complete air seal and strength.
 - c. Design distributors and holders to resist a dead load of 200 lbs applied vertically to the outer edge of the diffuser holder.
 - d. Provide threaded removable end caps complete with gasket, threaded coupling and end plate for clean out at the end of each distributor.
4. Air Distributor and Manifold Connection Joints
 - a. Join air distributor sections with positive locking fixed threaded union or flange type joints for all submerged header joints to prevent blow apart and rotation.
 - b. Design threaded union joints with spigot section connected to one end of the distribution header, a threaded socket section connected to the mating distribution header, an "O" ring gasket and a threaded screw on retainer ring. Factory solvent weld all joints.
 - c. Design flange joints with an angle face ring, follower flange with a 125-pound drill pattern and stainless steel hardware.
5. Supports
 - a. Provide adjustable pipe supports for the manifolds and air distributors.
 - b. Maximum support spacing shall be 8 feet.
 - c. Design all supports to allow for thermal expansion and contraction forces over a temperature range of 125°F and to minimize stress build up in the piping system.
 - d. Design supports to be adjustable without removing the air distributor from the support.
6. Diffuser Assemblies
 - a. Furnish diffuser assemblies including diffuser, diffuser gasket, holder, retaining ring and air flow control orifice.
7. Membrane Diffuser
 - a. Incorporate an integral check valve into the membrane diffuser.
 - b. Design and test diffusers for a dynamic wet pressure (DWP) of 12 inches \pm 20% water column @ 1.0 SCFM/diffuser and 2 inches submergence.
 - c. Observe diffusers for uniform air distribution across the active surface of the diffuser at 1.0 SCFM/diffuser and 2 inches of submergence. Active surface is defined as the perforated horizontal projected area of the diffuser.
 - d. Test diffuser using primary sampling criteria outlined in Military Standard 105E.
8. Diffuser Holders, Support Plate and Retainer Rings
 - a. Design holder with air flow control orifice and plenum chamber below the diffuser. Holder to provide peripheral support for the diffuser.
 - b. Provide a PVC support plate to form an air plenum under the diffuser and support for the membrane when the air is off.
 - c. Design retainer ring to seal the diffuser and O-ring in the holder to prevent air leakage around gasket.
 - d. Design retainer ring threads with minimum cross section of 1/8 inch and allow for one complete turn to engage threads.
9. Anchor Bolts

- a. Design anchor bolts for embedment in 4000 psi concrete with a pullout safety factor of 4.
- b. Provide a mechanical stainless steel expansion type anchor bolt system.

10. Liquid Purge System

- a. Provide a liquid purge system to drain the entire submerged aeration piping system for each aeration grid including airlift purge eductor line and control valve.

2.4 SPARE PARTS

- A. Provide the following spare parts.
 1. 260 diffuser elements with lubricant
 2. 26 diffuser retainer rings
 3. 26 base plates
 4. 26 diffuser holders
 5. 2 air distributor supports
 6. 2 air distributor sections
 7. 2 air distributor repair couplings
 8. 2 fixed joint assemblies
 9. One (1) 9-inch diffuser wrench
- B. Spare parts shall be boxed and clearly labeled as to what equipment it is provided for.
- C. Spare parts shall be of the same type and quality as the parts provided in the original equipment package.

3 EXECUTION

3.1 INSTALLATION

- A. Fine bubble aeration system and appurtenances shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. Fine bubble aeration system and appurtenances shall be field tested after installation to demonstrate proper operation to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.

- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **

SECTION 11500
HIGH DENSITY CROSS-LINKED POLYETHYLENE STORAGE TANKS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation high density cross-linked polyethylene storage tanks and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Dimensional drawings of tanks showing the location and orientation of openings, fittings, accessories, restraints, and supports
 - 2. Tank and fitting material
 - a. Resin manufacturer data sheet
 - b. Fitting material
 - c. Gasket style and material
 - d. Hardware material
 - 3. Calculations prepared and stamped by an engineer registered in the state of Georgia.
 - a. Wall thickness calculations per ASTM D 1998 using 600 PSI design hoop stress
 - b. Tank restraint system
 - 4. Electrical heat trace and foam insulation data sheets
 - 5. Printed warranty
 - 6. Certified Factory Test Report
 - a. Material verification
 - b. Wall thickness verification
 - c. Fitting placement verification
 - d. Visual inspection
 - e. Impact test
 - f. Gel test
 - g. Hydrostatic test

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.

- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for five (5) years from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
1. Poly Processing Company
 2. Snyder Industries, Inc.
 3. Assmann Corporation of America

2.2 DESIGN CRITERIA

- A. Provide one (1) high density cross-linked polyethylene storage tanks that meets the following design criteria.

Volume	Minimum 8,000 Gallons
Chemical Stored	Alum
Chemical Concentration	48.5%
Specific Gravity	1.34
Minimum Ambient Air Temperature	0 °F
Tank Diameter	Maximum 12'-0"
Tank Specific Gravity Rating	1.90
Exposure	Outside

- B. Provide one (1) high density cross-linked polyethylene storage tanks that meets the following design criteria.

Volume	Minimum 12,000 Gallons
Chemical Stored	Sodium Hydroxide
Chemical Concentration	50%/25%
Specific Gravity	1.52/1.27
Minimum Ambient Air Temperature	0 °F
Tank Diameter	Maximum 12'-0"
Tank Specific Gravity Rating	1.90
Exposure	Outside

2.3 CONSTRUCTION

A. General

1. Tanks shall be rotationally-molded, vertical, high density cross-linked polyethylene, one-piece seamless construction, cylindrical in cross-section, flat bottomed, domed top, and vertical.

2. Tanks shall be provided with an entrance man-way, fittings, electrical heat tracing, spray-on urethane foam insulation, and exterior coating.
3. Tanks shall have no bolt hole penetrations through the tank wall below the maximum storage level. All outlets below the maximum storage level shall be integrally molded outlets. Anchorage of accessories to the sidewalls shall be accomplished with stainless steel straps with welded on threaded studs that wrap around the tank.
4. Tanks shall be marked to identify the manufacturer, date of manufacture and serial number.
5. Unless otherwise specified, all metallic hardware, bolts, nuts, washers, etc. shall be Type 316 stainless steel.
6. All gasket materials shall be EPDM.

B. Polyethylene Storage Tanks

1. Tanks shall be manufactured using high density cross-linked polyethylene resin manufactured by Exxon Mobil Chemicals, or equal.
2. All materials shall be NSF/ANSI Standard 61 certified for storage of the specified chemical(s).
3. Resin shall contain a minimum of a UV 8 ultraviolet stabilizer.
4. Tank material shall meet or exceed the following properties:

Property	ASTM	Value
Density, g/cc	D1505	0.938-0.946
Environmental Stress Cracking Resistance, F50, hours, 10% Igepal	D1693	>1,000
Tensile Strength, Ultimate PSI, 2-inch/minimum	D638	>2,600
Elongation at Break, %, 2-inch/minimum	D638	>300
Vicat Softening Point, °F	D1525	248
Impact Brittleness Temperature, °F	D746	< -180
Flexural Modulus, PSI	D790	87,000

5. Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D 1998. Tanks shall be designed using a hoop stress no greater than 600 psi at 100 °F. Wall thickness calculations shall assume that all tank contents have a specific gravity of not less than 1.9.
6. In NO case shall the tank thickness be less than design thickness.
7. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation.

$$T = P \times OD/2SD \text{ or } 0.433 \times SG \times OD \times H \times OD/2SD$$

Where:

- T = wall thickness, in
- P = pressure, psi
- SG = specific gravity, gm/cc
- H = fluid head, ft
- OD = outside diameter, ft
- SD = hydrostatic design stress, 600 psi

8. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.1875" thick.

9. Top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.
10. Bottom head shall be integrally molded with the cylindrical wall.
 - a. The minimum Knuckle Radius for tanks with a diameter less than or equal to 6-feet shall be 1-inch.
 - b. The minimum Knuckle Radius for tanks with a diameter greater than 6-feet shall be 1-1/2 inch.
11. Tank outlet shall be integrally molded to the tank. Outlet shall have a 4-inch diameter 150 lb. flange connection.
12. Tank identification shall be permanently embossed into tank.
 - a. Manufacturer
 - b. Date of Manufacture
 - c. Serial Number
13. Tanks shall have a minimum of 3 lifting lugs.
 - a. Lifting lugs shall be designed for lifting the tank when it is empty.
14. Tanks shall have a minimum of 4 tie-down lugs.
 - a. Design tie-down lugs in accordance with 2012 International Building Code with 2014 Georgia Amendments. Assume 100 MPH wind load. Design shall be sealed by a structural engineer registered in the state of Georgia.
 - b. Metal components shall be Type 316 stainless steel and cables shall be PVC/vinyl coated Type 316 stainless steel.
15. Manway
 - a. Provide 24-inch diameter manway.
 - b. Metal components shall be Type 316 stainless steel.
 - c. Gasket material shall be EPDM.
16. Tank color shall be natural.

2.4 TANK ACCESSORIES

A. Ladder

1. Provide fiberglass access ladder with safety cage and standing platform with handrails for each tank.
2. Standing platform shall be minimum 24" x 24" square and shall be located 48" below the top of the tank. Safety handrails around standing platform shall be supplied.
3. Ladder anchors shall not penetrate the tank wall below the maximum storage elevation.
4. Use proper chemical resistant materials when anchoring to tank dome.
5. Ladders shall be designed to OSHA standard 2206; 1910.27.
6. Ladder design shall be signed and sealed by a registered professional engineer.
7. Ladders shall be mounted in a manner that will allow for tank expansion and contraction due to temperature and loading changes.
8. Fiberglass material shall be premium grade polyester resin with flame retardant and UV inhibitor additives.
9. Color: yellow

B. Fittings

1. Each tank shall be provided with the following fittings. Refer to drawings for locations.

- a. Fill Line
 - 1) Provide 2" PVC through dome fill assembly with external fill piping and internal anti-foam elbow. External piping shall be supported without penetrating the tank wall below the maximum storage level.
 - b. Overflow
 - 1) Provide 2" PVC through dome fitting for overflow piping. External overflow piping shall be supported without penetrating the tank wall below the maximum storage level.
 - c. Tank Drain Connection
 - 1) Provide a 4" flexible connection piece that connects the integrally molded drain connection.
 - d. Vent
 - 1) Provide minimum 6" PVC "U" vent fitting with PVC or polypropylene insect screen. Provide larger vent if manufacturer design calculations indicate a larger vent is required.
 - e. Level Sensor
 - 1) Provide 4" PVC through dome fitting with flange adapter for mounting ultrasonic level sensor.
 - f. Reverse Float Level Gauge
 - 1) Provide appropriate fittings and accessories for a reverse float level gauge on each tank. External piping shall be supported without penetrating the tank wall below the maximum storage level. All materials shall be compatible with chemical being stored.
2. Fitting shall be Schedule 80 PVC or a material that is compatible with the chemical being stored.
 3. Threads on threaded fittings shall be National Pipe Thread (NPT).
 4. Fittings shall be installed at the factory prior to application of the insulation.
 5. Gasket material shall be EPDM or a material that is compatible with the product being stored and shall be a minimum of ¼-in thick.
 6. All metal hardware, bolts, nuts, washers, etc. shall be Type 316 stainless steel.
 7. The head of the bolts for through dome fittings shall be encapsulated with polyethylene preventing fluid and vapor contact with the metal material. Encapsulated heads shall have a gasket to provide a sealing surface against the inner wall of the tank. Bolt holes shall straddle the principal centerline of the tank.
 8. Down pipes and fill pipes shall be supported at maximum 5-ft intervals. Down pipes and fill pipes shall be Schedule 80 PVC or material compatible with the chemical being stored.
 9. U-Vents
 - a. Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall be sized by the tank manufacturer and be furnished complete with insect screen.
 - b. U-vents shall be constructed of PVC or material compatible with the chemical stored.
- C. Tank Insulation and Heat Tracing
1. Tanks shall be heat traced and insulated.
 2. Heating systems shall be designed to meet the specific requirements of the tank such as tank material type, tank size, low ambient temperature, and desired maintenance temperature.

3. Heat tracing shall have a minimum delta-T of 60 °F.
4. Heating system components shall be NEMA 4 rated and factory pre-wired for 120 VAC.
5. Provide a control panel to monitor and operate the heat tracing system. The panel shall receive a single 120 volts, AC, 1-phase supply to operate the system as required. Provide all necessary components for a complete and fully functional system.
6. Insulation shall be polyurethane foam with a density of 2.0 - 3.0 lb/ft³ with an "R" value of 8.33/in.
7. The foam shall be applied with a nominal thickness of 2" to all external tank surfaces except the tank bottom shell.
8. Insulation shall be coated with a mastic material to protect the insulation from the outside environment.
9. Coating color shall be white.

D. Tank Labels

1. Labels identifying the chemical stored in the tank and the hazard rating.

2.5 FACTORY TESTING

A. Material Testing

1. Perform gel and low temperature impact tests in accordance with ASTM D1998 on condition samples cut from each polyethylene chemical storage tank.
2. Degree of Crosslinking
 - a. Use Method C of ASTM D1998-Section 11.4 to determine the ortho-xylene insoluble fraction of cross-linked polyethylene gel test. Samples shall test at no less than 60 percent.

B. Tank Testing

1. Dimensions
 - a. Take exterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D1998. Fitting placement tolerance shall be +/- 1/2-in vertical and +/- 1 degree radial.
2. Visual
 - a. Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking, and delamination.
3. Hydrostatic test
 - a. Following fabrication, the vertical, flat bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of 1/2 an hour and inspecting for leaks. Following successful testing, the vertical tank shall be emptied and cleaned prior to shipment.
4. Prior to shipping tanks, provide engineer with a certified statement from the tank manufacturer that each tank has passed these inspections.

3 EXECUTION

3.1 INSTALLATION

- A. High density cross-linked polyethylene tanks shall be installed in accordance with the Manufacturer's requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Contactor shall install six (6) layers of felt paper between the tank and the slab. Felt paper shall be trimmed to the diameter of the tank.
- C. All electrical conduits shall be routed above the top of the containment wall.

- D. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.2 STARTUP AND TESTING

- A. High density cross-linked polyethylene tanks shall be field tested after installation to demonstrate proper operation to the satisfaction of the Engineer. Field tests shall be conducted by the Manufacturer or his Authorized Representative. All tests shall be performed in the presence of the Engineer. Test results shall be in printed form and signed by the Manufacturer or his Representative and supplied to the Owner.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

3.3 CERTIFICATION

- A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certifications shall be provided that state the equipment is installed properly, is operating within the design parameters, and will be warranted as required by the specifications.

3.4 TRAINING

- A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.
- B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.
- C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.
- D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.
- E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

- A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **



SECTION 11510
FIBERGLASS SHELTERS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section include furnishing all labor, materials, and equipment required to install insulated fiberglass shelters and appurtenances as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the enclosure and equipment being provided.
 - 2. Printed warranty

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship and materials under normal use, operation and service. The warranty shall be for two (2) years from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Approved manufacturers include:
 - 1. Tracom, Inc.
 - 2. Warminster Fiberglass Company
 - 3. Engineer Approved Equal

2.2 DESIGN CRITERIA

- A. General
 - 1. Provide two (2) 120-inch wide by 96-inch deep by minimum 104-inch tall fiberglass reinforced plastic enclosures with sloped roof and double doors.
- B. Construction

1. Enclosures shall be manufactured out of fiberglass reinforced plastic having a minimum glass content of 25-percent. Interior and exterior surface shall each have a minimum 15 mil gel coat free from fiber pattern, roughness, and other irregularities. Interior and exterior laminate shall each be minimum 1/8" thick; chemically bonded to the surface gel coat and encapsulating the foam core.
 - a. Laminate Properties
 - 1) Minimum Tensile Strength (ASTM D638): 11,000 PSI
 - 2) Minimum Flexural Strength (ASTM D790): 18,000 PSI
 - 3) Minimum Shear Strength (ASTM D732): 12,000 PSI
 - 4) Minimum Barcol Hardness (ASTM D2583): 40
 - 5) Minimum Density/Specific Gravity (ASTM D792): 93.6 lbs/ft³/1.5
2. Fiberglass shall have a UV inhibitor to prevent degradation of the fiberglass reinforced plastic.
3. Enclosure color shall be white. Color shall be uniform through the entire thickness of the fiberglass reinforced plastic.
4. Design snow load shall be minimum 30 pounds per square foot.
5. Design wind load shall be minimum 125 MPH.
6. Enclosure shall be insulated with minimum 2" thick polyurethane foam insulation having a minimum density of 2 pounds per square foot, a minimum K-factor of 0.13 BTU inch/hr/ft²/°F, and a minimum R-value of 14.
7. All metal hardware and accessories shall be Type 316 stainless steel.
8. Enclosure shall be provided with double doors installed in the 120-inch wide wall having a minimum clear opening of 72-inches. Doors shall have the following accessories.
 - a. Type 316 stainless steel hinges
 - b. Type 316 stainless steel chain door stops
 - c. Type 316 stainless steel keyed cylindrical lockset with panic hardware
 - d. Neoprene weather-stripping
 - e. Type 316 stainless steel of fiberglass reinforced plastic threshold with neoprene gasket
9. Enclosure shall be provided with a Type 316 stainless steel or fiberglass reinforced plastic mounting flange for securing the enclosure to the floor. Enclosure shall also be provided with a neoprene gasket around the enclosure to provide a weather-tight seal between the flange and concrete floor.
10. Provide a minimum of two (2) stainless steel lifting eyes that can be used to move the enclosure.

2.3 ACCESSORIES

- A. Provide the following accessories with each fiberglass shelter.
 1. Electrical
 - a. Provide panel board rated for 120V/240V, 1 phase service mounted inside the shelter.
 - b. Panel board shall be minimum 125 A, main lug, 8 branch circuit breakers sized for the supplied loads, NEMA 3R rated thermoplastic enclosure. Panel Board shall provide power to all shelter electrical components. The lights, receptacles, exhaust fan and heater shall be preinstalled and prewired to the Panel Board by the shelter manufacturer.

- c. Electrical wiring shall be minimum 12 gauge stranded, color coded THHN/THWN/MTW electrical wiring in rigid, U.L. listed, corrosion resistant Schedule 40 PVC conduit.
 - d. Provide one (1) interior mounted 20A, 125V GFCI receptacle with 5mA, ± 1 mA trip threshold.
 - e. Provide one (1) exterior mounted weatherproof, double toggle switch box. One switch shall operate the light and one switch shall operate the fan.
 - f. All electrical equipment and devices shall be mounted a minimum of 48-inches above the finished floor.
2. Exhaust Fan
- a. Provide one (1) minimum 585 CFM, 10-inch diameter, corrosion resistant exhaust fan.
 - b. Fan shall be mounted on an automatic shutter and intake guard with a screened FRP outside vent cover.
 - c. Fan shall be wired to the exterior weatherproof double toggle switch.
3. Light
- a. Provide one (1) 48-inch 2-bulb, vapor-tight, fluorescent light fixture with cover.
 - b. Light shall be wired to the exterior weatherproof double toggle switch.
4. Vent
- a. Provide one (1) 10"x10" fiberglass gravity operated air intake vent with a screened FRP outside vent cover.
5. Heater
- a. Provide one (1) minimum 1,500 watt, 120V, corrosion resistant, wall mounted, fan-forced electric heater with built-in thermostat.

3 EXECUTION

3.1 INSTALLATION

- A. Fiberglass enclosures shall be installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.

** END OF SECTION **



SECTION 12121
PRE-ENGINEERED METAL BUILDING

1 GENERAL

1.1 DESCRIPTION

- A. This section includes materials, installation, and manufacturer's design of prefabricated metal buildings.

1.2 SUBMITTALS

- A. Submit shop drawings in accordance with the General Conditions, Section 01300, and the following:
- B. Submit letter of certification identifying the metal building manufacturer is IAS (AC472) certified fabricator and that all building components will be designed in accordance with the current edition of the IBC Building Code.
- C. Submit certification that the metal building manufacturer has been in business for at least 10 years and has designed and supplied at least five buildings similar to the specified project building. Include names of owners and locations for the referenced buildings.
- D. Submit manufacturer's catalog data describing the building construction and components. Submit project-specific design and erection drawings, shop painting and finishing specifications, instruction manuals, and other data to describe the design, materials, sizes, layouts, construction details, fasteners, and erection.
- E. Submit engineering design calculations for structural members and covering components, bracing, equipment supports, and anchor bolts. Submit the stress values utilized in the analysis stating the design criteria and procedures used. Design calculations shall be signed by a professional engineer registered in the state of Georgia.
- F. Submit certificate that the design meets the specified building codes.
- G. Submit erection drawings and diagrams for each building. Submit calculations verifying the base anchor/foundation assemblies indicated in the drawings are adequate to accommodate the project-specific metal building reactions. Show column base anchor details and anchor bolt sizes. Show roof and wall bracing.
- H. Submit color charts of the colors available for wall and roof panels, however, contract to include the cost to custom color match owners' preferred color for exterior wall panels.

1.3 GUARANTEE

- A. Buildings shall be guaranteed against water leaks arising out of or caused by ordinary wear and tear by the elements for a period of five years. Such guarantee is in addition to the guarantee required in the General Conditions and shall start upon final acceptance of the work by the Owner.
- B. Special Warranty on Metal Panel Finishes: Manufacturer's standard form in which manufacturer agrees to repair finish or replace metal panels that show evidence of deterioration of factory-applied finishes within specified warranty period, ABC Standard..
- C. Finish Warranty Period: 20 years from date of Substantial Completion.

2 MATERIALS

2.1 MANUFACTURERS

- A. Prefabricated metal buildings shall be manufactured by American Buildings, Butler, Varco-Pruden, or approved equal.

2.2 DESIGN CRITERIA

- A. Buildings shall be of the size and shape shown, complete with all accessories.

- B. The design of the building and components shall be in accordance with Metal Building Manufacturer's Association's "Recommended Design Practices Manual," latest edition, and the IBC Building Code.
- C. Design building for the dead load, specified live load, and the combinations of these loads as specified below. Reduction of loads due to tributary loaded area is permitted only for the rigid frames. Include the following loads in addition to the dead load:
 - 1. Live load 20 psf.
 - 2. A uniform collateral load of 5 psf in addition to the dead load of the building.
 - 3. Weights of mechanical equipment and process piping supported by the structure if greater than 8 psf.
 - 4. Wind load per the IBC requirements supplemented by ASCE 7-10: See Drawings.
- D. Rigid frame shall consist of welded up plate section columns and beams complete with necessary splice plates for bolted field assembly.
- E. End rigid frames shall be the same as interior rigid frames.
- F. Design structural steel members in accordance with AISC publication, "Specification for the Design, Fabrication, and Erection of Structural Steel for Buildings." Design structural cold-formed steel framing members in accordance with AISI publication, "Specification for the Design of Cold-Formed Steel Structural Members."
- G. Purlins and Girts shall be 8 in. minimum deep "Z" sections, precision roll formed.
- H. Eave struts shall be 8in. minimum deep "C" sections.
- I. All columns shall be designed as "Pin" connected. Moment transfer to footings will not be allowed.
- J. The building foundation plan is a preliminary design, the foundation design will be reviewed by the engineer once the Prefabricated Metal Building submittal is approved.
- K. Design framed openings to replace structurally the covering and framing displaced.
- L. Design 5-ton bridge crane runway beam support brackets as shown on design drawings. Design loads for support brackets shall be provided by the equipment manufacturer. Applicable impact load factors shall be included.
- M. Design of bridge crane runway rail stops.
- N. Welding of steel shall be in accordance with AWS D1.1.
- O. Except as modified hereinafter, design steel covering in accordance with AISI publication "Specification for the Design of Cold-Formed Steel Structural Members."
- P. Maximum wind load deflection for Primary Framing shall not exceed 1/60 of the eave height of the building.
- Q. Maximum wind load deflection for wall sheets shall not exceed 1/180 of the span between supports, and maximum live load deflection for roof sheets shall not exceed 1/180 of the span between supports. Maximum deflections shall be based on sheets continuous across two or more supports with sheets unfastened and fully free to deflect.

2.3 BRACING

- A. Provide roof bracing. Design bracing for controlling wind or seismic load combinations. Brace compression flanges of structural members as required by the code.

2.4 ASSEMBLY AND DISASSEMBLY

- A. The size of the prefabricated components and the field connections required for erection shall permit easy assembly and disassembly by means of the building manufacturer's standard fasteners and construction tools. The maximum size of any shop-assembled component of the building shall permit transportation from factory to site by commercial carrier.

- B. Clearly and legibly mark each and every piece and part of the assembly to correspond with previously prepared erection drawings, diagrams, and/or instruction manuals.
- 2.5 EXTERIOR COVERING COMPONENTS--STEEL
- A. Roof Covering shall be standing seam with minimum 26-gauge Galvalume steel sheeting conforming to ASTM A792, factory color finished. Panels shall have 2 major corrugations, 2 inches high not exceeding 24 inches.
 - B. Wall Covering shall be rib panel with minimum 26-gauge Galvalume steel conforming to ASTM A792, Galvalume, factory color finished.
- 2.6 ACCESSORIES
- A. Flashing, trim, metal closure strips, caps, and similar metal accessories shall be not less than the minimum thicknesses specified for covering. Molded closure strips shall be bituminous-saturated fiber, closed-cell or solid-cell synthetic rubber or neoprene, or PVC premolded to match configuration of the covering.
- 2.7 DISSIMILAR METAL ISOLATION
- A. Coat steel in contact with aluminum or aluminum-coated steel covering or provide rubber or nylon gaskets between steel and aluminum surfaces.
- 2.8 FASTENERS
- A. All structural framing shall utilize high-strength (H-S) bolts. H-S bolts, nuts, and washers shall conform to ASTM A325, Type 1 galvanized, ASTM A563, and ASTM F436, respectively. All hardware shall be galvanized.
 - B. Provide gasketed washers of a material compatible with the covering and with a minimum diameter of 3/8 inch for structural connections to waterproof the fastener penetration on the exterior side. Gasketed portion of washers shall be neoprene or other equally durable elastomeric material approximately 1/8 inch thick. Exposed wall fasteners shall be factory color finished or provided with plastic color caps to match the covering.
- 2.9 PAINTING OF ROOF PANELS
- A. Color finish roof covering at the factory on both sides. Prepare surfaces for coating by thoroughly cleaning, pretreating, and priming (if required by the finish coat) to provide a film that is compatible with the metal surface and the color finish. Treat galvanized steel surfaces per DOD-P-15328D. Clean surfaces of oil, grease, loose scale, and other foreign substances. Prime coat shall be in accordance with the manufacturer's standard system.
 - B. Color finish shall consist of a Kynar 500/Hylar 5000 fluoropolymer coating.
 - C. Dry-film coating thickness of the color coat shall be not less than 1.0 mil for exterior and interior surface finish. The exterior and interior finishing systems shall meet the quality standards specified in The Aluminum Association publication, "Aluminum Standards and Data," except that for salt spray resistance, exposure shall be 450 hours, and maximum undercutting from the scored line shall not exceed 1/8 inch.
 - D. Color shall match the color scheme at the existing project site.
- 2.10 FINISH OF GIRTS, PURLINS, BEAMS, COLUMNS, BRACING, AND EAVE STRUT
- A. Rigid frames and rod bracing shall be hot dipped-galvanized in accordance to ASTM A123
 - B. Secondary framing (Girts, Purlins, eave strut, etc) shall be galvanized with a G90 designation according to ASTM A653.
- 2.11 SEALANT
- A. Provide sealant of the type recommended by the building manufacturer at each joint.
- 2.12 SPARE PARTS
- A. Provide a minimum of 5% excess over the required amount of nuts, bolts, screws, washers, and other required fasteners with each building. Provide separate boxes for the parts for each building. Label each box with the name of the building to which it pertains; the

building manufacturer's name; and the local representative's name, address, and telephone number. Provide individual boxes for each item (nuts, bolts, washers, etc.).

3 EXECUTION

3.1 STORAGE AND PROTECTION

- A. Deliver, store, handle, and erect prefabricated components, sheets, panels, and other manufactured items such that they will not be damaged or deformed. Stock materials stored on the site before erection on platforms or pallets and cover with tarpaulins or other weathertight covering. Store metal sheets or panels so that water will drain off. Upon arrival on the jobsite, remove moisture on sheets and panels, restack, and protect until used.
- B. Do not store the sheets or panels in contact with materials that might cause staining. Remove stained, discolored, or damaged sheets from the site.

3.2 ERECTION

- A. Determine anchor bolt layouts before pouring concrete footings, walls, or slabs to support the buildings.
- B. Erect in accordance with the manufacturer's erection instructions and drawings and the requirements herein. Plug improper or mislocated drill holes with an oversize screw fastener and gasketed washers. Do not use sheets with an excess of such holes or with such holes in critical locations. Keep exposed surfaces clean and free from sealant, metal cuttings, and other foreign materials.
- C. Accurately set anchor bolts by template while the concrete is in a plastic state. Provide uniform bearing under baseplates and sill members using nonshrink grout. Accurately space members to assure proper fitting of covering. As erection progresses, securely fasten the work and brace to resist vertical loads and horizontal wind or earthquake loads.
- D. Apply wall covering with the longitudinal configurations in the vertical position. Apply roof covering with the longitudinal configurations in the direction of the roof slope.
- E. Except for self-framing buildings, make end laps over framing members with fasteners into framing members approximately 2 inches from the end of the overlapping sheet. Side lap distances, end lap distances, joint sealing, and spacing of fasteners shall be in accordance with the manufacturer's standard practice insofar as the maximum fastener spacing specified is not exceeded and provided such standard practice will result in a structure that will be free from water leaks and meet design requirements.
- F. Spacing of fasteners shall present an orderly appearance and shall not exceed 8 inches on center at end laps of covering, 12 inches on center at connection of covering to intermediate supports, 12 inches on center at side laps of roof coverings, and 18 inches on center at side laps of wall covering. Install fasteners in straight lines within a tolerance of 1/2 inch in the length of a bay.
- G. Seal side laps and end laps of roof and wall covering and joints at accessories. Drive fasteners normal to the surface and to a uniform depth to properly seat the gasketed washers. Fasten accessories into framing members.
- H. Insulate incompatible dissimilar materials that are in contact by means of gaskets or insulating compounds.

3.3 FIELD PAINTING

- A. Touch up galvanized coated surfaces with a heavy coat of zinc-rich touch-up paint.

** END OF SECTION **

SECTION 12670
UNIT KITCHENS AND CABINETS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section include furnishing all labor, materials, and equipment required to install unit kitchens and cabinets as specified herein and as shown on the drawings.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Product samples of cabinets, counter tops, hardware, etc.
 - 2. Drawings showing plan, elevation, and appropriate cross sections of the products being provided.
 - 3. Printed warranty

1.3 STORAGE AND PROTECTION

- A. Materials shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.4 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The manufacturer shall provide a warranty against defective or deficient workmanship and materials under normal use. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and apply to all similar units.

2 PRODUCTS

2.1 MATERIALS

- A. Wood Materials
 - 1. Softwood Lumber
 - a. PS 20
 - b. Graded in accordance with AWI Custom
 - c. Moisture content of 6-percent
 - 2. Hardwood Lumber
 - a. NHLA
 - b. Graded in accordance with AWI Custom
 - c. Moisture content of 6-percent
- B. Panel Materials
 - 1. Softwood Plywood
 - a. PS 1
 - b. Graded in accordance with AWI

- c. Core materials of particleboard.
 - 2. Hardwood Plywood
 - a. PS 51
 - b. Graded in accordance with AWI
 - c. Core materials of particleboard.
 - d. Type of glue recommended for application
 - 3. Wood Particleboard
 - a. PS 1
 - b. AWI standard
 - c. Composed of wood chips.
 - d. Medium density
 - e. Made with water resistant adhesive
 - f. Grade to suit application
 - g. Sanded faces
 - 4. Hardboard
 - a. ANSI A135.4
 - b. Pressed wood fiber with resin binder
 - c. Tempered grade
 - d. Smooth two sides
- C. Plastic Laminate Materials
 - 1. Product of one of the following manufacturer's
 - a. Formica Corporation
 - b. Micarta Corporation
 - c. Nevamar Corporation
 - d. Wilsonart International
 - e. Pionite
 - 2. High-Pressure Decorative Laminate
 - a. NEMA LD3, GP-50 General Purpose 0.050
 - 3. Low-Pressure Laminate
 - a. Melamine thermoset decorative overlay
 - 4. Color: To be selected from manufacturers standard selection.
- D. Countertops
 - 1. Tops shall be 1 ¼" thick build up utilizing M-2 engineered board core.
 - 2. Front edge to be Waterfall.
 - 3. Countertops shall conform to AWI-400C performance for fabricated high pressure decorative laminate countertops.
 - 4. Color: To be selected from manufacturers standard selection.
- E. Accessories
 - 1. Adhesive: Type recommended by AWI to suit application
 - 2. Fasteners: Size and type to suit application
 - 3. Bolts, Nuts, Washers, Lags, Pins, and Screws: Size and type to suit application

- 4. Concealed Joint Fasteners: Threaded steel
- F. Hardware
 - 1. Finish: Brushed Chrome

3 EXECUTION

3.1 FABRICATION

- A. Fabricate cabinets AWI AWQS, Section 400 – Architectural Cabinets, Custom Grade Standards.
- B. Shop assemble casework for delivery to site in units easily handled and to permit passage through building openings.
- C. Fit shelves, doors, and exposed edges with matching plastic edging. Use one piece for full length only.
- D. Cap exposed plastic laminate finish edges with material of same finish and pattern.
- E. When necessary to cut and fit on-site, provide materials with ample allowance for cutting. Provide trim for scribing and site cutting.
- F. Apply plastic laminate finish in full uninterrupted sheets consistent with manufacturers sizes. Fit corners and joints hairline; secure with concealed fasteners.
- G. Mechanically fasten backsplash to countertops with steel brackets at 16-inches on center.
- H. Provide cutouts for inserts, appliances, outlet boxes, fixtures, and fittings. Verify locations of cutouts from on-site dimensions. Prime paint cut edges.

3.2 EXAMINATION

- A. Verify that field measurements, surfaces, substrates, and conditions are as required and ready to receive work.
- B. Verify custom cabinet and fixture dimensions by field dimensions.

3.3 INSTALLATION

- A. Installed in accordance with the Manufacturers requirements to produce a finished product that is clean and demonstrates true craftsmanship.
- B. Set and secure fixtures in place; rigid, plumb, and level at locations indicated on Drawings.
- C. Attach to walls or floors with fasteners.
- D. Use fixture attachments in concealed locations for wall mounted components.
- E. Carefully scribe fixtures abutting other components, with maximum gaps of 1/32-inch. Do not use additional overlay trim for this purpose.
- F. Secure fixtures to floor using appropriate angles and anchorages.
- G. Countersink anchorage devices at exposed locations. Conceal with solid wood plugs of species to match surrounding wood. Finish flush with surrounding surfaces.

3.4 CONSTRUCTION

- A. Site Tolerances
 - 1. Maximum Variation from True Position: 1/16"
 - 2. Maximum Offset from True Alignment with Abutting Materials: 1/32"

3.5 FIELD QUALITY CONTROL

- A. Contractor shall inspect cabinet and fixture installation, alignment, attachment to structure, and connection to data and communication lines.

3.6 ADJUSTING

- A. Adjust moving or operating parts to function smoothly and correctly.

3.7 CLEANING AND PROTECTION

- A. Clean casework, counters, shelves, hardware, fittings, and fixtures.

** END OF SECTION **

SECTION 13660 SURGE PROTECTION

1 GENERAL

1.1 SECTION INCLUDES

- A. Comprehensive surge protection for all instrumentation devices supplied as part of these Specifications.

1.2 SUBMITTALS

- A. Submit detailed product data.

1.3 QUALITY ASSURANCE

- A. It is the responsibility of the System Manufacturer to provide appropriate protection against transients and surges for all field instruments, field wiring, and devices interfacing with control panels including but not limited to:
 - 1. All instrument signal wiring, control wiring, telephone wiring and data transmission wiring which enters or exits buildings shall be protected against lightning spikes, and other transient surges at all control panel termination points.
 - 2. All instrument signal wiring, control wiring, telephone wiring and data transmission wiring which terminates in outdoor control panels shall be protected against lightning spikes, and other transient surges at all control panel termination points.
 - 3. All AC control power wiring shall be protected against lightning spikes, and other transient surges at all control panel termination points. Lightning and surge devices shall protect the system from induced surges in analog, discrete and control circuitry and power supply lines.
- B. The protective devices shall not interfere with the normal operation of the panel hardware and shall be designed not to have a maximum clamping voltage in excess of what the protected device is capable of withstanding.
- C. All field instruments located indoors or outdoors provided by the System Manufacturer under this contract shall be supplied with surge protection for 120 VAC power to the instrument.
- D. Surge protectors shall include a combination of surge suppression technologies including, metal oxide varistors, gas discharge tubes, diodes, and 3AG size fuses for line-to-line and line-to-ground protection.
- E. Surge protectors in controls panels shall be DIN rail-mounted with plug-in modules.
- F. Where the length of the wire or cable with surge protection is greater than 90 feet, provide surge protection on each end.
- G. All surge and lightning protection shall have UL or FM approval. System Manufacturer shall verify approvals.

2 PRODUCTS

2.1 EQUIPMENT

- A. Field Instruments - Analog Signals

1. Direct mounted surge protectors for analog signals shall screw directly into the unused conduit entry hub of the instrument. The surge protector housing shall be 304 stainless steel minimum. Surge protectors shall be specifically manufactured for protecting field instruments.
 2. Where direct mount is not possible, the surge protectors for analog signals shall be located as close to the field instrument as practical. The surge protector shall be rated NEMA 4X, or shall be mounted in a stainless steel NEMA 4X enclosure.
- B. Field Instruments - Discrete Signals
1. Surge protectors for discrete signals wiring shall be located as close to the field instrument as practical. The surge protector shall be NEMA 4X, or shall be mounted in a 304 stainless steel NEMA 4X enclosure.
- C. Control Panels
1. All instrument analog and discrete signal wiring, data transmission wiring and 120 VAC power supply wiring which enters or exits buildings or which terminates in outdoor control panels shall be individually protected against lightning spikes, and other transient surges at all control panel termination points.
 2. Provide surge protectors for all power wiring to control panels whether located indoors or outdoors.
- D. Instrument Power Wiring
1. Provide surge protectors for all power wiring to individual instrument devices whether located indoors or out-of-doors. For instrument devices, protection shall be located as close to the device as practical. The surge protector shall be NEMA 4X, or shall be mounted in a NEMA 4X enclosure. Enclosures shall be NEMA 4X, stainless steel.
- E. Miscellaneous Digital Equipment
1. Provide surge protection for SCADA panel and other miscellaneous digital hardware to include communications wiring and 120 VAC power supply wiring for each device.

2.2 ACCESSORIES

A. Spare Parts

1. Provide 10 percent spare surge protectors of each type used with a minimum of 5 of each type used.

2.3 SOURCE QUALITY CONTROL

A. Acceptable Products

1. Surge protection shall be equal to the following (or their latest offerings):

Surge Protector Acceptable Model Numbers		
	Telematic	Phoenix Contact
Field Instrument Analog Signals Direct Mounted	TP48	S-PT1-2PE-24VDC
Field Instrument Analog Signals Remote Mounted	SD Series	UFBK-M2-PE Series
Analog Signals Control Panel	SD Series	UFBK-M2-PE Series
120 VAC Power Control Panel	MA Series	UAK2-PE/S Series
Discrete Inputs/Outputs Control Panel	SD Series	UFBK-2/2 Series
RS-232	NP Series	MT Series, D-UFB Series
RS-485	NP Series	MT Series, D-UFB Series
Telephone Line	DP200 Series	TELETRAB-4X Series
Ethernet	NP Series	D-ETH Series
Antenna Cable	CA Series	COAXTRAB Series

2. Protection on 120 VAC power circuits may be also by Isolatrol (Model "Elite").

3 EXECUTION

3.1 INSTALLATION

- A. Install all surge protection equipment in strict accordance with manufacturer's guidelines.
- B. For surge protectors located outdoors and for antenna surge protectors, surge protector grounding shall use individual ground rods located as close to the surge protector as possible. The grounding conductor shall be sized in accordance with manufacturer's recommendations and be routed via the shortest path possible. Bends in the grounding conductor shall be avoided. If bends in the grounding conductor are unavoidable then the number of bends shall be kept to an absolute minimum.
- C. Provide installation for all field mounted surge protection equipment. Provide for all wiring terminations for surge protection equipment.
- D. If a particular piece of equipment is protected by two surge protectors in series, ensure that the resulting equipment protection is not diminished.

END OF SECTION



SECTION 13420

INSTRUMENTATION DEVICES

1 GENERAL

1.1 SECTION INCLUDES

- A. Primary elements.
- B. Transmitters.
- C. Receivers.
- D. Analytical instruments.
- E. Devices.
- F. Cables.

1.2 RELATED SECTIONS

- A. Section 13400.
- B. Section 13650.

1.3 REFERENCES

- A. See Section 13400.
- B. American Society for Testing and Materials (ASTM)

1.4 SYSTEM DESCRIPTION

- A. System consists of all field and panel mounted instrumentation devices as noted, complete with all necessary signal converters, isolators, amplifiers, power supplies, cables and other appurtenances necessary for interfacing with other components.
- B. Except as noted, scale all indicators in engineering units.

1.5 SUBMITTALS

- A. Submit product data.

1.6 QUALITY ASSURANCE

- A. Refer to Section 13400.

1.7 MAINTENANCE AND TEST EQUIPMENT

- A. In addition to the tools and test equipment specified in Section 13400, provide the following complete with carrying cases, patch cords, etc.
 - 1. One portable admittance tester with rechargeable batteries as manufactured by Drexelbrook or equal, to calibrate the admittance instruments provided.
 - 2. One pneumatic calibrator as manufactured by Wallace & Tiernan, Meriam Instrument, or equal.
 - 3. One (1) hand held smart transmitter calibrators shall be provided by the transmitter manufacturer to calibrate all smart field transmitters provided.

B. Spare Parts

1. Miscellaneous Spare Parts
 - a. One year supply of items recommended by the Manufacturer of the equipment for each component.
2. The spares shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.
3. Provide other spare parts as indicated on the individual device specifications.

2 PRODUCTS

2.1 INSTRUMENTS AND DEVICES

A. Pressure Transmitters

1. Type: "SMART" gauge or differential transmitter as indicated with capacitance or piezoresistive element and integral digital indicator.
2. Accuracy: ± 0.10 (minimum) percent of calibrated span.
3. Output: Isolated, 4-20 mADC into loop loads of 0 to 500 ohms (minimum).
4. Adjustments: Span and zero shall be continuously adjustable. Maximum zero elevation shall be at least 400 percent of calibrated span. Maximum zero suppression shall be at least 300 percent of calibrated span.
5. Enclosure: NEMA 4X; low copper aluminum with epoxy, polyester, or polyurethane coating; suitable for 2-inch pipe mounting. Welded parts to be 316 or 316L stainless steel.
6. Power Supply: 24 VDC (two-wire).
7. Three-Valve Manifold: When required, transmitter shall be furnished with single flanged manifold valve. Valve shall be hard seated type with PTFE packing material. Stem, manifold body and all wetted materials shall be 316 stainless steel. Acceptable manufacturers are Hex Valve or Anderson –Greenwood.
8. Display: 4-digit LCD display. Process variable shall be shown in Engineering Units.
9. Signal Processing: Provide square-root extraction for DP Transmitters used for Flow.
10. Diaphragm Seals: When required by the schedule below, provide threaded, remote diaphragm seal with single flushing connection equal to Rosemount Model 1199 ARTW. Provide 316 stainless steel armored capillary of sufficient length for proper remote mounting of transmitter.
 - a. Fluid Fill: Glycerin and water.
 - b. Diaphragm Material: For water service, 316, stainless steel. For gaseous chlorine service, diaphragm shall be Teflon, Viton, or as otherwise recommended by the diaphragm seal manufacturer for gaseous chlorine service.
 - c. Lower Housing and Wetted Parts Material: For water service, 316 stainless steel. For gaseous chlorine service, Hastelloy C, Monel, or as otherwise recommended by the diaphragm seal manufacturer for gaseous chlorine service.
 - d. Lower housing Process Connection: 1/2-inch NPT.
 - e. Mounting Ring Material: 316 stainless steel.
 - f. Upper housing Material: 316 stainless steel.
11. Acceptable Manufacturers: Equal to Rosemount Model 1151, Siemens Sitrans Series Smart Transmitters.

B. Level Transmitters – Ultrasonic

1. Type: Microprocessor based ultrasonic level transmitter. Unit shall have input or output filter capability.
2. Sensor: Sensors shall have minimum 26 foot range and shall be supplied with sufficient cable length for arrangement indicated. Sensor shall have a NEMA 4X (minimum) enclosure. Unit shall be supplied with automatic temperature compensation as required below. Sensor face material shall be Kynar or Teflon as required.
3. Accuracy: ± 1.0 percent of calibrated range or better for ranges greater than 25-inches (with temperature compensation).
4. Output: Isolated 4-20 mADC into loop loads of 0 to 500 ohms (minimum), two (2) Form "C" Relay Contacts rated at 5A, 250 VAC, non-inductive.
5. Enclosure: NEMA 4X, polycarbonate or fiberglass.
6. Power Supply: 120 VAC
7. Mounting: The System Manufacturer shall coordinate mounting to ensure that the sensor is mounted away from vessel walls and other obstructions in accordance with the manufacturer's recommendations. All chemical storage tank sensors shall have Teflon face suitable for 4" flange mounting. The System Manufacturer shall provide appropriate standoff distance for sensor face from the highest liquid level to accommodate blanking distance.
8. Acceptable Manufacturers: Equal to Milltronics (Hydro-Ranger 200), Endress & Hauser (Prosonic), Systematic Controls, or STI.

C. Level Transmitter (Capacitance Type)

1. Type: Capacitance/RF admittance type with high frequency radio circuitry to minimize the effect of media build-up.
2. Probe- Rigid, 316 stainless steel construction/PTFE coated.
3. Grounding: Provide separate 316 stainless steel ground tube either as a part of probe or as part of mounting bracket per manufacturer's recommendation.
4. Output: Isolated 4-20 mADC output.
5. Power: 120 VAC, single phase, 60 Hz.
6. Transmitter Mounting: Remote from probe. Remote mounted configuration shall be suitable for wall mounting and 2-inch pipe stand mounting. Furnish sufficient cabling to connect probe and transmitter. Transmitter shall have a 3-1/2 digit display, showing level in feet and tenths of feet.
7. Enclosure: Enclosure for transmitter shall be NEMA 4X (minimum). Transmitter shall be provided with local indicator.
8. Accessories: Provide mountings along the lengths of the LE-3466 and LE-3546 probes to prevent bending by water flow in the measurement channel. Mountings shall be non-conductive and shall be placed at minimum 2 ft. O.C.
9. Acceptable Manufacturers: Equal to Siemens – Milltronics, Systematic Controls, Endress & Hauser, or Drexelbrook.

D. Level Transmitter (Submersible Head-Type)

1. Type: Pressure sensor
2. Transmitter: Control box with Local LED display of level in Feet and built-in power supply to convert 110/1/60 to 24 VDC for pressure sensor loop power. Control box to have one or two displays as required.
 - a. Outputs: one or two 4-20 mA outputs
 - b. Accuracy: 0.3% of full range
 - c. Enclosure: NEMA 4X, polycarbonate housing
 - d. Power Supply: 120VAC, 1 PH, 60 HZ
3. Sensor: 316SS sensor housing and pressure sensor diaphragm with 33' of viton cable. Polarity independent leads for 24 VDC powered loop from transmitter. Atmospheric compensation tube built into cable. Range as specified on instrument chart.
4. Cleaning: Not required
5. Transmitter (Control Box) Mounting: mounted to 1/8" aluminum mounting plate with drip lid and SS hinged opaque sun shield.
6. Sensor Mountings:
 - a. PVC hanger with minimum of 4" of cable contact and SS cable for hanging to eye bolt on side of tank or as specified on instrument chart.
 - b. Slide Rail Mounting: Sensor supplied with two SS clips and 19" long SS Slide rail for wall mounting
7. Start-Up: provide minimum of 2 hours/meter of service by factory-authorized representative for system start-up plus ½ day of training.
8. Acceptable Manufacturer: Cerlic Model NV52d (0-16.5') or NV152d (0-35') or approved equal that meets or exceeds the spec's prior to bid opening. Cerlic is the basis of design. Substitution submittals must include changes necessary to accommodate the substituted item.

E. Level Switch (Float Type)

1. Type: Submersible coated 316 stainless steel, polypropylene, or polyethylene body; non-mercury switch contact rated 4 amps at 120 VAC; normally open, normally closed, or Form C (N.O. and N.C.) contact configuration as indicated. Mercury float switches are unacceptable.
2. Cable: Minimum 18 gauge, 300 volt (minimum) rated; heavy-duty type SOW or equivalent. Provide sufficient length for mounting at the elevations indicated.
3. Junction Box: Provide NEMA 4X stainless steel junction box, mounted near the switch, for terminating vendor supplied cable and discrete control wiring to control panel.
4. Switch Mounting: The System Manufacturer shall provide 3/4 or 1 inch Schedule 40 PVC, 316 stainless steel pipe, or 1.25 inch cable for mounting the floats for a particular tank or well. The pipe shall extend from two feet above the highest switch setting (up to the top of the vessel) to two feet below the lowest level setting (down to the vessel bottom) for the vessel or well and allow for adjustment of the switch or switches anywhere along the length of the pipe. The method for fixing the float to the pipe shall be easily adjustable and shall provide for protection and strain relief for the float switch cable. Provide a minimum of two mounting brackets for fixing the pipe to the vessel wall while maintaining appropriate standoff distance. The System Manufacturer shall ensure mounting is in accordance with the manufacturer's recommendations.
5. Spare Parts: Provide 2 spare float switches.
6. Acceptable Manufacturers: Equal to Warrick Series M, Anchor Scientific.

F. Analyzer – pH

1. Type: Glass bulb pH electrode, non-refillable for 0-14 pH range. Digital sensor communication with control box.
2. Transmitter: Common control box for all sensors like: DO, pH, ORP, Suspended Solids, flow, etc. Plug & play sensor connections with up to 4 digital input signals and sensor tagging on screen. Built-in heater strip to activate at 40° F.
 - a. Outputs: two 4-20 mA or four digital outputs with optional protocol card.
 - b. Accuracy: +/- 1.5% of full scale
 - c. Enclosure: NEMA 4X, polycarbonate housing with built-in heater strip
 - d. Power Supply: 120VAC, 1 PH, 60 HZ
3. Sensor: 316SS sensor housing with 33' communication cable and m12 fitting. Digital sensor design, which stores calibration values, and displays last calibration date.
4. Cleaning: sensor to have built-in flushing nozzle and flushing solenoid mounted and connected to transmitter. Transmitter to hold sensor output signal constant during flush and control flush cycle. Flushing with 40 psig air or water.
5. Transmitter (Control Box) Mounting: mounted to 1/8" aluminum mounting plate with drip lid and SS hinged opaque sun shield.
6. Sensor Mountings:
 - a. Slide Rail Mounting: Sensor supplied with two SS clips and 19" long SS Slide rail for wall mounting
 - b. Attached to DO/Solids Rod: PVC sensor clip supplied to attach to DO or Solids meter sensor and hold submersible pH sensor with 30' cable
 - c. Rod Mounting: 5 Ft to 10 Ft telescoping fiberglass rod, 316SS spring loaded handrail mounting bracket for standard 1 1/2" handrails
7. Start-Up: Provide minimum of 2 hours/pH meter of service by factory-authorized representative for system start-up plus 1/2 day of training
8. Acceptable Manufacturer: Cerlic Model PHX/BB2 or approved equal that meets or exceeds the spec's prior to bid opening. Cerlic is the basis of design. Substitution submittals must include changes necessary to accommodate the substituted item.

G. Magnetic Flowmeter

1. Primary Flow Head
 - a. Electromagnetic flowmeter shall operate on electromagnetic induction principle and give an output signal directly proportional to the liquid rate of flow.
 - b. Each meter shall have a stainless steel metering tube and a non-conductive liner suitable for the liquid being metered. End connections shall be steel flanged for sizes 1/2" and greater, ANSI Class 150#, for meter sizes up to 24" and AWWA Class B or D for meters larger than 24". The housing shall be epoxy coated steel, welded at all joints. Bolted coil enclosures shall not be acceptable.
 - c. The field coils of the meter shall be supplied with a precisely adjusted bi-polar direct current.
 - d. There shall be no electronic components on the primary flow head. Coil drive power shall be supplied by a remote signal converter. Output signal from the primary shall be fed through 'DS' proprietary cable supplied with the meter to the signal converter.

- e. Complete Submergence NEMA 6P (IP68) enclosure rating
 - f. Electrode material shall be compatible with the process fluid.
 - g. Liner material will be hard rubber.
 - h. Meter will have field replaceable electrodes with access ports.
 - i. The instrument shall be manufactured in an ISO 9001 approved facility.
 - j. When installed in lined or non-metallic piping, the meter shall be provided with corrosion resistant grounding rings. Grounding electrodes shall not be acceptable.
 - k. Meter calibration shall be performed by a direct volumetric comparison method. A calibration certificate shall accompany each meter. Calibration facility shall be certified to .03% accuracy, and be traceable to national standards.
 - l. The meter shall be Krohne Model ENVIROMAG series or approved equivalent.
2. Converter for Magnetic Inductive Flowmeter
- a. The Magnetic Flowmeter Converter shall be remotely mounted and provide precisely controlled and regulated, bipolar DC primary field excitation pulses at a keyed frequency of 1/6, 1/16, or 1/32 of line frequency digitally selectable. It shall convert the primary flowmeter signal into a 4-20 mA DC and pulse output directly proportional to the flow rate.
 - b. The full scale measuring range shall be a direct digital input in gpm and fully adjustable over a range from 1.0 to 40 ft/sec.
 - c. Each converter shall contain self diagnostics, automatic data integrity checking, and be completely interchangeable with other converters of the same type without need for recalibration. No auxiliary test meter or primary simulator shall be required for commissioning, zeroing, or interchanging of flow meter/converter.
 - d. Each converter shall contain the following features as standard equipment:
 - i. Simultaneous analog output (500 ohm load) and a scaled pulse output.
 - ii. Adjustable damping of analog signal from 0.2 to 99 seconds.
 - iii. Low flow cutoff.
 - iv. Forward/reverse flow measurement capabilities
 - v. Integral rate of flow indicator and 7-digit LCD totalizer
 - vi. Capability of testing analog and frequency outputs.
 - vii. The converter shall be capable of interfacing with an IBM compatible PC utilizing the PC Config software via a RS 232 converter.
 - viii. Ten year data retention without the need for auxiliary power.
 - ix. Engineering units for display and programming; flow and total shall be user programmable in any engineering unit of measure.
 - x. All adjustments and changes of above features shall be by direct digital input.
 - xi. Repeatability shall be 0.1% of rate.
 - e. Accuracy of the system (Primary Flow Head and Converter) shall be:
 - i. Meter sizes 3/8" - 24" +/- 0.3% of actual flow rate(for velocities of 1.3 - 40 ft/sec)
 - ii. Meter sizes 28" - 40" +/- 0.5% of actual flow rate(for velocities of 0.8 - 40 ft/sec)
 - f. The enclosures shall be rated NEMA 4X (IP-65)
 - g. The instrument shall be manufactured in an ISO 9001 approved facility.
 - h. The converter shall have HART smart protocol. It shall use the HART protocol via FSK transmission along the analog signal wire to remotely configure, read flowrate, total and

diagnose problems without affecting the measurement signal. The intelligence must reside within the converter.

- i. The signal converter shall be Krohne model IFC020K/F or approved equivalent.
- j.

H. Dissolved Oxygen (DO) Analyzer

1. Type: Clark replaceable cartridge electrode with built-in temperature sensor for automatic temperature compensation. Digital sensor communication with control box.
2. Transmitter: Common control box for all sensors like: DO, pH, ORP, Suspended Solids, flow, etc. Plug & play sensor connections with up to 4 digital input signals and sensor tagging on screen. Built-in heater strip to activate at 40° F.
 - a. Outputs: two 4-20 mA or four digital outputs with optional protocol card.
 - b. Accuracy: +/- 2% over 0-15 mg/l range
 - c. Enclosure: NEMA 4X, polycarbonate housing with built-in heater strip
 - d. Power Supply: 120VAC, 1 PH, 60 HZ
3. Sensor: 316 SS sensor housing with 33' of viton communication cable with m12 fitting. Digital sensor design, which stores calibration values, last calibration date, and saturated air calibration values to check calibrations. Sensors to supply temperature output on channel two for final effluent applications.
4. Cleaning: sensor to have built-in flushing nozzles (3) and flushing solenoid mounted and connected to transmitter. Transmitter to hold sensor output signal constant during flush and control flush cycle. Flushing with max. 40 psig air or water.
5. Transmitter (Control Box) Mounting: mounted to 1/8" aluminum mounting plate with drip lid and SS hinged opaque sun shield.
6. Sensor Mountings:
 - a. Rod Mounting: 5 Ft to 14 Ft telescoping fiberglass rod, 316SS spring loaded handrail mounting bracket for standard 1 1/2" handrails
 - b. Rod with Chain Mounting: 1 1/4" aluminum pipe rod, 20' SS chain, SS sensor adaptor and 316 SS Spring Loaded Handrail mounting bracket for standard 1 1/2" handrails.
 - c. Chain Mounting: 10 Ft to 30 Ft SS chain with SS sensor adaptor for contractor supplied 6" perforated stilling well pipe and eyebolt at top of pipe. The required chain length shall be determined during the installation.
 - d. Slide Rail Mounting: Sensor supplied with two SS clips and 19" long SS Slide rail for wall mounting
7. Start-Up: Provide minimum of 2 hours/DO meter of service by factory-authorized representative for system start-up plus 1/2 day of training.
8. Acceptable Manufacturer: Cerlic Model O2X/BB2 or approved equal that meets or exceeds the spec's prior to bid opening. Cerlic is the basis of design. Substitution submittals must include changes necessary to accommodate the substituted item.

I. Thermal Dispersion Type Flow Switch

1. Flow measurement that measures the amount of cooling that results then the fluid passes over a heated element.
2. Temperature differential is proportional to the flow rate. Design Criteria: Heater shall be customized for each specific application including whether fluid is liquid or gas.

3. Wetted parts shall be made from Type 316 stainless steel or a material suitable for the process conditions and compatibility with the process fluid. Flow switch assembly to be rated NEMA 4X or as specified. Flow switch to be suitable for operation in the associated area classification.
4. Provide general-purpose snap action switches contacts - SPDT or DPDT as specified. Contacts for 120VAC circuits to be rated for 10 amps at 120 VAC. Contacts for DC circuits shall be made from silver or gold rated for 5 Amps at 125 VDC.
5. Switching accuracy shall be +/- 0.5% of setpoint. Switching action shall be repeatable with +/- 1 % of full-scale flow.
6. Flow switches are inserted into smaller pipeline thru a threaded pipe "tee" or elbow. In larger lines, a threaded coupling is attached to the process piping. Flow switches must be orientated in the indicated direction of flow.
7. Thermal dispersion type flow switch shall be FCI model 12-64 or approved equal.

J. Pressure and Vacuum Gauges

1. General: Pressure and vacuum gauges shall, unless otherwise specified, conform to the following. Gauges shall be of the stem-mounting type unless panel-mounted type is shown on the Schedule. Refer to Section 15100 – Valves, for additional requirements.
2. Construction: Gauges shall be of the bourdon tube or bellows type with 270 degrees clockwise pointer travel. Dials shall be white with black numerals. Dial size shall be 4 1/2-inch. Panel-mounted gauges shall have round bezels for flush mounting and rear connection, others shall have a stem-mounting bottom connection. Connections for all gauges shall be male 1/2-inch NPT with square wrench flats. Wetted parts shall be corrosion-resistant to the process fluid shown in the Table A and unless specified in the Table A shall be the manufacturer's best quality standard. All dials shall be glycerin filled, hermetically sealed. Cases shall be black phenolic. Accuracy shall be $\pm 0.5\%$ of span.
3. Chemical Seal: Where used for sewage or sludge service, the gauge shall be furnished with a diaphragm seal unless specified elsewhere. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the instruments pressure element shall be completely filled with a suitable fill liquid – defaulting to silicone oil. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch or any other pressure instrument. The diaphragm seal shall have a removable bottom housing to permit the servicing of the need to refill. All exposed surfaces, top and bottom housings, and diaphragm shall be constructed of Type 316 stainless steel as a minimum and shall be compatible with the process fluid. The process connection shall be a 3/4-inch threaded connection with a flushing connection.
4. Manufacturers: The gauges shall be as manufactured by Ashcroft Duraguage, U.S. Gauge, or user approved equal. The diaphragm seals shall be as manufactured by Ashcroft 200 series, Mansfield and Green SG Series, or approved equal.

K. Pressure Switches

1. General: Pressure switches shall sense absolute or gauge pressure and incorporate bourdon tubes, diaphragms, or bellows as the sensing and actuating element.
2. Construction: The actuating element shall be Type 316 stainless steel. The actuating point shall be readily field adjustable in the range specified, and shall be of the narrow differential (dead band) type. Switches shall be DPDT, rated at 10 amperes minimum at 120 vac. Enclosures shall be NEMA 4X unless specified explosion-proof (XP) in the schedule. Process

connection shall be 1/4-inch NPT. When specified in the schedule, switches shall have an external manual reset.

3. Chemical Seal (Diaphragm type process liquid isolation): Pressure switch shall be furnished with a diaphragm seal. Diaphragm seals shall consist of bottom housing, lower ring, diaphragm capsule, fill screw, flushing connection, and a top housing. The diaphragm seal shall attach to the inlet connection of a pressure instrument to isolate its measuring element from the process fluid. The space between the diaphragm and the instruments pressure element shall be completely filled with a suitable fill liquid – defaulting to silicone oil. Displacement of the liquid fill in the pressure element through the movement of the diaphragm shall transmit process pressure changes directly to a gauge, transmitter, switch or any other pressure instrument. The diaphragm seal shall have a removable bottom housing to permit the servicing of the need to refill. All exposed surfaces, top and bottom housings, and diaphragm shall be constructed of Type 316 stainless steel as a minimum and shall be compatible with the process fluid. The process connection shall be a 3/4-inch threaded connection with a flushing connection.
4. Manufacturers: The pressure switches shall be as manufactured by Mercoild, United Electric, ASCO, or user approved equal. The diaphragm seals shall be as manufactured by Ashcroft 200 series, Mansfield and Green SG Series, or approved equal.

L. In-Line Pressure Seal

1. Where specified provide a pressure isolating ring that uses a elastomer membrane to isolate a pressure measurement from the process fluid in the pipeline. The membrane/diaphragm shall provide direct contact with the process fluid but shall isolate the pressure measurement from the effects of solids, abrasives and slurries in the pipe line that would clog standard pressure sensing lines.
2. The pressure sensed by the membrane shall be transmitted to the associated pressure sensor, gauges, and/or transmitter via use of a suitable fill fluid – defaulting to silicone oil. Any air between the membrane and the associated pressure devices shall be fully evacuated during the filling process.
3. Inside diameter of the measuring membrane shall match the inside diameter of the associated pipeline.
4. Manufacturers: The in-line pressure seal shall be manufactured by Onxy Valve, Red Valve, or approved equal.

2.2 CABLES

A. Fiber Optic Cable

1. Fiber optic cable shall be optic multimode, loose tube, all-dielectric cable, Siemens, Nordx/CDT, Belden, or approved equal, and meet the following specifications:

Cladding Diameter	125.0 Microns
Core Diameter	62.5 Microns
Attenuation Range	≤0.8 dB/KM at 1300 NM ≤3.1 dB/KM at 850 NM
Bandwidth Range	≥600 Mhz-KM at 1300 NM ≥200 Mhz at 850 NM
Cable Construction	Splitable outdoor cable
Core Type	Hollow core, filled

Materials

- basic element PVC, gray
- strain relief Kevlar fibers and impregnated glass
- outer sheath/cable color PVC black

Mechanical Characteristics

- dimensions of basic element (3.5 ± 0.2) mm dia
- cable dimensions (6.3 X 9.8) ± 0.4 mm
- cable weight approx. 65 kg/km
- permissible tensile load ≤ 500 N (short time)
- bending radii ≥ 100 mm Over flat side only

Permissible Ambient Conditions

- laying and installation temp. -5°C to +50°C
- operating temperature -25°C to +60°C
- storage temperature -25°C to +70°C

Cable shall be compliant with EIA, ANSI Standards, graded index. All fibers must be color coded for easy identification with all-dielectric construction. All cables shall be of an insulation type rated for the purpose of installation. Where shown on Contract Drawings all fiber optic conduit run shall contain redundant 24 strand fiber optic cables as specified in this section.

2. Connector Type BFOC
3. Coordinate the exact fiber cable requirement with the SCADA system integrator.

B. Industrial Twisted Pair (ITP) 100 Mb Fast Ethernet Cables

1. ITP cable shall have two cores stranded with two dummy elements to form a pair.
2. Each pair shall be sheathed in plastic film and shielded with two plastic-clad aluminum foils.
3. The outer shield braid shall be made of tinned copper wires around all pairs.
4. The plastic sheath shall be PVC.
5. The ITP cable shall be a standard 9 pin cable with RJ45 type connectors.
6. ITP Cables shall be Siemens Industrial Twisted Pair standard cable or equal by AT&T or Belden.

3 EXECUTION

3.1 INSTALLATION

A. Instrument Tagging

1. Provide stainless steel identification tags attached with stainless steel wire or screws for all field instruments.

3.2 FIELD QUALITY CONTROL

A. Tests And Calibration

1. Perform continuity and insulation resistance tests on instrumentation conductors.

2. Calibrate each instrument to its published accuracy. Submit calibration sheets including the instrument tag number or name, the date, name of individual performing calibration, procedures and equipment used, and results obtained.

END OF SECTION



SECTION 13430
PANELS

1 GENERAL

1.1 SCOPE OF WORK

- A. The General Provisions of Section 13400 shall apply to this section.
- B. Furnish all labor, materials, equipment and incidentals required to fabricate, complete and ready for operation, the panels depicted on the Drawings and in the Panel List below.
- C. All work in this Section shall be the product of the Process Instrumentation and Control Supplier (PICS). Sub-suppliers and/or manufacturers may provide components, enclosures and/or fabrication services to the PICS, but the final product shall conform to this specification and shall be the sole responsibility of the PICS.

1.2 RELATED WORK

- A. Refer to Section 13400.

1.3 SUBMITTALS

- A. Submittals shall be prepared and transmitted to the Engineer for approval in compliance with Section 13400 of these specifications. In addition, shop drawings shall include the following information:
 - 1. Materials for all panels and enclosures.
 - 2. Drawings shall be prepared on 11" by 17" paper, shall be to scale and shall show the location of panel mounted devices as well as doors, louvers and sub-panels.
 - 3. Drawings shall include a panel legend and a bill of materials.
 - 4. The panel legend shall list and identify front of panel devices by their assigned tag numbers, nameplate inscriptions, service legends and annunciator inscriptions.
 - 5. The bill of materials shall list devices mounted within the panel that are not listed in the panel legend and shall include the tag number, description, manufacturer and model number for each item.
- B. Interconnecting Wiring Diagrams
 - 1. Provide interconnecting wiring diagrams showing electrical connections between panels, consoles, terminal junction boxes and field mounted components.
 - 2. Diagrams shall show component and panel terminal identification numbers and external wire and cable numbers.
 - 3. Circuit names corresponding to the Conduit Schedule shall be shown.
 - 4. These diagrams shall be coordinated with the Electrical Subcontractor and shall bear his mark showing that this has been done.

1.4 SYSTEM DESCRIPTION

- A. See SCADA System Block Diagram for SCADA system components.

1.5 DELIVERY, STORAGE AND HANDLING

- A. Refer to Section 13400.
- B. The panels and consoles shall be mounted on wood skids four inches high. Adequate crating shall be provided to protect the panels or consoles from damage during shipping.
- C. Instruments and components shall be blocked and tied down to prevent damage during shipping. Front-panel mounted instruments or components shall be removed or securely protected from damage during shipment. Items removed from the panels shall be repacked in their original containers and shipped with the panel.
- D. Accessories, drawings, instruction bulletins, etc. shall be packed and shipped with the associated panel.

1.6 SPARE PARTS AND TEST EQUIPMENT

- A. Provide spare parts and test equipment as specified in Section 13400 and as indicated below.
 - 1. Fuses: 20 percent of each size and type used, but no less than ten of each size and type.
 - 2. Relays: 10 percent of each type used, but no less than five of each type.
 - 3. Indicating Light Bulbs: 25 of each size and type used.
 - 4. DC Power Supplies: 20 percent of each size and type used, but no less than two of each size and type.
 - 5. Five spare pilot indicating lights, rotary hand switches, pushbuttons of each type used.
 - 6. One spare analog indicator of each type used.
 - 7. Corrosion Inhibiting Vapor Capsules: Provide 20 of each type and size used.
- B. All spare parts shall be packed in a manner suitable for long-term storage and shall be adequately protected against corrosion, humidity and temperature.

2 PRODUCTS

2.1 CONTROL PANEL GENERAL REQUIREMENTS

- A. Furnish and install the panels per the Specifications and Drawings.
- B. The construction and wiring for the panels shall be in accordance with this Specification and applicable panel drawings. The panel drawings will specify the arrangement of instruments to be mounted on the front, rear and sides of the panels.
- C. All panels shall be fully enclosed for use with high-density instrumentation mounting.
- D. All panel doors shall have a lock installed in the door handle, or a hasp and staple for padlocking. Locks for all panels provided under this Contract shall be keyed alike.
- E. The instruments and equipment designated for rear-of-panel mounting shall be arranged within the panel according to associated panel drawings in a manner to allow for functionality, ease of maintenance and adjustment.
- F. Conductors running from the field to the panels shall be continuous without splices, except at approved junction boxes. All junction boxes and panels shall have 25 percent spare terminals.
- G. Conduits and cables entering panels shall be sealed to prevent the intrusion of gas and moisture.
- H. All components shall be mounted in a manner that shall permit servicing, adjustment, testing and removal without disconnecting, moving or removing any other component. Components mounted

on the inside of panels shall be mounted on removable plates, in such a manner that the component may be removed without removing the plate and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required by the manufacturer to protect equipment from vibration. Mounting orientation shall be in accordance with the requirements of each component.

- I. Components shall be identified with suitable plastic or metal engraved tags attached adjacent to (not on) each component identifying the component in accordance with the Drawings, Specification and PICS data.
- J. The internal framework of each panel shall permit panel lifting without distortion. Provide removable lifting rings designed to facilitate simple, safe rigging and lifting of the panel during installation. Plugs shall be provided and shall unobtrusively fill the panel lifting ring holes when substituted for the lifting rings after installation is complete.
- K. All panels, consoles and exterior mounted equipment shall be installed with suitable gaskets, faceplates, etc. required to maintain the NEMA rating of the panel.
- L. All panels shall be supplied with suitable nameplates, which identify the panel and individual devices as required. Nameplates shall be provided for all flush mounted equipment in the interior and exterior of each panel. Nameplates shall be constructed of white and black laminated phenolic material having engraved letters extending through the white face into the black layer. Nameplate shall be beveled and attached to panels by adhesive or glue.

2.2 PANEL MATERIALS AND CONSTRUCTION

A. General

- 1. All panels located in indoor areas, unless otherwise specified, shall be NEMA 12 construction.
 - a. Freestanding panels shall be constructed of 12 gauge or thicker steel, suitably braced internally for structural rigidity and strength. All exposed welds, seams or edges shall be ground smooth.
 - b. Wall or Unistrut mounted panels shall be constructed of 14 gauge or thicker steel. All exposed welds, seams or edges shall be ground smooth.
 - c. Front panels or panels containing instruments or components shall be 10 gauge or thicker sheet steel reinforced to prevent warping or distortion.
 - d. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument or component mounting.
 - e. All doors shall be lockable, mounted with strong, continuous, piano type hinges and shall be provided with door handles and three point latches or screw clamps.
- 2. All panels located in outdoor areas, or in indoor areas where otherwise specified, shall be NEMA 4X stainless steel construction.
 - a. Freestanding panels shall be constructed of 12 gauge or thicker steel, suitably braced internally for structural rigidity and strength. All exposed welds, seams or edges shall be ground smooth.
 - b. Wall or Unistrut mounted panels shall be constructed of 14 gauge or thicker steel. All exposed welds, seams or edges shall be ground smooth.
 - c. Front panels or panels containing instruments or components shall be 10 gauge or thicker steel reinforced to prevent warping or distortion.
 - d. Interior panels of 10 gauge steel construction shall be provided where necessary for instrument or component mounting.
 - e. All doors shall be lockable, mounted with strong, continuous, piano type hinges and shall be provided with door handles and three point latches or screw clamps.

3. Panels shall be provided with full length, fully gasketed rear doors or front access doors as shown on the panel drawings. Front access doors with mounted instruments or control devices shall be of sufficient width to permit door opening without interference from flush mounted instruments or control devices.
 4. The panel shall be suitable for top or bottom conduit entry as required by the Electrical Drawings.
 5. All conduit and cable penetrations shall be provided with ground bushings, hubs, gasketed locknuts or other accessories as required to maintain the NEMA rating of the panel and the electrical rating of the conduit system.
- B. Finish Requirements
1. All panel sections shall be descaled, degreased, filled, ground and finished. The enclosure, when fabricated of carbon steel, shall be furnished with two rust resistant phosphate prime coats and two coats of enamel, polyurethane or lacquer finish, which shall be applied by either the hot air spray or conventional cold spray methods. Brushed anodized aluminum, stainless steel and fiberglass-reinforced polyester panels will not require a paint finish.
 2. The panels shall have edges ground smooth and shall be sandblasted and then cleaned with solvent. Surface voids shall be filled and ground smooth.
 3. Immediately after cleaning, one coat of a rust-inhibiting primer shall be applied inside and outside, followed by an exterior intermediate and top coat of a two-component type epoxy enamel. A final sanding shall be applied to the intermediate exterior coat before the final top coat is applied.
 4. The panel interior shall have a minimum of two coats of flat white lacquer after priming.
 5. Unless otherwise noted, the finish exterior colors shall be selected by the Owner from color chips supplied by the PICS.
- C. Manufacturers
1. The panels shall be manufactured by Hoffman or Engineer approved equal.

2.3 TEMPERATURE CONTROL

- A. Freestanding panels shall be provided with louvers, forced air ventilation or air conditioning as required to prevent temperature buildup due to ambient temperature conditions and/or electrical devices mounted in or on the panel.
- B. Panels that require louvers shall have them mounted on the rear at the top and bottom of the panel unless the panel is located against a wall, then they shall be mounted on the sides.
- C. Panels that require forced air ventilation fans shall provide a positive internal pressure within the panel and shall be provided with washable or replaceable filters. Fan motors shall operate on 115 VAC, 60 Hz power.
- D. Panels that require air conditioning shall use side-mount air conditioners manufactured by Hoffman Proair or Engineer approved equal. Air conditioners shall operate on 115 VAC, 60 Hz power.
- E. The internal temperature of all panels shall be regulated so as not to exceed 100° F.
- F. The panel cooling equipment shall not compromise the NEMA rating of the panel.

2.4 CORROSION CONTROL

- A. Panels shall be protected from internal corrosion by the use of corrosion-inhibiting vapor capsules as manufactured by Hoffman or Engineer approved equal.

2.5 INTERNAL CONSTRUCTION

A. Internal Electrical Wiring

1. Panel equipment and components shall be mounted and wired on or within the panel or console. Wiring shall comply with the National Electric Code. Wiring within the panel shall be grouped together with wire ducts and secured to the structure. Wiring shall be numbered in compliance with the numbering system used on the wiring / connection diagrams. Wiring and connection diagrams shall comply with ISA S5.4 Instrument Loop Diagrams and shall be as part of the Shop Drawings for review by the Engineer.
2. Power wires shall be 14 AWG Type THWN stranded and shall be insulated for not less than 600 volts. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90° C.
3. Control wires shall be 16 AWG Type THWN stranded and shall be insulated for not less than 600 volts. Conductors shall be of tinned copper construction. All interconnecting wiring, except for electronic circuits, shall be rated for not less than 90° C.
4. Analog signal cables shall be single pair 16 AWG shielded cable with a ground wire. Conductors shall be of tinned copper construction.
5. All wiring leaving or entering the panel shall be terminated on terminal blocks that are rigid, numbered and located for ease of access and troubleshooting.
6. Terminal strips shall be separated into groups for power, control and analog signals.
7. Terminal strips and/or block systems shall be manufactured by Phoenix, Allen Bradley or Weidmuller and shall be rated for a minimum of 600 volts.
8. Wire ducts for supporting internal wiring shall be a plastic type with snap on covers.
9. Each wire shall be provided with a numbered and typed heat shrink tubing identification marker at both ends. Handwritten markers or paper markers will not be permitted. Each individual wire shall be assigned a number that corresponds to the number shown on the Drawings.
10. Each freestanding panel shall have a switched single-tube 20 Watt fluorescent light fixture mounted internally in the ceiling of the panel manufactured by Hoffman.
11. Each panel shall have a duplex convenience receptacle mounted internally within the panel in an appropriate steel box and cover.
12. A single lamp test button shall be provided on a panel, where appropriate, to test all of the indicator lamps in the panel at the same time.
13. Each panel shall be provided with an isolated copper grounding bus for all signal and shield ground connections. Grounding shall be in accordance with the instrumentation manufacturer's recommendations.
14. Each panel shall be provided with a separate copper power grounding bus (safety) in accordance with the National Electric Code.
15. Each panel shall be provided with analog signal isolation (I/I) when analog signals are sent from one panel or console to another.
16. Each panel shall be provided with surge suppression protection (electrical transients) for connections between AC power systems and electrical or electronic equipment. Surge suppressor grounding shall be in accordance with the manufacturer's recommendations.
17. Each panel shall be provided with a circuit breaker power disconnect switch.
18. Each digital output shall be wired to an interposing relay and one normally open contact from each relay shall be wired to the terminal strip. The contact shall be rated for 115 VAC, 10 Amp or 24 VDC, 10 Amp.

B. Print Storage Pockets

1. Print storage pockets shall be provided on the inside of each panel or console. Its size shall be sufficient to hold all of the prints and documentation necessary to service the equipment attached to it or within it.

2.6 MISCELLANEOUS PANEL COMPONENTS

A. Panel Meter - Digital Readout

1. Type
 - a. Numerical digital process meter.
2. Functional Performance
 - a. The meter shall be a 3-½ digit minimum resolution LED indicator and shall display the value of the analog input signal in engineering units with a scaled range, as noted. The decimal point shall be field selectable and the meter shall provide an over range indication.
 - b. Accuracy shall be 99.9 percent.
 - c. Power requirements shall be 120 VAC or 24 VDC, as required.
 - d. The operating temperature limits shall be 0 to 60° C.
3. Physical
 - a. The meter shall be housed in a NEMA 4X high impact plastic enclosure with a splash proof lens.
 - b. The meter shall provide a permanent service legend to display the engineering units of the process variable.
 - c. The meter dimensions shall not exceed 4" wide x 2" high x 5" deep.
4. Manufacturers
 - a. The digital readout panel meter shall be Model PD690 as manufactured by Precision Digital or Engineer approved equal.

B. Pilot Indicating Lights

1. Type
 - a. Heavy-duty oil tight type utilizing low voltage lamps with integral lamp test.
2. Functional Performance
 - a. Units shall be provided with low voltage lamps suitable for 24 VDC power.
 - b. Units shall provide for a remote lamp test function.
 - c. Lamps shall be replaceable from the front of the unit.
3. Physical
 - a. Lens colors shall be as indicated on the Drawings and shall be approximately 1 ¼ inch in diameter.
 - b. Provide legend nameplates engraved to indicate the required function of each device.
 - c. Units shall be rated NEMA 4X for outdoor weatherproof conditions.
4. Manufacturers
 - a. The pilot indicating lights shall be Model 800T as manufactured by Allen Bradley or Engineer approved equal.

C. Rotary Hand Switches and Pushbuttons

1. Type
 - a. Control devices shall be heavy-duty oil tight type with stackable contact blocks.

2. Functional Performance
 - a. Provide control devices, switch configurations as required for the control system specified and as shown on the Drawings.
 3. Physical
 - a. For 115 VAC service, provide contacts rated 10 Amps at 115 VAC, for 24 VDC service provide contacts rated 5 Amps at 125 VDC, for electronic (millivolt / milliamp) switching provide gold plated contacts rated at 28 VDC.
 - b. Pushbuttons shall have flush type operators and selector switches shall have knob or wing lever operators.
 - c. Provide legend nameplates engraved to indicate the required function of each device.
 - d. Units shall be rated NEMA 4X for outdoor weatherproof conditions.
 4. Options / Accessories Required
 - a. Provide lockout pushbuttons, key-operators, etc. as indicated on the Drawings.
 - b. Provide make-before-break bridging contacts as required for the control system specified.
 5. Manufacturers
 - a. The rotary hand switches and pushbuttons shall be Model 800T as manufactured by Allen Bradley or Engineer approved equal.
- D. General Purpose Relays and Time Delay Relays
1. Type
 - a. Units shall be general-purpose plug-in type.
 2. Functional Performance
 - a. Provide general-purpose control relay and time delay relay configurations as required for the control system specified and as shown on the Drawings.
 - b. Mechanical life expectancy shall be in excess of 10 million operations and the duty cycle shall be rated for continuous operation.
 - c. Relays shall be provided with an integral indicating light to display when a relay is energized.
 - d. Solid-state time delay relay periods shall be 0.1 second to 4.5 hours and shall be adjustable, provided with polarity protection and transient protection.
 3. Physical
 - a. For 115 VAC service, provide contacts rated 10 Amps at 115 VAC, for 24 VDC service provide contacts rated 5 Amps at 125 VDC, for electronic (millivolt / milliamp) switching provide gold plated contacts rated at 28 VDC.
 - b. Relays shall be provided with dust and moisture resistant covers.
 4. Options / Accessories Required
 - a. Provide all mounting rails, mounting sockets, etc. that are required.
 5. Manufacturers
 - a. The general-purpose relays and time delay relays shall be Model 700HF as manufactured by Allen Bradley or Engineer approved equal.
- E. Signal Isolators / Boosters / Converters
1. Type
 - a. Solid-state electronic type.
 2. Functional Performance

- a. Provide signal isolators, boosters or converters as required for the control system specified and as shown on the Drawings.
- b. Accuracy shall be 0.15 percent or better.
- c. Inputs shall be current, voltage, frequency, temperature or resistance as required.
- d. Outputs shall be current or voltage as required.
- e. Isolation shall be complete between input circuitry, output circuitry and the power supply.
- f. Zero and span adjustments shall be provided.
- g. RFI protection shall be provided.
- 3. Physical
 - a. Units shall be suitable for mounting in a rack or an enclosure.
 - b. Units shall be provided with dust and moisture resistant covers.
- 4. Options / Accessories Required
 - a. Provide all mounting rails, racks, etc. that are required.
- 5. Manufacturers
 - a. The signal isolators / boosters / converters shall be Series 4000 as manufactured by AGM or Engineer approved equal.
- F. Surge Protection
 - 1. See Section 13105.

3 EXECUTION

3.1 Installation

- A. Refer to Section 13400.
- B. The panels and consoles shall be factory tested and approved by the Engineer prior to shipment.
- C. The panels and consoles shall be installed at locations as shown on the Drawings.

END OF SECTION

SECTION 14300
HOISTS AND CRANES

1 GENERAL

1.1 DESCRIPTION

- A. Provide Hoists and Cranes and appurtenances as indicated or specified.
 - 1. Design, furnish and install bridge crane and appurtenances for all hoists.
 - 2. Design of bridge crane, beams, hangers, braces and all attachment details shall be the responsibility of hoist supplier.

1.2 REFERENCES

- A. Requirements of Regulatory Agencies: Comply with all applicable federal, state and municipal codes, and with requirements of all authorities having jurisdiction.
- B. UL: Underwriters Laboratory regulations as specified.

1.3 SUBMITTALS

- A. The contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications.
 - 1. Certified shop and erection drawings.
 - 2. Manufacturer's specifications, catalog data, descriptive matter, illustrations, electrical control diagrams, erection drawings and complete motor data.
 - 3. Manufacturer's installation instructions.
 - 4. Operating and maintenance instructions and parts lists.
 - 5. Design Responsibility:
 - a. Certificate of Design: Complete form and submit to Engineer prior to manufacture of bridge crane system.
 - b. Support Data: Submit following with Certificate of Design:
 - 1) Certification, signed by Registered Professional Engineer, stating that all members, elements and connections are designed to withstand required loads and forces.
 - c. Codes and specifications to which structural design conforms.
 - d. Do not submit design calculations to Engineer. In the event such calculations are submitted to the Engineer they will be returned to the Contractor without review or checking by the Engineer.
 - 6. Shop painting product data and color chart.
 - 7. Recommended spare parts other than those specified.
 - 8. Printed warranty

1.4 QUALITY ASSURANCE

- A. Permanently mark the capacity of the hoist and trolley on each hoist, in easy to read letters and in a prominent position.
- B. Certificate of design: Refer to SUBMITTALS paragraph.
- C. Welding: In accordance with latest applicable American Welding Society Code.

1. Qualifications for Welders: Provide certification that welders who will be employed in work have satisfactorily passed AWS qualification tests. If recertification of welders is required, retesting is the Contractor's responsibility at no additional cost to the Owner.
2. Visually inspect welding while the operators are making the welds and again after the work is completed. After the welding is completed, hand or power wire brush welds and clean them before the inspector makes the check inspection. Inspect under light for surface cracking, porosity, slag inclusions; excessive roughness; unfilled craters; gas pockets; undercuts; overlaps; size; and insufficient throat concavity.

D. Provide only safety type hooks.

E. Do not use hoists for construction purposes of any nature.

1.5 OPERATION AND MAINTENANCE DATA

A. The contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operation and Maintenance Data.

1.6 STORAGE AND PROTECTION

A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.7 WARRANTIES AND BONDS

A. The contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.

B. The equipment manufacturer shall provide a warranty against defective or deficient equipment, workmanship, and materials under normal use, operation, and service. The warranty shall be for one (1) year from the date of Engineer's acceptance of the work. The warranty shall be in printed form and shall apply to all similar units.

2 PRODUCTS

2.1 MANUFACTURERS

A. Approved manufacturers include:

1. Engineered Material Handling, Inc., Valley City, OH
2. Demag, Material Handling Division, Solon, OH
3. Dresser Industries, Hoist and Tower Division, Muskegon, MI
4. Wright Hoist Division of American Chain and Cable Co., Inc., York, PA
5. Yale Hoists and Cranes Division, Forest City, AK

2.2 DESIGN CRITERIA

A. Provide one (1) bridge crane that meets the following design criteria:

Bridge Crane Type	Top Running Single Girder Crane
Capacity	5 tons
Hoist Type	2 Part, Double Reeved, Wire Rope Hoist with True Vertical Lift
Span	40'-10"
Minimum Hook Height Above Finished Floor	16'-0"
Minimum Lift	30'-0"
Maximum Hoist Motor HP	7.5 HP

Maximum Trolley Motor HP	0.75 HP
Minimum Bridge Drive Motor HP (2 each)	0.75 HP each
Runway Length	59'-1"

B. Provide one (1) monorail hoist that meets the following design criteria:

Capacity	3 tons
Hoist Type	2 Part, Double Reeved, Wire Rope Hoist with True Vertical Lift
Travel Length	52'-8"
Minimum Hook Height Above Finished Floor	12'-0"
Minimum Lift	30'-0"
Minimum Hoist Motor HP	7.5 HP
Minimum Trolley Motor HP	0.5 HP

C. Provide one (1) chain hoist with geared trolley that meets the following criteria:

Capacity	3 tons
Minimum Lift	10'-0"

2.3 ELECTRIC HOISTS/BRIDGE CRANE

A. Electric Hoist

1. Spur-gear driven antifriction bearings throughout, a mechanical load brake, and a separate electrically operated motor brake. Design either brake with capability of supporting the full load and be easily accessible for external adjustment by removing cover plates. Design shafts of motor, drum, and drum pinion to run in grease-lubricated ball or roller bearings. Design the mechanical-load brake and gear train and bearings to be oil-bath lubricated.
2. Arrange hoist for mounting from a 4-wheel geared trolley as required for the application shown in the schedules on the drawings.
3. Hoist shall be double reeved for true vertical lift.
4. Design drum with machine-cut grooves and guarded flanges and with capacity to take entire run of cable in one layer with no overlapping.
5. Provide hoist with an upper and lower geared limit switch with automatic reset control circuit to prevent over travel.
6. Supply hoisting cable with hoists for two-part double reeving and to accommodate not only the maximum lift but two additional wraps on drum. Make cable flexible high-strength plow steel cable with a load safety factor of at least 5 to 1.
7. Make load block of rugged construction containing a ball-bearing sheave and a high-grade forged-steel swivel hook with antifriction bearings.
8. Mount control equipment in an enclosed compartment which forms an integral part of hoist and include a transformer for a 120-volt control circuit. Suspend pendant pushbutton station from control compartment.

B. Trolleys

1. Motor-Driven Trolleys: Four-wheel type consisting of a fully enclosed, two-speed, electric motor equipped with a magnetic brake, a geared transmission completely enclosed in an oil-tight housing and suspended on flanged driving wheels with power to two wheels. Use ball or roller bearings throughout.
2. Make trolleys suitable for operation on beam or rail indicated on drawings or acceptable to Engineer. Have hoist manufacturer provide trolleys.

C. Bridge Crane

1. Provide crane meeting the capacity and span shown in the Design Criteria.
2. Crane girders shall be designed to resist all vertical, lateral and torsional loads.
3. Fabricate girders from carbon steel conforming to ASTM A36. Full penetration welds shall be used to join all structural members.
4. Girders shall be rigidly connected to end trucks in both the vertical and horizontal planes. Design and construct girders to keep entire bridge structure square and aligned under all operating conditions.
5. Provide end trucks of welded steel construction. End trucks shall be a minimum of 1/8 the crane span.
6. Provide double flanged wheels of forged or cast steel with hardened treads. Wheels shall be designed to carry the maximum load under normal operating conditions without undue wear. Wheels shall be attached to carbon steel axle. Provide grease lubricated ball or roller bearings on ends of axles. Provide for easy removal of wheels and axles.
7. End trucks shall be driven by two-speed drive motors.
8. Bridge crane to be provided by hoist manufacturer who shall be responsible for all components and details of construction necessary for a complete and operable system.

D. Safety Stops

1. Provide safety stops on all open ends of track (or where indicated) to prevent trolley from running off ends or damaging structures. Design stops with capability of withstanding impact imposed by motion of fully loaded hoist and trolley.

E. Electrical Controls

1. Supply complete integral electrical control system with the electric Hoists and Cranes (by hoist manufacturer) consisting of starters, circuit breakers, overload relays, limit switches, control transformer for a 120-volt control circuit, control relays, and controlling devices.
2. Furnish magnetic controls for motors. Design controls to permit "inching" in both forward and reverse directions under full load, automatically regulated acceleration, and rapid brake response.
3. Provide each winch with limit switches of automatic-reset control circuit type to prevent over travel in both raising and lowering directions.
4. Provide tag line festooning system to carry power supply cables for each system.

F. Motors

1. Motors for Cranes, Hoists and Trolley: Reversible, induction motors especially adapted to hoist service and suitable for operation on 460V, 3-phase, 60-Hertz alternating current of voltage with a 1.15 service factor.

G. Push Button Control

1. Provide two (2) remote control pendant pushbutton control stations with each hoist. Pendant pushbutton control station shall have sufficient pushbuttons to control all

operations of bridge crane, hoist, and trolley, as necessary for the particular application. Clearly mark each pushbutton to indicate its function.

2. Provide pushbutton station operating magnetic controls to provide automatically regulated acceleration and rapid brake response.

2.4 CHAIN HOIST AND TROLLEY

- A. Chain hoist shall be a chain operated heavy duty hoist.
- B. Trolley shall be a chain operated geared trolley with contoured wheels that fit both tapered and flat-flange beams.
- C. Hoist shall be lug mounted to trolley.

2.5 SHOP PAINTING

- A. Shop apply to all exterior ferrous surfaces, with the exception of stainless steel, a high solids epoxy with the following characteristics:
 1. Solids by Volume: Minimum 69 percent (percent ± 2).
 2. Type: Polyamidoamine, self-priming.
 3. Dry Film Thickness: 4-8 mils per coat.
 4. No. of Coats required: Two.
 5. V.O.C. Requirement: 2.79 max.
 6. Color: To be selected by the Engineer.
- B. Surface preparation, mixing and application and safety requirements shall be in accordance with the paint manufacturer's printed instructions.
- C. Ferrous surfaces obviously not to be painted shall be given a shop applied coat of grease or rust resistant coating.

3 EXECUTION

3.1 INSTALLATION

- A. All equipment shall be installed in accordance with the manufacturer's requirements to produce a finished product that is clean and demonstrates true craftsmanship. The controls shall be easily accessed, moving components shall be adequately shielded, and walking areas shall be unobstructed.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site to assist the contractor with the installation of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.
- C. Verify all dimensions and clearances in field prior to erection and be responsible for proper fitting and operation of equipment.
- D. Install Hoists and Cranes in strict conformance with printed recommendations of each manufacturer and under direct supervision of manufacturer's technical representative.
- E. Furnish services of manufacturer's technical representative required for any adjustment and repairs as specified.
- F. Obtain approval before attaching any rigging or Hoists and Cranes to any part of building structure.

3.2 STARTUP AND TESTING

- A. A manufacturer's certified representative shall be made available to the contractor during equipment installation.
- B. Manufacturer shall allow for a minimum of one (1) trip to the project site for startup and testing of the equipment. If additional trips are required, they shall be the responsibility of the Contractor and there shall be no additional cost to the Owner.

C. Test equipment at rated loads and adjust to operate smoothly without malfunctions under all load conditions.

D. Include a check of horizontal and vertical alignment of rails.

3.3 CERTIFICATION

A. A manufacturer's representative that is qualified in the particular equipment requirements shall fully inspect and certify the equipment installation. Written certification shall be provided that states that the equipment is installed properly, is operating within the design parameters, and will be warranted as required by these specifications.

3.4 TRAINING

A. Training shall be conducted in accordance with Section 01790, Demonstration and Training.

B. The manufacturer shall conduct two (2) training classes for the Owner's personnel. The training classes shall be conducted on two consecutive days.

C. Training classes shall not be conducted concurrently with startup and testing; therefore, manufacturer shall allow for one (1) additional trip to the project site.

D. Training classes shall not be conducted until the manufacturer has certified that the equipment is properly installed and operational.

E. Training classes shall be scheduled with the Owner a minimum of one (1) week prior to conducting the class.

3.5 ACCEPTANCE

A. Acceptance of equipment will not be made until all equipment has been installed and tested, the manufacturer has certified the installation, the manufacturer has conducted the required training classes, final operation and maintenance manuals have been submitted to the engineer, and all spare parts have been turned over to the Owner.

** END OF SECTION **

SECTION 15062
DUCTILE IRON PIPE

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test ductile iron pipe as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. Use only pipe manufactured in the USA.
- B. All pipe shall be new and the product of one manufacturer.
- C. All pipe shall be tested and inspected at the place of manufacture for all requirements of the latest ASTM and Commercial Standard tests and certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.
- D. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 - 1. Nominal size
 - 2. Type and grade of material and ASTM standard
 - 3. Pressure class
 - 4. Manufacturer
 - 5. ANSI/NSF seal of approval

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Shop Drawings, Product Data, and Samples.

1.4 STORAGE AND PROTECTION

- A. Ductile iron pipe shall be stored and protected in accordance with the requirements of the manufacturer, this section, and Section 01620, Product Storage and Handling Requirements.
- B. Store pipe on level ground.
- C. Do not stack pipe more than 8 feet high.
- D. Do not drop pipe, drop objects on pipe, or subject pipe to external loads.
- E. Do not drag pipe across the ground or over obstacles.
- F. Remove pipe found with any visible damage from the job site.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, Warranties.

2 PRODUCTS

2.1 MATERIALS

A. Ductile Iron Pipe

- 1. Ductile iron pipe shall be designed and manufactured in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51.

2. Ductile iron used to manufacture ductile iron pipe shall meet the following minimum physical properties.
 - a. Minimum Tensile Strength – 60,000 PSI
 - b. Minimum Yield Strength – 42,000 PSI
 - c. Minimum Elongation – 10 percent
3. Ductile iron pipe thickness shall be in accordance with ANSI/AWWA C150/A21.50.
 - a. 4-inch through 12-inch ductile iron pipe shall be Pressure Class 350.
 - b. Greater than 12-inch ductile iron pipe used for pressurized force mains shall be minimum Pressure Class 250.
 - c. Greater than 12-inch ductile iron pipe used for non-pressurized lines shall be minimum Pressure Class 200.
4. Joints:
 - a. Buried Pipe:
 - 1) Push-on joints in accordance with ANSI/AWWA C111/A21.11.
 - b. Above Grade (Non-Buried) Pipe:
 - 1) Flanged joints in accordance with ANSI/AWWA C115/A21.15.
5. Gaskets:
 - a. Standard Push-on Joints:
 - 1) Liquid Service: Styrene-butadiene rubber (SBR) gasket in accordance with ANSI/AWWA C111/A21.11.
 - 2) Air Service: Fluoroelastomer (FKM) rubber gasket in accordance with ANSI/AWWA C111/A21.11.
 - b. Restrained Push-on Joints:
 - 1) Liquid Service: Styrene-butadiene rubber (SBR) gasket with restraining teeth meeting the requirements of ANSI/AWWA C111/A21.11.
 - 2) Air Service: Fluoroelastomer (FKM) rubber gasket with restraining teeth meeting the requirements of ANSI/AWWA C111/A21.11.
 - 3) Acceptable manufacturers of restrained joint gaskets:
 - a) American Ductile Iron Pipe Company Fast-Grip Gasket
 - b) McWane SURE STOP 350 Gasket
 - c) U.S. Pipe FIELD LOK 350 Gasket
 - d) Engineer Approved Equal
 - c. Flanged Joints:
 - 1) Full face, 1/8" thick, gasket with bulb-type ring(s).
 - 2) Gaskets shall meet the dimensions of ANSI/AWWA C115/A21.15.
 - 3) Material
 - a) Liquid Service: Styrene-butadiene rubber (SBR) gasket in accordance with ANSI/AWWA C111/A21.11.
 - b) Air Service: Fluoroelastomer (FKM) rubber gasket in accordance with ANSI/AWWA C111/A21.11.
 - 4) Gaskets shall be American Toruseal, U.S. Pipe Flange-Tyte, or equal.
6. Hardware:
 - a. Flanged Joints:

- 1) Bolts shall be heavy hex type, low carbon steel, zinc plated in accordance with ASTM A307, Grade B.
- 2) Nuts shall be heavy hex type, low carbon steel, zinc plated in accordance with ASTM A563, Grade A.
- 3) Washers shall be SAE flat washers, low carbon steel, zinc plated in accordance with ASTM F844.

7. Coatings:

a. Buried Pipe:

1) Interior:

- a) Liquid service: Standard thickness cement-mortar in accordance with ANSI/AWWA C104/A21.4.
- b) Air service: Unlined

2) Exterior:

- a) Asphaltic coating in accordance with ANSI/AWWA C151/A21.51.

b. Above Grade (Non-Buried) Pipe:

1) Interior:

- a) Liquid service: Standard thickness cement-mortar in accordance with ANSI/AWWA C104/A21.4.
- b) Air service: Unlined

2) Exterior:

- a) Universal primer

8. Acceptable manufacturers of ductile iron pipe and fittings:

- 1) American Cast Iron Pipe Company
- 2) McWane, Inc.
- 3) U.S. Pipe and Foundry Company

B. Ductile Iron Fittings

1. Standard ductile iron fittings shall be designed and manufactured in accordance with ANSI/AWWA C110/A21.10.
2. Compact ductile iron fittings shall be designed and manufactured in accordance with ANSI/AWWA C153/A21.53.
3. Ductile iron used to manufacture ductile iron fittings shall meet the following minimum physical properties.
 - a. Minimum Tensile Strength – 70,000 PSI
 - b. Minimum Yield Strength – 50,000 PSI
 - c. Minimum Elongation – 5 percent
4. Joints:
 - a. Buried Fittings:
 - 1) Mechanical joints in accordance with ANSI/AWWA C111/A21.11.
 - 2) Mechanical joints that require restraining shall be restrained with wedge type mechanical joint retainer glands for ductile iron pipe. Retainer glands shall be manufactured from high strength ductile iron in accordance with ASTM A536, Grade 65-45-12. Retainer gland dimensions shall be in accordance with ANSI/AWWA C111/A21.11 or ANSI/AWWA C153/A21.53.
 - 3) Acceptable manufacturers of retainer glands:

- a) Mega-Lug Series 1100
 - b) Sigma ONE-LOK Series D-SLDE
 - c) Uni-Flange Series 1400
 - d) Engineer Approved Equal
- b. Above Grade (Non-Buried) Fittings:
- 1) Flanged joints in accordance with ANSI/AWWA C110/A21.10.
5. Gaskets:
- a. Mechanical Joints:
 - 1) Liquid Service: Styrene-butadiene rubber (SBR) gasket in accordance with ANSI/AWWA C111/A21.11.
 - 2) Air Service: Fluoroelastomer (FKM) rubber gasket in accordance with ANSI/AWWA C111/A21.11.
 - b. Flanged Joints:
 - 1) Full face, 1/8" thick, gasket with bulb-type ring(s).
 - 2) Gaskets shall meet the dimensions of ANSI/AWWA C115/A21.15.
 - 3) Material
 - a) Liquid Service: Styrene-butadiene rubber (SBR) gasket in accordance with ANSI/AWWA C111/A21.11.
 - b) Air Service: Fluoroelastomer (FKM) rubber gasket in accordance with ANSI/AWWA C111/A21.11.
 - 4) Gaskets shall be American Toruseal, U.S. Pipe Flange-Tyte, or equal.
6. Hardware:
- a. Mechanical Joints:
 - 1) Bolts shall be low carbon steel, zinc plated, tee-head bolts in accordance with ANSI/AWWA C111/A21.11.
 - 2) Nuts shall be low carbon steel, zinc plated in accordance with ANSI/AWWA C111/A21.11.
 - b. Flanged Joints:
 - 1) Bolts shall be heavy hex type, low carbon steel, zinc plated in accordance with ASTM A307, Grade B.
 - 2) Nuts shall be heavy hex type, low carbon steel, zinc plated in accordance with ASTM A563, Grade A.
 - 3) Washers shall be SAE flat washers, low carbon steel, zinc plated in accordance with ASTM F844.
7. Coatings:
- a. Buried Fittings:
 - 1) Interior:
 - a) Liquid service: Double thickness cement-mortar in accordance with ANSI/AWWA C104/A21.4.
 - b) Air service: Unlined
 - 2) Exterior:
 - a) Asphaltic coating in accordance with ANSI/AWWA C151/A21.51.
 - b. Above Grade (Non-Buried) Fittings:
 - 1) Interior:

- a) Liquid service: Double thickness cement-mortar in accordance with ANSI/AWWA C104/A21.4.
- b) Air service: Unlined
- 2) Exterior:
 - a) Universal primer
- C. All ductile iron pipe and fittings used on a project shall be new and shall be the product of a single manufacturer, unless otherwise approved by the HCWSA Engineer.
- D. Acceptable manufacturers of ductile iron pipe and fittings:
 - 1. American Cast Iron Pipe Company
 - 2. McWane, Inc.
 - 3. U.S. Pipe and Foundry Company

3 EXECUTION

3.1 INSTALLATION

A. General

- 1. Ductile iron pipe shall be installed in accordance with the pipe manufacturers written instructions.
- 2. Pipe shall be cleaned of all foreign material prior to installation.

B. Cutting

- 1. Make square and smooth cuts using cutting tools that are designed for use on ductile iron pipe.
- 2. Remove burrs from outside and inside of pipe.

C. Buried Pipe Installation

- 1. Ductile iron gravity sewer pipe shall be installed in accordance with ANSI/AWWA C150/A21.50 and ANSI/AWWA C151/A21.51, Type 5 Laying Condition.
 - a. Ductile iron pipe shall be bedded to its centerline with No. 57 stabilization stone. There shall be a minimum of 4-inches of No. 57 stabilization stone under the pipe. Stabilization stone shall be compacted to a minimum of 90 percent of the maximum dry density as determined by ASTM D698.
 - b. Backfill from centerline of pipe to top of pipe with No. 57 stabilization stone or select earth backfill. Backfill shall be placed in 6-inch lifts and manually compacted to a minimum of 90 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.
 - c. Backfill from top of pipe to finished grade with select earth backfill. Backfill shall be placed in 6-inch lifts and mechanically compacted to a minimum of 90 percent of the maximum dry density, as determined by ASTM D698, prior to placing succeeding lifts.

- D. Above grade pipe shall be supported in accordance with manufacturer recommendations.

3.2 FIELD TESTING PIPE

- A. Ductile iron pipe shall be tested in accordance with Section 01666, Testing of Pipelines and Hydraulic Structures.

** END OF SECTION **



SECTION 15064
POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test polyvinyl chloride (PVC) and chlorinated polyvinyl chloride (CPVC) pipe and fittings as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. Use only pipe and fittings manufactured in the USA.
- B. All pipe shall be tested and inspected at the place of manufacture for all requirements of the latest ASTM and Commercial Standard tests and certified copies of the test reports covering each shipment shall be submitted to the Engineer prior to laying.
- C. Each length of pipe and each fitting shall have the following data clearly marked on each piece:
 - 1. Nominal size
 - 2. Type and grade of material and ASTM standard
 - 3. SDR, class, or schedule rating
 - 4. Manufacturer
 - 5. ANSI/NSF seal of approval

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Shop Drawings, Product Data, and Samples.

1.4 STORAGE AND PROTECTION

- A. PVC pipe and fitting shall be stored and protected in accordance with the requirements of the manufacturer, this section, and Section 01620, Product Storage and Handling Requirements.
- B. Protect pipe and fittings stored outdoors from direct exposure to sunlight. Covers must be non-transparent and covering must provide adequate air circulation above and around the pipe to prevent excessive heat absorption.
- C. Store pipe on level ground in the unit packages provided by the manufacturer.
- D. Do not stack pipe more than 8 feet high.
- E. When stacking pipe, make sure the weight of the upper pipe units does not cause deformation of the lower pipe units. Stack palletized pipe wood on wood.
- F. Do not store pipe in tightly enclosed areas subject to elevated temperatures or close to heat producing sources.
- G. Do not drop pipe, drop objects on pipe, or subject pipe to external loads.
- H. Do not drag pipe across the ground or over obstacles.
- I. Remove pipe or fittings found with any scratches, splits, or gouges from the job site.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, Warranties.

2 PRODUCTS

2.1 MATERIALS

- A. Schedule 80 Polyvinyl Chloride (PVC) Pipe
 - 1. PVC Material: Type 1, Grade 1 with Cell Classification 12454 per ASTM D1784
 - 2. Construction: Iron pipe size per ASTM D1785
 - 3. Maximum Service Temperature: 140 °F
 - 4. Color: Dark Gray
- B. Schedule 80 Chlorinated Polyvinyl Chloride (CPVC) Pipe
 - 1. PVC Material: Type 4, Grade 1 with Cell Classification 23447 per ASTM D1784
 - 2. Construction: Iron pipe size per ASTM F441
 - 3. Maximum Service Temperature: 200 °F
 - 4. Color: Light Gray
- C. Schedule 80 Polyvinyl Chloride (PVC) Fittings
 - 1. PVC Material: Type 1, Grade 1 with Cell Classification 12454 per ASTM D1784
 - 2. Construction: Per ASTM D2467
 - 3. Maximum Service Temperature: 140 °F
 - 4. Color: Dark Gray
- D. Schedule 80 Chlorinated Polyvinyl Chloride (CPVC) Fittings
 - 1. PVC Material: Type 4, Grade 1 with Cell Classification 23447 per ASTM D1784
 - 2. Construction: Per ASTM F439
 - 3. Maximum Service Temperature: 200 °F
 - 4. Color: Light Gray
- E. Primer
 - 1. Conform to ASTM F656
- F. Solvent Cement
 - 1. PVC: Conform to ASTM D2564
 - 2. CPVC: Conform to ASTM F493

3 EXECUTION

3.1 INSTALLATION

- A. Cutting
 - 1. Make square and smooth cuts using cutting tools that are designed for use on plastic pipe.
 - 2. Remove burrs from outside and inside of pipe.
 - 3. Place a 10° to 15° bevel approximately 1/16" to 3/32" in width on the end of the pipe.
- B. Solvent Cementing
 - 1. Clean pipe, fittings, and tools so they are free of dirt, moisture, grease, and other contaminants.
 - 2. Condition pipe, fittings, and accessories to same temperature conditions prior to use.
 - 3. Measure socket depth and mark on pipe as a reference mark to ensure pipe is completely bottomed into fitting during assembly.
 - 4. Apply primer to fitting/accessory socket and to pipe end.

5. Apply solvent cement to fitting/accessory socket and to pipe end while primer is still tacky.
6. While both surfaces are still wet with solvent cement, immediately insert the pipe fully into the fitting socket while rotating the pipe ¼ turn. Hold assembly for approximately 30 seconds to ensure initial bonding.
7. Allow solvent cemented assembly to set for 1 to 5 minutes, depending on pipe size and temperature, without any stress on the joint.

C. Buried Pipe Installation

1. PVC and CPVC pipe for underground pressure applications shall be installed in accordance with AWWA C605 with Type 5 embedment.
2. Minimum Depth of Cover: 3-feet
3. Maximum Depth of Cover: 14-feet.

D. Above Ground Installation

1. Support PVC and CPVC pipe and fittings using appropriate pipe supports as specified in Section 15094, Hangers and Supports for Plumbing and Equipment.
2. PVC and CPVC pipe shall be supported and maximum intervals recommended by the pipe manufacturer; however, the pipe support spacing shall not exceed the distances shown in the following tables.

PVC Pipe Support Spacing (feet)		
Pipe Size (inches)	Schedule 40	Schedule 80
¼	2	2
3/8	2	2.5
½	2.5	2.5
¾	2.5	2.5
1	2.5	3
1¼	3	3
1½	3	3.5
2	3	3.5
2½	3.5	4
3	3.5	4
3½	4	4.5
4	4	4.5
6	4.5	5
8	4.5	5.5
10	5	6
12	5.5	6.5
14	6	7
16	6.5	7.5
18	7	9
20	8.5	9.5
24	9.5	10.5

CPVC Pipe Support Spacing (feet)		
Pipe Size (inches)	Schedule 40	Schedule 80
¼	2.5	2.5
3/8	2.5	2.5
½	2.5	2.5
¾	2.5	2.5
1	2.5	3
1¼	3	3

CPVC Pipe Support Spacing (feet)		
Pipe Size (inches)	Schedule 40	Schedule 80
1½	3	3.5
2	3	3.5
2½	3.5	4
3	3.5	4
3½	4	4.5
4	4	4.5
6	4.5	5
8	5	5.5
10	5.5	6
12	6	6.5
14	6	8
16	7	8.5
18	7.5	9
20	7.5	9.5
24	8	10

3. Paint all exposed pipe as specified in Section 09900, Painting.
4. Outdoor Applications
 - a. Protect all pipe installed above ground and outside from freezing using insulation and heat trace tape.

3.2 FIELD TESTING PIPE

- A. All pressure tests must be witnessed by Engineer.
- B. **DO NOT** pressure test piping assembly with air or compressed gas.
- C. Pressure test piping assembly with water.
- D. All solvent cemented connections must be fully cured prior to pressure testing.
- E. Piping assembly must be adequately anchored/restrained prior to pressure testing.
- F. Pressure test piping assembly to 200% of maximum working pressure or to the maximum working pressure of the lowest pressure rated component in the system, whichever is less.
- G. Test Procedure
 1. Slowly fill system with water, venting air from valves at piping run ends and at elevations during the filling process.
 2. Any slow buildup of gauge pressure or any fluctuating gauge needle on a completely liquid filled system is a strong indication that entrapped air is present in the system. In this case, immediately release pressure and re-bleed line.
 3. Pressurize system to test pressure using hydraulic hand pump or water supply line, if pressure is sufficient.
 4. System must hold pressure for a minimum of 2-hours to demonstrate system integrity.
 5. If leak is found or pressure is not maintained, relieve remaining pressure, cut-out failed sections, replace, and allow time to cure properly prior to retesting.

** END OF SECTION **

SECTION 15066
STAINLESS STEEL PIPE AND FITTINGS

1 GENERAL

1.1 SCOPE

- A. The contractor shall furnish all materials, tools, equipment, transportation, labor, supervision and incidentals required to supply, store, install, clean, and test the shop fabricated stainless steel pipe & fittings as shown on the drawings and as specified herein.

1.2 QUALIFICATIONS

- A. All shop fabricated stainless steel pipe and fittings shall be furnished by a single manufacturer who is experienced, reputable and qualified in the manufacture and fabrication of the items to be furnished. The pipe and fittings shall be shop fabricated and field installed in accordance with common industry wide practices and methods and shall comply with these specifications.

1.3 SUBMITTALS

- A. The contractor shall submit piping layouts, schedules, shop fabrication drawings, specifications, catalog cuts and other data necessary to show conformance of the complete piping systems of these specifications. The contractor's submittal shall include dimensions, fittings, locations of equipment, valves, and appurtenances, joint locations and details, types and locations of supports, coordination with all other work and existing conditions, and all other pertinent technical specifications for the piping systems to be furnished.
- B. Shop fabrication drawings shall show alloys, diameters, pipe wall thicknesses, flanges and other joint preparation details, dimensions, fittings and other appurtenances to be supplied.
- C. Provide Qualification Test reports bearing witness certification to ASME Section IX by an independent testing laboratory for each welder, welding operator and tacker, within the last six months, to be employed in the work.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable manufacturers include:
 - 1. Douglas Brothers
 - 2. Felker Brothers Corporation
 - 3. Bristol Metals
 - 4. Or equal.

2.2 PIPE AND FITTINGS

- A. Stainless steel pipe used for liquid service or is submerged in liquids shall be type 316L stainless steel. Stainless steel pipe for air service shall be type 304L stainless steel, unless otherwise noted.
- B. Pipe shall be seamless or straight-seam welded austenitic pipe for high temperature and general corrosive service manufactured in accordance with ASTM A312.
- C. Pipe shall be manufactured to nominal pipe sizes as listed in ANSI B36.19, Table 2, with Schedule 10S wall thickness.
- D. Fittings shall be butt weld type manufactured in accordance with ASTM A774 of the same raw material and in the same thicknesses as the pipe. Long radius elbows up to 24" diameter shall be smooth flow; i.e. centerline to end of elbow equals 1.5 times the nominal pipe size. Reducers shall be straight tapered, cone type. Tees, crosses, laterals and wyes shall be shop fabricated from pipe.

2.3 FLANGES

- A. Flanged pipe ends shall be made up of type 304L or 316L stainless steel, as required, slip-on type rolled angle face rings with back-up flanges drilled to ANSI 16.1 class 125 standard. The angle face ring thickness shall be equal to or greater than the wall of the pipe or fitting to which it is welded and it shall be continuously welded on both sides to the pipe or fitting. The angle leg shall not interfere with the flange bolt holes.

2.4 COUPLINGS

- A. The piping shall be shop prepared for pipe couplings at pipe-to-pipe connections, where shown on the drawings or specified herein.
- B. Couplings shall be stainless steel of equal or superior alloy and wall thickness as the pipe and shall be Depend-O-Lok type as manufactured by Victaulic Depend-O-Lok or equal. Couplings shall have restrained style ends – DOL FxF, or equal. The pipe shall be plain end with external weld beads ground smooth and with stainless steel restraining rings shop welded to the piping for fixed type couplings.
- C. Expansion couplings shall be stainless steel of equal or superior alloy and wall thickness as the pipe and shall be Depend-O-Lok type as manufactured by Victaulic Depend-O-Lok or equal. Couplings shall have restrained style ends – DOL FxE, or equal. The pipe shall be plain end with external weld beads ground smooth and with stainless steel restraining rings shop welded to the piping for fixed by expansion type couplings.
- D. Gasket material for all couplings shall be silicone for high temperatures.

2.5 JOINTS

- A. Flanges shall be provided as a minimum at all flanged valves, meters, couplings, and connection to other equipment.
- B. All flange connections shall be bolted with through stud or tap bolts of required size as directed. Bolts and nuts shall be Grade 316 stainless steel.

3 EXECUTION

3.1 FABRICATION

- A. After the manufacture of individual stainless steel fittings and pipe lengths, they shall be pickled by immersion in a tank containing an ambient nitric hydrofluoric acid solution made up from Oakite Deoxidizer SS, or equal, and monitored to generally maintain a 25% or higher solution by volume of water. The duration of immersion shall be 15 to 20 minutes and may be supplemented by manually scrubbing or brushing with non metallic pads or stainless steel wire brushes. The acid treatment shall be followed by immersion in a rinse water tank, followed if necessary by a spray rinse. The stainless steel products shall then be allowed to air dry to achieve passivation.
- B. Welding of pipe spools shall be performed using welders and procedures qualified in accordance with ASME Section IX. Piping with wall thicknesses up to and including 11 gauge (0.125") shall be welded with the TIG (GTAW) process. Heavier walls shall be beveled according to procedure, root pass welded with the TIG (GTAW), and have subsequent weld passes performed using the TIG (GTAW), MIG (GMAW), or Metallic Arc (SMAW) process. Filler metal of equal or superior ELC grades only shall be added to all welds to provide a cross section at the weld equal to or greater than the parent metal. Weld deposit shall be smooth and evenly distributed.
- C. Concavity, undercut, cracks or crevices in welding shall not be allowed. Butt welds shall have full penetration to the interior surface, and inert argon gas shielding shall be provided to the interior and exterior of the joint. Angle face rings shall be continuously welded on both sides to pipe or fitting. Exterior welds, such as the back side of face rings or flanges and structural attachments, may be welded by the MIG (GMAW) or Metallic Arc (SMAW) process, however care shall be taken to avoid melting through to the interior surface on very light walls. Excessive weld deposits, slag, spatter and projections shall be removed by grinding. Welds on gasket surfaces shall be ground smooth.

- D. Spools shall be fabricated to the "Pipe Fabrication Institute" fabricating tolerances ES-3.
- E. All fabricated piping shall have openings plugged and flanges secured for storage and/or transport after fabrication. All fabricated piping shall be piece marked with identifying numbers or codes which correspond to the contractor's layout and installation drawings. The marks will be located on the spools at opposite ends and 180 degrees apart.
- F. The piping supplier during manufacturing, fabrication and handling stages, and the contractor during handling and installation stages, shall use extreme care to avoid the contact of any ferrous materials with the stainless steel piping. All saws, drills, files, wire brushes, etc. shall be used for stainless steel piping only. Pipe storage and fabrication racks shall be non ferrous or stainless steel or rubber lined. Nylon slings or straps or alloy chains or cable shall be used for handling stainless steel piping. After installation, the contractor shall wash and rinse all foreign matter from the piping surface. If rusting of embedded iron occurs, the contractor shall pickle the affected surface with Oakite Deoxidizer SS or equal, scrub with stainless steel brushes and rinse clean.

3.2 INSTALLATION AND TESTING

- A. Support piping in a manner which will prevent undue strain on valve, fitting, or equipment. Provide pipe supports on interior pipe at changes in direction or elevation, adjacent to flexible couplings, adjacent to non-rigid joints, and where otherwise shown.
- B. Clean off dirt, dust, oil, grease and other foreign material, before pressure and leakage tests.
- C. Furnish and install temporary testing plugs or caps; pressure pumps, pipe connections, meters, gauges, equipment, and labor.
- D. Stainless steel pipe shall be tested in accordance with Section 01666, Testing of Pipelines and Hydraulic Structures.

** END OF SECTION **



SECTION 15094
PIPE SUPPORTS AND HANGERS

1 GENERAL

1.1 SCOPE OF WORK

- A. The work covered by this section includes providing all pipe supports, hangers, and brackets necessary to install piping furnished under these Contract Documents. The Contractor shall furnish and install all foundations, anchor bolts, pipe supports, shims, hangers, clamps, and hardware required for a complete installation as shown on the Drawings and/or specified herein.
- B. For clarity, not all pipe supports are shown on the drawings. All pipes shall be supported in accordance with these specifications. All valves and changes in pipe direction shall be supported by concrete pier or mechanical type pipe support.

1.2 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Submittals.

1.3 STORAGE AND PROTECTION

- A. Pipe supports and accessories shall be stored and protected in accordance with the requirements of Section 01620, Storage and Protection.

1.4 SHOP PAINTING

- A. Fabricated pipe supports and accessories, except where shown on the Drawings to be galvanized, shall be cleaned and shop primed in accordance with requirements of Section 09900, Painting.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with requirements of Section 01740, Warranties and Bonds.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Anvil International
- B. Cooper B-line
- C. Or equal

2.2 MATERIALS

- A. All supports and hangers shall meet the following material requirements:
 - 1. All structural carbon steel shall conform to ASTM A36.
 - 2. All 304L/316L stainless steel shall conform to ASTM A276
 - 3. All pipe support columns shall conform to ASTM A53, Grade B, and shall be minimum Schedule 40.
 - 4. Pipe supports shall be adjustable.
 - 5. Threaded rods and U-Bolts shall be type 316 stainless steel.
 - 6. All hardware shall be type 316 stainless steel.

3 EXECUTION

3.1 GENERAL

- A. Long runs of pipe subject to expansion shall be hung by means of adjustable swivel pipe roll hangers.
- B. Short runs of uninsulated pipe subject to expansion in sizes up to and including 3½ inches, as well as, all pipe of those sizes not subject to expansion shall be hung by means of adjustable swivel, split pipe ring.
- C. Insulated piping and tubing, short lengths of 4 inches and larger pipe subject to expansion, and pipe 4 inches and larger not subject to expansion shall be hung by means of adjustable steel clevis hangers.
- D. Pipe 2 inches and less in diameter and not subject to expansion may, when paralleling walls, be supported by single hook clamp hangers.
- E. Flat strap hangers will not be permitted. Hangers relying on mastics or adhesives shall not be used.
- F. Pipe supported from underneath and subject to expansion shall have adjustable pipe roll stand supports. The pipe roll stand shall be supported by concrete piers, structural steel, or steel brackets as required.
- G. Pipe supported from underneath and not subject to expansion shall have cast-in-place concrete supports or adjustable pipe saddle supports on properly sized pipe stanchions and ample, properly grouted floor flanges.
- H. Hangers suspended from structural steel shall be supported on U.F.S. beam clamp with links as required.
- I. Hangers from concrete work shall be secured by universal, galvanized metal inserts placed in the concrete at the time of pouring. Wooden plugs or other improvised means shall not be used for any form of hanger fastening.
- J. All interior and exterior concrete piers shall be Class A concrete meeting the requirements of these Specifications.
- K. Rods for supporting suction bells or foot valves of pump intakes shall be stainless steel. The rods shall be furnished complete with stainless steel turnbuckles and eyes or other approved means for connection to the suction bell and stainless steel eye bolt anchored in the concrete. Supports for other pump suction pipelines shall be as shown on the Drawings.
- L. Uninsulated copper tubing shall be hung by means of copper-plated, split ring hangers with copper-plated sockets.

3.2 INSTALLATION

- A. Contact between ferrous supports and non-ferrous piping materials shall not be permitted. Supports and clamps shall be rubber coated or copper plated as necessary to prevent this condition.
- B. Adequate supports shall be provided so that there is no movement or visible sagging between supports.
- C. Hangers shall permit a minimum of 1½-inch vertical adjustment after installation.
- D. Hanger rods shall be carbon steel conforming to the following sizes:

Rod Diameter (Inch)	Pipe Size (Inch)
½ and under	¼ - 2
¾	2½ - 4
5/8	5 - 8
7/8	10 and up

- E. Carbon steel, alloy steel, stainless steel, and hard-drawn copper pipe shall have maximum support intervals as recommended by pipe manufacturer; however, support intervals shall not exceed the intervals shown in the following tables:

Maximum Interval for Steel, Feet

Pipe Size, In.	Liquid	Gas	Maximum Interval for Copper, Feet
1/2	5	6	4
3/4	6	7	5
1	7	9	6
1 1/2	9	11	8
2	10	13	8
2 1/2	11	14	9
3	12	15	10
4	13	17	11
6	17	21	-
8	19	24	-
10	22	27	-
12	23	29	-
14	25	32	-
16	27	35	-
18	28	37	-
20	30	39	-
24	32	42	-

- F. Annealed copper tubing, polyethylene tubing, and PVC piping shall be supported on maximum intervals as follows:

Tube Size, In.	Maximum Interval, Ft.
3/8 and smaller	2
1/2 - 1	2.5
1 1/4 - 2	3
2 1/2 - 3	3.5
3 1/2 - 4	4
6-8	4.5

- G. Where indicated or directed by the Engineer, exposed piping and tubing carrying liquid shall be sloped as necessary to permit complete draining. Pipe deflection between supports shall be considered when determining the slope required to permit complete drainage. All underground piping shall be sloped uniformly for complete drainage.
- H. Cast iron or ductile iron piping shall be supported as recommended by the manufacturer, and at all valves and fittings larger than 4 inches in size. At least one support shall be provided per pipe section or at every other joint, whichever is closer. Supports shall be located next to hubs or bells.
- I. Open ends of pipe columns used for support shall be completely covered with a 1/4-inch-thick plate or angle leg welded in place.
- J. All threaded connections installed loose, such as hanger rods and U-bolts, shall have a double nut installation.
- K. Vertical piping shall be supported as shown or required to prevent buckling or swaying utilizing special brackets. Unless otherwise shown, vertical piping shall be supported at the bottom and at each floor. Vertical copper tubing 1 inch and smaller in size shall be supported at 5-foot intervals.
- L. Provide a support within 18 inches of each elbow and within 24 inches of each equipment connection.
- M. Pipes passing through non-load bearing walls and partitions shall not bear on building construction. Pipes shall not be supported from roof decking, bar joists, or ceiling suspension systems unless approved by the Engineer.

- N. Insulation on hot piping (carrying fluids above 70°F) shall be protected at supports and hangers with a 12-inch long galvanized steel protection saddle with welded center support. Protection saddle shall be Grinnell Figure 160 or 161, Fee and Mason Figure 171 or 1710, or equal.
- O. Insulation on cold piping (carrying fluids at 70°F or below) shall be protected at supports and hangers by galvanized steel insulation shields with a 180-degree contour. Insulation shields shall be Grinnell Figure 167, Fee and Mason Figure 81, or equal.
- P. On insulation finished with an aluminum jacket, a 1/32-inch thick sheet of neoprene shall be provided between the jacket and the shield.
- Q. Hangers shall be selected to fit around insulation.
- R. Following installation all pipe supports shall be field primed and painted with the specified painting system for the application in accordance with requirements of the section titled "Painting" of these Specifications.
- S. Unless otherwise shown, piping shall not be fastened to a support in such a manner that would prevent axial movement due to thermal expansion and contraction.
- T. No pipe supports shall be anchored to or supported from floor grating.
- U. Unless otherwise noted, piping dimensions shown on the Drawings are for reference only and shall be verified in the field by the Contractor. The Contractor shall size supports and hangers using actual field dimensions.

** END OF SECTION **

SECTION 15100
VALVES

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, materials, and equipment required to install, test, and place into satisfactory operation all valves and valve appurtenances as shown on the Drawings and/or specified herein.

1.2 SUBMITTALS

- A. The Contractor shall submit shop drawings and product data to the Engineer in accordance with the requirements of Section 01300, Submittals.
- B. At a minimum, the submittals shall contain, but not be limited to, the following information to establish compliance with these specifications:
 - 1. Drawings showing plan, elevation, and appropriate cross sections of the valves being provided. Drawings shall clearly show the location and position of the valve operator for each valve provided.
 - 2. Complete engineering data including, but not limited to, descriptive data, material specifications, and piping diagrams, as appropriate, to support the design of the valves being provided.
 - 3. A complete description of the warranty to be provided.

1.3 OPERATION AND MAINTENANCE DATA

- A. The Contractor shall provide operation and maintenance data in accordance with the requirements of Section 01730, Operating and Maintenance Data.

1.4 STORAGE AND PROTECTION

- A. Equipment shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.
- B. Valves shall be completely drained prior to shipment. Ends of flanged and mechanical joint valves shall be protected with full size wooden baffles securely bolted to the valve ends. Size of baffles shall be at least equal to outside diameter of flange. Valves 24-inches in size and larger shall be secured to a wooden skid to facilitate handling and storage.

1.5 WARRANTIES AND BONDS

- A. The Contractor shall provide a warranty against defective or deficient materials and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.
- B. The valve manufacturers shall provide a warranty against defective or deficient equipment, workmanship and materials for a period of five (5) years under normal use, operation and service. The warranty shall be in printed form and apply to all similar units.

1.6 QUALITY ASSURANCE

A. General

- 1. The valve manufacturers shall furnish a written certification to the Engineer that all valves comply with all applicable requirements of the governing AWWA standards specified herein.

B. Manufacturer

- 1. Valves and equipment furnished under this section shall be the product of firms regularly engaged in the design and manufacture of such equipment for a minimum of five (5) years.

C. Installer

1. Installation, calibration and testing of valves and equipment furnished under this section shall be performed by qualified, skilled technicians who are regularly engaged in such activities involving systems of similar complexity, and who possess all licenses and certificates required to perform such work.

2 PRODUCTS

2.1 GENERAL

- A. Contractor shall note that all valves, especially in the smaller sizes, are not necessarily shown completely on the drawings, which are more or less schematic. However, the Contractor shall furnish and install all valves indicated or required for proper operation of the equipment or services requiring such valves.
- B. Contractor shall be responsible for coordinating the location and position of valve operators. Operator positions for each valve shall be clearly shown in the shop drawings.
- C. Each valve body shall have cast thereon the word "OPEN," an arrow indicating the direction to open, and flow direction arrows.

2.2 VALVES

A. Ball Valves

1. Bronze Ball Valves (3" and Smaller)
 - a. Threaded, 2-piece, standard port ball valves.
 - b. Body: Lead-Free Bronze (ASTM B584)
 - c. Ball: Chrome plated lead-free alloy
 - d. Stem: Lead-Free Alloy
 - e. Packing: PTFE
 - f. Cold Working Pressure: Minimum 600 PSI
 - g. End Connections: FNPT x FNPT
 - h. Lever: Zinc plated steel with vinyl cover
 - i. Manufacturers
 - 1) Conbraco Industries, Apollo Valves
 - 2) Nibco, Inc.
 - 3) Engineer approved equal.
2. Stainless Steel Ball Valves (3" and Smaller)
 - a. Threaded, 2-piece, standard port ball valves.
 - b. Body: Type 316 stainless steel (CF8M)
 - c. Ball: Type 316 stainless steel (ASTM A276)
 - d. Stem: Type 316 stainless steel (ASTM A276)
 - e. Packing: PTFE
 - f. Cold Working Pressure: Minimum 600 PSI
 - g. End Connections: FNPT x FNPT
 - h. Lever: Type 304 stainless steel with vinyl cover
 - i. Manufacturers
 - 1) Conbraco Industries, Apollo Valves

- 2) Nibco, Inc.
 - 3) Engineer approved equal.
 - 3. PVC Ball Valves
 - a. True Union Ball Valves
 - b. Body Material: PVC Cell Class 12454 per ASTM D1784
 - c. Full port design
 - d. Reversible PTFE seats
 - e. End Connections: True Union SOC x True Union SOC
 - f. Seals: FPM
 - g. Ball Valves used for sodium hypochlorite service shall be vented type.
 - h. Pressure Rating
 - 1) ½" to 2" Valves: 250 PSI @ 70°F Non-Shock
 - 2) 2½" to 4" Valves: 235 PSI @ 70°F Non-Shock
 - i. Manufacturers
 - 1) Hayward Industries, Inc.
 - 2) Engineer approved equal.
- B. Butterfly Valves
 - 1. Resilient seated butterfly valve in accordance with AWWA C504.
 - 2. Valve Body: ASTM A536, Grade 65-45-12 ductile iron.
 - 3. Valve Disc: ASTM A536, ductile iron with Type 316 stainless steel edge.
 - 4. Valve Stem: Type 316 stainless steel (ASTM A276)
 - 5. Seats
 - a. Water Service: EPDM
 - b. Air Service: Viton
 - 6. Working Pressure: Minimum 150 PSI
 - 7. Valves shall open counter-clockwise (left).
 - 8. End Connections:
 - a. Buried Valves: MJ x MJ
 - b. Non-Buried Valves: FLG x FLG or wafer type as shown on drawings.
 - 9. Interior and exterior surfaces shall be coated with fusion-bonded epoxy coating in accordance with ANSI/AWWA C550.
 - 10. Valve shall be NSF/ANSI Standard 61 compliant.
 - 11. Acceptable Manufacturers:
 - a. Dezurik
 - b. Henry Pratt Company
 - c. Mueller Company
 - d. Val-Matic Valve and Manufacturing Corporation
 - e. Engineer approved equal.
- C. Check Valves
 - 1. Swing Type Metal Check Valves (4-Inches and Larger)

- a. Rubber flapper type swing check valves in accordance with ANSI/AWWA C508 with spring assisted closure to minimize surge and water hammer. Check valves shall be of the full body type with a domed access cover, flexible disc, spring, mechanical position indicator, and screw-type backflow actuator.
 - b. Valve Body and Cover: ASTM A536 Grade 65-45-12 ductile iron.
 - c. Valve Disc: Buna-N (NBR) rubber.
 - d. Spring shall be stainless steel.
 - e. Working Pressure: Minimum 250 PSI
 - f. Interior and exterior of valves shall be coated with an ANSI/NSF 61 approved epoxy coating.
 - g. Acceptable Manufacturers:
 - 1) Series 7200 Surgebuster manufactured by Val-Matic Valve and Manufacturing Corporation
 - 2) Figure SB200D Slaminator manufactured by GA Industries
 - 3) Engineer approved equal.
2. Bronze Check Valves (3" and Smaller)
- a. Bronze check valves with renewable seats conforming to MSS SP-139.
 - b. Body: Lead-Free Bronze (ASTM B584)
 - c. Cold Working Pressure: Minimum 200 PSI
 - d. End Connections: FNPT x FNPT
 - e. Manufacturers
 - 1) Conbraco Industries, Apollo Valves
 - 2) Nibco, Inc.
 - 3) Engineer approved equal.
3. PVC Check Valves
- a. True Union Ball Check Valves
 - b. Body and Ball Material: PVC Cell Class 12454 per ASTM D1784
 - c. Horizontal or vertical installation
 - d. Square cut seat for positive sealing
 - e. Seats with minimum back pressure
 - f. End Connections: True Union SOC x True Union SOC
 - g. Seals: FPM
 - h. Pressure Rating: 150 PSI @ 70°F Non-Shock
 - i. Manufacturers
 - 1) Hayward Industries, Inc.
 - 2) Engineer approved equal.
- D. Gate Valves
1. Large Gate Valves (4" and Larger)
- a. Resilient-seated gate valve in accordance with AWWA C509.
 - b. Valve Body and Bonnet: ASTM A536 ductile iron
 - c. Disc: Cast iron encapsulated in rubber
 - d. Valve Stem: Cast bronze

- e. Working Pressure: Minimum 200 PSI
 - f. Operators:
 - 1) Buried Valves: Non-Rising Stem (NRS)
 - 2) Non-Buried Valves: Outside Stem and Yoke (OS&Y)
 - g. Valves shall open counter-clockwise (left).
 - h. End Connections:
 - 1) Buried Valves: MJ x MJ
 - 2) Non-Buried Valves: FLG x FLG
 - i. Interior and exterior surfaces shall be coated with fusion-bonded epoxy coating in accordance with AWWA C550.
 - j. Valve shall be NSF/ANSI Standard 61 compliant.
 - k. Acceptable Manufacturers:
 - 1) M&H Valve Company, Style 4067
 - 2) Mueller Company, 2360 Series
 - 3) U.S. Pipe Valve and Hydrant Division, A-USP0-20
 - 4) Engineer approved equal.
2. Small Gate Valves (3" and Smaller)
- a. Threaded, full-port, non-rising stem gate valve.
 - b. Body: Lead-Free Bronze (ASTM B584)
 - c. Disc/Wedge: Lead-Free Bronze (ASTM B584)
 - d. Cold Working Pressure: Minimum 200 PSI
 - e. End Connections: FNPT x FNPT
 - f. Manufacturers
 - 1) Conbraco Industries, Apollo Valves
 - 2) Nibco, Inc.
 - 3) Engineer approved equal.
- E. Plug Valves
- 1. Full-port eccentric plug valve in accordance with AWWA C517.
 - 2. Valve Body:
 - a. Plug valves located on membrane tank drain lines shall have Type 316 stainless steel bodies.
 - b. All other plug valves shall have ASTM A536 ductile iron bodies.
 - 3. Valve Plug: Type 316 stainless steel (ASTM A276) with resilient coating.
 - 4. Valve Stem: Type 316 stainless steel (ASTM A 276)
 - 5. Working Pressure: Minimum 175 PSI for valves less than or equal to 12" in size. Minimum 150 PSI for valves greater than 12" in size.
 - 6. Operators:
 - a. Pneumatic actuator where shown on drawings
 - b. Rotary type actuator or lever actuator for all other valves as specified herein.
 - 7. End Connections:
 - a. Buried Valves: MJ x MJ

- b. Non-Buried Valves: FLG x FLG
 - 8. Interior and exterior surfaces shall be coated with fusion-bonded epoxy coating.
 - 9. Acceptable Manufacturers:
 - a. M&H Valve Company
 - b. Val-Matic Valve & Manufacturing Corporation
 - c. Engineer approved equal
- F. Pressure Reducing Valves
 - 1. Water pressure reducing valves for the protection of plumbing systems.
 - 2. Body: Lead-Free Bronze (ASTM B584)
 - 3. Bonnet: Bronze (ASTM B548)
 - 4. Diaphragm: Buna-N with nylon
 - 5. Bolts and Springs: Stainless steel
 - 6. Cold Working Pressure: Minimum 400 PSI
 - 7. End Connections: FNPT x FNPT
 - 8. Manufacturers
 - a. Conbraco Industries, Apollo Valves
 - b. Nibco, Inc.
 - c. Engineer approved equal.
- G. Combination Air/Vacuum Valves
 - 1. Combination air/vacuum valve shall be suitable for potable water or sanitary sewage service.
 - 2. Valve body shall be carbon steel.
 - 3. Maximum Operating Pressure: 250 PSI
 - 4. Operating Range: 0 to 250 PSI
 - 5. Air Release Capacity: 135 CFM
 - 6. Connection:
 - a. 2" to 3": FNPT
 - b. 4" and larger: AWWA C115/ANSI B16.1
 - 7. 2" to 3" connection nipples and isolation ball valves shall be Type 316 stainless steel.
 - 8. Interior and exterior of 4" and larger valves shall be epoxy coated.
 - 9. Acceptable Manufacturers:
 - a. H-Tec Model 986
- H. Solenoid Valves
 - 1. Normally closed, 2-way solenoid valve.
 - 2. Body shall be brass or Type 316L stainless steel as shown on drawings.
 - 3. Minimum 150 PSI working pressure.
 - 4. Threads shall be FNPT.
 - 5. Seals and discs shall be PTFE.
 - 6. 120V, 60 hertz, single-phase power.
 - 7. Solenoid valves shall be rated for Class I, Division 2 service.
 - 8. Manufacturers

- a. ASCO
 - b. Engineer approved equal.
- I. Strainers
 - 1. Threaded, full-port, non-rising stem gate valve.
 - 2. Body: Lead-Free Bronze (ASTM B584)
 - 3. Screen: Type 304 stainless steel
 - 4. Cold Working Pressure: Minimum 200 PSI
 - 5. End Connections: FNPT x FNPT
 - 6. Manufacturers
 - a. Conbraco Industries, Apollo Valves
 - b. Nibco, Inc.
 - c. Engineer approved equal.
- J. Yard Hydrants
 - 1. Yard hydrants shall be Simmons 800LF Series, lead-free, frost-proof yard hydrants.
- K. Hose Bibbs
 - 1. Hose bibbs shall be angle-hose valves of lead-free bronze construction suitable for 200 PSI minimum working pressure. Valves shall have a renewable Teflon or resilient disc and shall be furnished with a ¾" inch male hose outlet connection. Valves shall be furnished with a tamper-proof vacuum breaker. Valves shall be furnished with a suitable cap and chain. Handwheel shall be cast iron.
- L. Curb Stops and Corporation Stops
 - 1. Curb stops shall be of lead-free bronze construction with straight-through unobstructed pattern flow, Teflon coated plug, top and bottom O-ring plug seals, O-ring port seals, and solid tee handle. Valves shall be suitable for 175 PSI minimum working pressure. A quarter turn shall operate the valve from fully open to fully closed position. Valves shall comply with applicable requirements of AWWA C800.
 - 2. Curb stops shall be furnished with cast iron foot pieces to permit the curb box to rest on a solid surface without bearing on the curb stop or piping.
 - 3. Curb boxes shall be of cast iron, shall have a 2-inch inside diameter, and shall be of the extension type with lid and plug. One compatible steel shut-off rod of suitable length shall be furnished. Curb boxes and bases shall be coated with a suitable bituminous coating.
 - 4. Corporation stops for service line connections shall be precision fitted, individually lapped, ground joint key stops of all bronze construction. For tapped connections to water mains, inlet threads shall be of the steel taper, corporation stop type. Corporation stops shall conform to the applicable requirements of AWWA C800.

2.3 PNEUMATIC VALVE ACTUATORS

- A. Pneumatic actuators shall be of the vane type design suitable for OPEN/CLOSE operation and shall conform to AWWA C541.
- B. Pneumatic actuators shall be provided with all solenoid valve(s), speed controls, limit switches, position switches, I/O contacts, and all other appurtenances required for proper operation.
- C. Pneumatic actuators shall be rated for minimum 150 PSI working pressure.
- D. Pneumatic actuator shall operate on 80 to 150 PSI air pressure.
- E. Pneumatic actuator shall fail closed.
- F. Pneumatic actuator shall be provided with exhaust air muffler(s).

- G. Pneumatic actuator shall be provided with a manual override.
- H. Pneumatic actuator shall be provided with a position indicator.
- I. Solenoid valves shall operate with 120V, 1 phase, 60 hertz power.
- J. Control

- 1. Actuator shall be provided with the following minimum I/O contacts
 - a. Provide output contacts for the following:
 - 1) Actuator OPEN status
 - 2) Actuator CLOSED status
 - b. Provide input contacts for the following:
 - 1) Actuator OPEN command
 - 2) Actuator CLOSE command

- K. Motorized actuator shall be Rotork K-Tork or Engineer approved equal.

2.4 MANUAL VALVE OPERATORS

- A. Unless otherwise shown or specified, butterfly and plug valves shall be furnished with manual operators as follows:
 - 1. Butterfly valves and plug valves 8" and smaller that are installed above grade and less than 7 feet above the working surface shall have a lever operator.
 - 2. Butterfly valves and plug valves greater than 8" that are installed above grade and less than 7 feet above the working surface shall have a rotary operator with handwheel.
 - 3. Butterfly valves and plug valves located more than 7 feet above the working surface shall have a rotary operator with chainwheel.
 - 4. Butterfly valves and plug valves 8" and smaller that are installed for buried service shall have a 2" operating nut, extension stem, and valve box.
 - 5. Butterfly valves and plug valves greater than 8" that are installed for buried service shall have a rotary operator with extension stem, 2" operating nut, and valve box.
- B. Unless otherwise shown or specified, gate valves shall be furnished with manual operators as follows:
 - 1. Gate valves that are installed above grade and less than 7 feet above the working surface shall have a handwheel operator.
 - 2. Gate valves that are installed above grade and more than 7 feet above the working surface shall have a chainwheel operator.
 - 3. Gate valves that are installed for buried service shall have a 2" operating nut, extension stem, and valve box.
 - 4. Gate valves that are installed in a deep vault or are submerged shall have an extension stem with floor stand and a handwheel operator.
- C. Operating nuts for buried valves shall be standard 2" square nuts and shall conform to AWWA C500. Extension stems, valve boxes, and stem guides shall be furnished where shown, specified, or required for proper operation.
- D. Hand lever operators shall have heavy-duty cast iron bracket, cast iron latching lever, and self-lubricating bushings and shall be capable of securing the valve in any position. Lever operators shall be installed so that the lever is parallel with the axis of the pipe in which the valve is installed when the valve is fully open.
- E. Rotary manual operators for aboveground service shall be of the worm gear or traveling nut type. Rotary operators shall have a heavy-duty, weatherproof cast iron or steel housing with gasketed, removable cover and shall be equipped with a mechanical dial or slot type position indicator and suitable hand wheel. Manual operators shall be totally enclosed and sealed to prevent the entrance of rain, dirt, and corrosive atmospheres. Traveling nut

operators shall have a grease lubricated alloy steel screw stem, brass nut, and self-lubricating bronze bushings. Worm gear operators shall have hardened, grease-lubricated alloy steel worms and bronze worm gears. All exterior bolts and fasteners shall be bronze or stainless steel for corrosion resistance. The valve shall open with counterclockwise rotation of the hand wheel.

- F. Rotary manual operators for buried service shall conform with the paragraph above except, the operator shall be totally enclosed and completely sealed to prevent the entrance of water and dirt. Buried operators shall be coated with a bituminous coating. Manual rotary operators shall be capable of withstanding 300 foot-pounds of torque on the operating nut or hand wheel. A corrosion resistant, dial type valve position indicator shall be provided at the operating nut on the extension stem of the buried operators to provide a remote indication of valve position.
- G. Chain wheel operators shall be of heavy cast iron construction and shall be equipped with chain guide and looped, flexible, operating chain. Chain shall be galvanized or cadmium plated and shall extend to within 48-inches of the floor.
- H. All manual rotary and lever operators shall be capable of seating or unseating the valve disc under the most adverse conditions in the particular application with no more than an 80-pound pull on the hand wheel or lever. Valve operators shall be capable of holding the valve in any position between fully open and fully closed without creeping or fluttering. Operators shall be provided with adjustable, mechanical, stop-limiting devices to prevent over-travel of the valve disc in the open and closed positions. Manual rotary and lever operators shall comply with all applicable requirements of AWWA C504.
- I. Contractor shall be responsible for coordinating the location of valve operators. Operator locations for each valve shall be clearly shown for each valve on the shop drawings.

2.5 EXTENSION STEMS

- A. Extension stems shall be solid steel not smaller than the stem of the valve. Extension stems shall connect to the valve by a flexible socket coupling. All couplings shall be pinned, keyed, or socket type.
- B. Extension stems for buried service valves shall extend to within 6" of the top of the valve box or floor box and shall be provided with spacers which will center the stem in the valve box. A standard 2" nut shall be provided on the top of the extension stem.
- C. Stem guides shall be bronze-bushed, cast iron construction adjustable in two directions. Stem guides shall be installed so the unsupported length of the extension stem does not exceed 10 feet or an L/r of 200.

2.6 VALVE BOXES

- A. All buried valves shall be provided with 3-piece, cast iron, extension sleeve type valve boxes suitable for the depth of cover as shown on the Drawings.
- B. Valve boxes shall not be less than 5" in diameter, shall have a minimum thickness of 3/16" at any point, and shall have cast thereon an appropriate name designating the service for which the valve is intended ("W" for water, "S" for sanitary). Cover in roadways shall be of the deep locking type.
- C. All parts of valve boxes, bases, and covers shall be heavily coated with a suitable bituminous finish.
- D. Valves and valve boxes shall be set plumb. Each valve box shall be placed directly over the valve it serves with the top of the box flush with the finished grade.

2.7 T-HANDLE OPERATING WRENCH

- A. The Contractor shall furnish two (2) T-handle, steel valve operating wrenches with sockets compatible with standard 2" square valve operating nuts.
- B. Length of operating wrenches shall be long enough to extend from the operating nut to 36" above the finished grade.

2.8 PAINTING

- A. All internal cast or ductile iron surfaces, except finished or bearing surfaces, shall be shop painted with two coats of asphalt varnish conforming to Federal Specification TT-C-494.
- B. All exterior steel or cast or ductile iron surfaces of each valve, except finished or bearing surfaces, shall be shop painted with one or more coats of Alkyd primer. Valves for buried service shall have two coats of Alkyd primer. Valves for buried service shall have two coats of asphalt varnish per Federal Specification TT-C-494.
- C. All exposed valves shall be field primed and painted in accordance with the requirements of the section entitled "Painting" of these specifications.

2.9 SHOP TESTING

- A. All ball valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in AWWA Standard C507.
- B. All butterfly valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in AWWA C504.
- C. All check valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in AWWA C508.
- D. All gate valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in AWWA Standard C500.
- E. All plug valves shall be subjected to hydrostatic, shop leakage and performance tests as specified in AWWA Standard C517.
- F. All other valves shall be subjected to hydrostatic test at two times the rated pressure of the valve, shop leakage and performance tests. During the hydrostatic test, there shall be no leakage through the metal, the end joints, or the shaft stem seal, nor shall any part be permanently deformed. Leakage shall not exceed that permitted by ANSI B16.104, Class IV, for metal-seated valves and Class VI for resiliently seated valves.

3 EXECUTION

3.1 INSTALLATION

- A. All valves and appurtenances shall be installed in strict conformance with the drawings and manufacturer's instructions.
- B. Valves shall be installed in such a way that operators and packing are easily accessible. Valves with field replaceable seats shall be installed with sufficient clearance to permit removal of valve bonnet and stem without removing valve from the line.

3.2 FIELD TESTING

- A. Following installation, all valves shall be tested by the Contractor under the anticipated operating conditions. The ability of the valves to operate properly without leakage, binding, sticking, fluttering, or excessive operating torque shall be demonstrated to the satisfaction of the Engineer. The Contractor shall at his own expense adjust and/or replace any valve as necessary to assure satisfactory operation.
- B. Following installation and testing, all ferrous and non-machined surfaces of exposed valves, operators, floorstands, and stem guides shall be field primed and painted with a finish suitable for the intended service in accordance with the requirements of the section entitled "Painting" of these specifications.

** END OF SECTION **

SECTION 15255
HEAT TRACING

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install and test heat tracing tape and accessories as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. Factory Mutual approved constant wattage cable.
- B. UL Listed thermostat and contactor panel
- C. UL Listed control/monitor panel

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Submittals.

1.4 STORAGE AND PROTECTION

- A. Materials shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.

2 PRODUCTS

2.1 HEAT TRACING

- A. Piping shall be heat traced for freeze protection where exposed to subfreezing temperatures or where shown or specified on the Drawings. All heat traced piping shall be insulated. All necessary fittings, tape, end seals, and other accessories shall be furnished and installed.
- B. Heat tracing shall be of the parallel circuit, self-limiting, semiconductor type electric resistance heat tracing suitable for cut-to-length field installation. Heat tracing shall be waterproof and chemical resistant. Heat tracing shall be UL listed and FM approved for Class I, Division 2 hazardous locations.
- C. Heat tracing shall have a watt per foot rating at 50° F as follows:

Pipe Size (inches)	Insulation Thickness (inches)	Watts Per Foot
1 and smaller	1	2.0
1½	1½	2.0
2	1½	2.2
2½	1½	2.5
3	1½	2.9
4	1½	3.5
6	2	3.9
8	2	4.8
10	2	5.8
12	2	6.7

- D. Heat tracing strip shall have a flat profile and shall be furnished with a noncorrosive metal braid shield or jacket. Unless otherwise shown or required, heat tracing shall operate at 120 volts, 60 hertz, single phase.
- E. Heat tracing rated 5 watts per foot or less shall be suitable for ambient temperature control and shall not be damaged if crossed in direct contact.
- F. Heat tracing rated 5 watts per foot or less shall be controlled by a separate, liquid-filled, ambient sensing thermostat. Thermostat shall have a tamperproof calibrated setpoint dial SPST or SPDT contacts rated minimum 20 amps at 120 volts, a cast aluminum NEMA 4 enclosure.
- G. Heat tracing rated in excess of 5 watts per foot shall be controlled by a separate, pipeline sensing, liquid-filled thermostat with stainless steel bulb and a minimum 10 feet of flexible stainless steel capillary tubing. Thermostat shall have a tamperproof, calibrated setpoint dial, SPST or SPDT contacts rated minimum 20 amps at 120 volts, 6°F differential, and a cast aluminum NEMA 4 enclosure.
- H. Thermostats shall be furnished by the heat tracing manufacturer and shall be adjustable over an operating range of 25°F to 90°F.
- I. Circuit breakers used to protect electric heat tracing circuits shall be of the ground fault interrupter type, 30 mA, rated for heat trace application.

3 EXECUTION

3.1 GENERAL

- A. Piping shall be heat traced for freeze protection where exposed to subfreezing temperatures or where shown or specified on the Drawings. All necessary fittings, tape, end seals, and other accessories shall be furnished.
- B. In general, and unless otherwise specified, heat tracing shall be required on all exterior exposed liquid carrying pipe 12-inches in diameter or smaller.
- C. All heat traced piping shall be insulated in accordance with Section 15257, Pipe Insulation.

3.2 INSTALLATION

- A. Install heat tracing in accordance with IEEE 515.1.
- B. Install heat tracing cable after piping has been tested and before insulation is installed.
- C. Heat tracing cable shall be installed in a continuous straight strip along the pipe or spirally wrapped as required to obtain the necessary watt density. An additional turn shall be taken around valves, fittings and strainers.
- D. Length of circuits shall not exceed the rating of the controlling thermostat or the maximum circuit length specified by the manufacturer.
- E. Heat tracing shall be secured to the pipe using heat-resistant tape at intervals of 12 inches or less. Heat tracing shall be protected from damage and from the weather until weather resistant insulation jackets are in place.
- F. After installation and before applying insulation, test the system for grounds and short circuits using a 500 VDC meter. Insulation resistance should exceed 10,000 megohms per 250 feet.

** END OF SECTION **

SECTION 15257
PIPE INSULATION

1 GENERAL

1.1 SCOPE

- A. The work covered by this section includes furnishing all labor, equipment, and materials required to install pipe insulation and accessories as shown on the Drawings and/or specified herein.

1.2 QUALITY ASSURANCE

- A. All insulation and accessories is to be installed by a licensed applicator and applied in accordance with manufacturer's recommendations.

1.3 SHOP DRAWINGS AND ENGINEERING DATA

- A. Complete shop drawings and engineering data shall be submitted to the Engineer in accordance with the requirements of Section 01300, Submittals.

1.4 STORAGE AND PROTECTION

- A. Materials shall be stored and protected in accordance with the requirements of the manufacturer and Section 01620, Storage and Protection.

1.5 GUARANTEE

- A. Provide a guarantee against defective equipment and workmanship in accordance with the requirements of Section 01740, Warranties and Bonds.

2 PRODUCTS

2.1 PIPE INSULATION

- A. Preformed rigid, noncombustible, fiberglass pipe insulation complying with ASTM C547, Type 1
- B. Thermal Conductivity, k: 0.24 BTU*in/(hr*ft²*°F) at 75 °F mean temperature
- C. Maximum Service Temperature: 850 °F
- D. Flame Spread Index: < 25 per ASTM E84, UL 723, and NFPA 255
- E. Smoke Developed Index: < 25 per ASTM E84, UL 723, and NFPA 255
- F. Thickness
 - 1. Piping 1" Diameter and Smaller: 1"
 - 2. Piping 1½" to 4" Diameter: 1½"
 - 3. Piping Greater Than 4" Diameter: 2"
- G. When being used over stainless steel, pipe insulation must comply with the requirements of ASTM C795.
- H. Provide with all-service vapor-retarder jacket. Vapor-retarder jacket shall be a white, kraft paper, reinforced with a fiber yarn and bonded to an aluminum foil with self-sealing longitudinal closure laps and butt strips.

2.2 ELASTOMERIC PIPE AND TUBE INSULATION

- A. Closed-cell, flexible elastomeric pipe insulation shall be provided where shown on the Drawings or required to prevent condensation or freezing.
- B. Elastomeric pipe insulation shall be supplied in preformed tubular sections without longitudinal joints or seams and shall be designed to slip over straight pipe section.
- C. Elastomeric pipe insulation shall be suitable for operating temperatures of -40°F to +220°F and shall comply with ASTM C534, Type I, or ASTM D1056, SBE 41-42. Water absorption

shall not exceed 3.0 percent by weight when tested in accordance with ASTM D1056, and water vapor permeability shall not exceed 0.17 perm-in. when tested in accordance with ASTM C355. Flame spread shall not exceed 25 in accordance with ASTM E84.

D. Thickness of insulations shall be as follows:

1. 3/8-inch Thickness for hot and cold water piping running in masonry walls
2. 3/4-inch Thickness for refrigerant and hot gas bypass piping in sizes 1-5/8 inches and smaller.

2.3 ALUMINIUM JACKETS

A. Aluminum Jacket: 0.016" thick sheet, embossed finish, with longitudinal slip joints and 2" laps, die-shaped fitting covers with factory-attached protective liner.

3 EXECUTION

3.1 GENERAL

- A. Piping shall be insulated where shown or specified on the Drawings or where required to (1) prevent freezing, (2) protect people and building surfaces from injurious temperatures, and (3) prevent condensation in finished building areas. In general, and unless otherwise specified, insulation shall be required on the following piping:
1. Steam supply and condensate piping.
 2. Hot water piping.
 3. All piping with a normal surface temperature exceeding 120°F, unless otherwise directed by the engineer.
 4. Exposed cold water piping located outside or in unheated building areas or crawl spaces.
 5. Cold water piping located in exterior masonry walls.
 6. Cold water piping located in finished building areas including offices, laboratories, break rooms, toilets corridors, control rooms, conference rooms, lobbies, and spaces above suspended ceilings, where condensate on piping would be undesirable.
 7. Air conditioning refrigerant piping.
 8. Roof drain piping located above suspended ceilings.
 9. Chemical piping located outside or in exterior trenches.
- B. Where piping is specified to be insulated, insulation shall be applied to all valves, fittings, and other appurtenances installed in the piping.
- C. Insulation shall be applied in such a way so as not to interfere with the normal operation of any valve, controller, or any other device.
- D. On items requiring removal for normal maintenance, insulation shall be installed so that maintenance can be performed without damaging insulation or vapor seal.
- E. Insulation shall be installed in accordance with the manufacturer's written instructions and recommendations using approved materials.
- F. Exterior of pipe shall be thoroughly clean and dry before insulation is installed. Mastics and adhesives shall be applied within the temperature range recommended by the manufacturer.
- G. Insulated piping shall be identified using color-coded plastic arrows, bands, and lettering, located and sized in accordance with requirements of the Section 09900, Painting.
- H. Insulation shall not be installed until all pressure testing is complete.

3.2 INSTALLATION OF FIBERGLASS INSULATION

- A. Ensure that the surfaces over which the insulation is going to be installed are clean and dry.
- B. Ensure the insulation is clean, dry, and in good mechanical condition with factory-applied vapor or weather barriers intact and undamaged. Do not install wet, dirty, or damaged insulation.
- C. Ensure that pressure testing of piping and fittings has been completed prior to installation.
- D. Install insulation materials with smooth and even surfaces. Insulate each continuous run of piping with full-length units of insulation, with single cut piece to complete run. Do not use cut pieces or scraps abutting each other. Butt insulation joints firmly to ensure complete, tight fit over piping surfaces.
- E. Maintain the integrity of factory-applied vapor retarder jacketing on pipe insulation, protecting it against puncture, tears or other damage. Seal circumferential joints with butt strips that are compatible with vapor retarder jacket facing.
- F. On cold systems, seal penetrations of the vapor retarder jacket and exposed ends of insulation with vapor barrier mastic. Mastic pipe section ends at every fourth pipe section joint and at each fitting to provide isolation of water incursion.
- G. Cover valves, fittings, and similar items in each piping system with one of the following:
 - 1. Mitered sections of insulation equivalent in thickness and composition to that installed on straight pipe runs.
 - 2. Insulation cement, equal in thickness to the adjoining insulation.
 - 3. PVC fitting covers insulated with material equal in thickness and composition to adjoining insulation.
- H. Seal fitting joints with vapor retarder sealing tapes or mastics.
- I. Use standard oversizing practices for valves and flanges.
- J. Butt pipe insulation against hanger inserts and pipe supports.
- K. After insulation is installed, install aluminum jacket over insulation. Overlap metal jacket 2 to 3 inches and hold in place with metal bands. Seal all joints with solvent welding adhesive.

3.3 INSTALLATION OF ELASTOMERIC PIPE INSULATION

- A. Pipe insulation shall be cut to length and slipped over straight portions of piping.
- B. At fittings and valves, insulation shall be slit longitudinally and mitered or nested for proper fit. All joints shall be butted together tightly and sealed with approved adhesive. Insulation shall be banded until adhesive sets up.
- C. Insulation exposed to the weather shall be finished with 2 coats of a flexible weatherproof finish.

3.4 FIELD QUALITY ASSURANCE

- A. Upon completion of insulation work, visually inspect the work and verify that it has been correctly installed.

3.5 PROTECTION

- A. Replace damaged insulation, which cannot be satisfactorily repaired, including insulation with vapor barrier damage and moisture-saturated insulation.
- B. Protect completed work during the remainder of the construction period to avoid damage and deterioration of the finished insulation work.

** END OF SECTION **



8



SECTION 16000
ELECTRICAL POWER AND SYSTEMS

1 GENERAL

1.1 SCOPE

- A. The electrical work commences with the point of electrical service where shown on the Drawings and includes furnishing all material and labor for a complete electrical installation.
- B. The requirements of Division 1 apply to all work hereunder. The General and Special Conditions are a part of this Division of the Specifications and all provisions contained therein which affect this work are as binding as though incorporated herein.

1.2 DEFINITIONS

- A. Provide: Furnish, install, and connect.
- B. Product Data: Catalog cuts and descriptive literature.
- C. Shop Drawings: Factory prepared specific to the installation.
- D. Low Voltage: 0-600 volts.
- E. High Voltage: Above 600 Volts.
- F. Indicated: Shown on the Drawings.
- G. Noted: Indicated or specified elsewhere.

1.3 MATERIAL NOT FURNISHED

- A. Unless otherwise noted, the following are furnished and installed under other Divisions:
 - 1. Motors
 - 2. Electric heating and air conditioning equipment
 - 3. Electrical heat tracing
 - 4. Pilot and control devices for the above equipment
- B. Power wiring and equipment connections for the above items are included in this Division. Also included in this Division is control wiring to the extent shown on the Electrical Drawings; other control wiring is furnished under the applicable Mechanical Division.

1.4 LOCAL CONDITIONS

- A. Power will be supplied by the utility company substation. Verify and comply with all power company requirements for connections to new substation bus. Make necessary arrangements with the power company for temporary service requirements. Have the power company review submittals on equipment containing utility metering sections.
- B. Verify and comply with all requirements of the local telephone company concerning the complete telephone system.

1.5 QUALITY ASSURANCE

- A. Provide the complete electrical installation in accordance with the 2014 National Electrical Code (NFPA 70), Life Safety Code (NFPA 101), and in accordance with applicable local codes. Obtain all necessary permits and have all work inspected by appropriate authorities.

- B. All products shall be designed, manufactured, and tested in accordance with industry standards. Where applicable, products shall be labeled or listed by third party certification agencies.
- C. Industry Standards: Standards organizations and their abbreviations, as used herein, are as follows. Applicable date for industry standards is that in effect on the date of advertisement of the Project.
 - 1. American National Standards Institute (ANSI)
 - 2. American Society for Testing and Materials (ASTM)
 - 3. Federal Specifications (FS)
 - 4. Institute of Electrical and Electronics Engineers (IEEE)
 - 5. Insulated Cable Engineers Association (ICEA)
 - 6. National Electrical Manufacturers Association (NEMA)
 - 7. National Fire Protection Association (NFPA)
 - 8. Underwriters Laboratories, Inc. (UL)
 - 9. Southern Building Code (SBC)

1.6 SUBMITTALS

- A. Make all submittals in accordance with the requirements of Section 01340. Approval drawings consist of shop drawings, product data and other information as noted in the individual equipment sections. Except as noted, submittal information is for approval and equipment may not be installed until submittals have been returned with stamped approval.
- B. Information required "for reference" such as product samples, similar unit test reports and time current curves is for the purpose of determining the suitability of a product, selecting breaker settings, etc. This information is to be submitted at the same time as approval data; however, this information will not be returned and stamped approval is not required prior to installing the equipment.
- C. Except as noted, installation instructions are not required to be submitted. However, it is the Contractor's responsibility to obtain installation information from the manufacturer for all equipment prior to installing the equipment.
- D. Submit O&M data per Section 01730.

1.7 RECORD DRAWINGS

- A. Furnish record drawings in accordance with the requirements of Section 01720. Record drawings consist of submittal data as listed above, operation and maintenance data, and as-built drawings. Record drawings are to reflect the final installation, including any changes during approval, manufacturing tests, and installation.
- B. In addition to other required sets, furnish one set of operation and maintenance data for all apparatus requiring service in accordance with Section 01730.
- C. Coordination Study: Furnish 3 copies incorporating any changes and corrections from submittal phase.
- D. As-Built Drawings: Furnish one set of prints maintained at the job site at all times with all changes during construction marked thereon. Include on the as-built drawings sufficient dimensions to permit location of underground conduits.
- E. Submit the results of any tests required in the individual equipment sections.

1.8 SHORT CIRCUIT / COORDINATION / ARC FLASH STUDY

A. Scope

1. The contractor shall furnish short-circuit, protective device coordination and arc flash studies which shall be prepared by the project design engineers (EDEC, Inc. (770-493-8685)).
2. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E-Standard for Electrical Safety in the Workplace, reference Article 130.

B. Submittals for Construction

1. The results of the short circuit, protective device coordination, and arc flash hazard analysis studies shall be summarized in a final report. One (1) bound copy of the complete final report shall be submitted.
2. The report shall include the following sections:
 - a) One Line Diagram showing protective device ampere ratings, and associated designations, cable size & length, transformer kVA & voltage ratings, motor & generator kVA ratings, and switchgear/switchboard/panelboard designation.
 - b) Descriptions, purpose, basis and scope of study
 - c) Tabulations of the worst-case calculated short circuit duties as a percentage of the applied device rating (Automatic transfer switches, circuit breakers, fuses, etc.); the short circuit duties shall be upward-adjusted for X/R ratios that are above the device design ratings.
 - d) Protective device time vs current coordination curves with associated one line diagram identifying the plotted devices, tabulations of ANSI protective relay functions and adjustable circuit breaker trip unit settings
 - e) Fault study input data, case descriptions, and current calculations including a definition of terms and guide for interpretation of the software print out reports.
 - f) Incident energy and flash protection boundary calculations
 - g) Comments and recommendations for system improvements, where needed.
 - h) Executive summary including source of information and assumptions.

B. Qualifications

1. The short-circuit, protective device coordination and arc flash hazard analysis studies shall be conducted under the supervision and approval of a registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.

C. Studies

1. Contractor shall furnish short circuit and protective device coordination studies as prepared by the project design engineer. The coordination study shall begin with the utility company's feeder protective device and include all of the electrical protective

devices down to and including the largest feeder circuit breaker and motor starter in the 480 volt system. The study shall also include variable frequency drives, harmonic filters, power factor correction equipment, transformers, and protective devices associated with variable frequency drives, emergency and standby generators associated paralleling equipment and distribution switchgear.

2. The contractor shall furnish an Arc Flash Hazard Analysis Study per NFPA 70E-Standard for Electrical Safety in the Workplace, reference Article 130.3 and Annex D.

D. Data Collection

1. Contractor shall furnish all field data as required by the power systems studies. The Engineer performing the short circuit, protective device coordination, and arc flash hazard analysis studies shall furnish the contractor with a listing of required data immediately after award of the contract.

E. Short Circuit and protective Device Evaluation Study Details

1. Use actual conductor impedances if know. If unknown, use typical conductor impedances based on IEEE standards 141, latest edition.
2. Transformer design impedances and standard X/R ratios shall be used when test values are not available.
3. Calculate short circuit momentary and interrupting duties for three-phase bolted fault current at:
 - Electric Utility's supply termination point
 - Enclosed breaker and Disconnect Switches
 - 480V and 240V Panelboards
 - Reduced Voltage Starters
 - Generators and Automatic Transfer Switches
4. Provide the following within the report:
 - a) Calculation methods and assumptions
 - b) Selected base per unit quantities
 - c) One Line Diagram of the system being evaluated with available fault at each bus, and interrupting rating of devices noted.
 - d) Source impedance data, including electric utility system and motor fault contribution characteristics
 - e) Typical calculations tabulated including short circuit duty report.
 - f) Results, conclusions, and recommendations.

F. Protective Device Coordination Study Details

1. Proposed protective device coordination time-current curves shall be graphically displayed on log-log scale paper
2. Include on each curve sheet a complete title and one-line diagram with legend identifying the specific portion of the system covered.
3. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which device is exposed
4. Identify device associated with each curve by manufacturer type, function, time delay, and instantaneous settings.
5. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
6. Plot the following characteristics on curve sheets, where applicable:
 - Electric Utility's protective device
 - Medium voltage relay's
 - Medium/low voltage fuses
 - Low voltage equipment circuit breaker trip characteristics.
 - Conductor damage curves
 - Ground Fault Protective devices
 - Motor Starting Curves
 - Transformer full-load current, magnetizing inrush current, and ANSI transformer withstand parameters

G. Arc Flash Hazard Analysis

1. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA 70E-2004, Annex D.
2. When appropriate, the short circuit calculations and the clearing times of the phase overcurrent devices will be retrieved from the short-circuit and coordination study model.
3. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution systems (enclosed breaker, power control panel, junction boxes, generator, ATS, MCC, Switchgear, etc.) where work could be performed on energized parts.
4. The arc-flash hazard analysis shall include all MV, 480V locations and significant locations in 240V or 208V systems fed from transformers equal to or greater than 125kVA.

5. Safe working distances shall be specified for calculated fault locations based upon the calculated arc flash boundary considering an incident energy of 1.2cal/cm².
6. The arc flash hazard analysis shall include calculations for maximum and minimum contributions of fault current magnitude.
7. Arc Flash calculations shall be based on actual overcurrent protective device clearing time. Maximum clearing time will be capped at 2 seconds based on IEEE 1584-2002 section B.1.2.

H. Field adjustments

1. Adjust relay/protective device settings according to the recommended settings table provided by the coordination study.
2. Make minor modifications to equipment as required to accomplish conformance with short circuit and protective device coordination studies.
3. Notify Owner in writing of any required major equipment modifications.

I. Arc Flash Warning Labels

1. The vendor shall provide 4" x 6" thermal transfer type label of high adhesion polyester for each work locations analyzed.
2. The label shall have an orange header with the wording "WARNING, ARC FLASH HAZARD" and shall include the following information:
 - a) Device ID (location designation)
 - b) Nominal voltage
 - c) Flash protection boundary
 - d) Hazard risk category
 - e) Incident energy
 - f) Working distance
 - g) Date of study
3. Labels shall be machine printed, with no field marking
4. Labels shall be field installed by contractor in a manner that is easily readable by anyone who shall have to perform maintenance on the piece of equipment.

1.9 DELIVERY, STORAGE AND HANDLING

- A. Ship products to the job site in their original packaging. Receive and store products in a suitable manner to prevent damage or deterioration. Receive and store products in a suitable manner to prevent damage or deterioration. Keep equipment upright at all times. Provide heat (incandescent lamps or temporary power for space heaters) for distribution equipment until equipment is energized.

- B. Investigate the spaces through which equipment must pass to reach its final destination. Coordinate with the manufacturer to arrange delivery at the proper stage of construction and to provide shipping splits where necessary.
- C. Comply with requirements of Section 01611.

2 PRODUCTS

2.1 MATERIALS

- A. Provide only new products of the manufacturer's latest design.

2.2 SUBSTITUTIONS

- A. Where the words "equal to" follow or precede the listed acceptable manufacturers, equal products of other manufacturers are acceptable and request for substitution may be made during submittal stage.
- B. Where the words "or equal" follow the listed acceptable manufacturers, products of other manufacturers must be submitted and approved prior to the Bid, in accordance with the Instructions to Bidders of the Contract Documents.

3 EXECUTION

3.1 INSTALLATION

- A. The complete installation is to be accomplished by skilled electrical tradesmen, with certified or suitably qualified individuals performing all special systems installation and testing. All workmanship shall be of the highest quality, sub-standard work will be rejected.
- B. Schedule the work and cooperate with all trades to avoid delays, interferences, and unnecessary work. If any conflicts occur necessitating departures from the Drawings and Specifications, details of departures and reason therefore shall be submitted immediately for the Engineer's consideration.
- C. Prior to final inspection, clean all dirt, mud and construction debris from all boxes, cabinets, manholes and equipment enclosures.

3.2 CERTIFICATION AND TESTS

- A. Prior to request for final review, test all systems and repair or replace all defective work. Submit, with request for final review, written certification that all electrical systems are complete and operational.
- B. At the time of final review of electrical work, demonstrate the operation of electrical systems. Furnish labor, apparatus and equipment for systems' demonstration.
- C. After final review and acceptance, turn over to the Owner all keys for electrical equipment locks. Present to the Owner of the Owner's designated representative, demonstrations and oral instructions for proper operation and maintenance of the electrical equipment and systems.

END OF SECTION



SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

1 GENERAL

1.1 SCOPE

This Section includes basic materials and methods common to all Sections of Division 16.

1.2 SUBMITTALS

Submit product data.

2 PRODUCTS

2.1 BOXES

- A. Sheet Metal Boxes: NEMA OS-1.
- B. Cast Boxes: Galvanized with gasketed cover and threaded hubs.
- C. Floor Boxes: Cast iron, adjustable.

2.2 DISCONNECT SWITCHES

- A. Disconnect Switches: UL-98 and NEMA KS-1; 600 volt; heavy duty; quick make, quick break type; horsepower and I²t rated. Provide lever type operating handle directly connected to the switch mechanism; rocker types are not acceptable. Include padlocking provisions and nameplate clearly indicating "ON" and "OFF" positions. Equip all switches with a ground lug and, where neutral conductors are scheduled, provide insulated neutral lugs.
- B. Fusible Switches: Equip with rejection clips for types noted.
- C. Enclosure: As indicated. NEMA 4/4X enclosures are stainless steel.
- D. Acceptable Manufacturer: Equal to Culter-Hammer, General Electric, Square D or Siemens.

2.3 INDIVIDUAL MOTOR STARTERS

- A. Manual Starters: NEMA ICS-2; general purpose type; trip-free mechanism; with overload relays. Provide pushbutton operation for integral horsepower sizes, and toggle switch or lever for fractional sizes.
- B. Magnetic Starters: NEMA ICS-2; NEMA size 1 minimum; magnetically held contactor with field replaceable coil and contacts; bimetallic or melting alloy overload relay, manually reset. Starters shall be rated in accordance with NEMA size designations; fractional sizes and ratings per IEC recommendations are not acceptable.
- C. Magnetic Starter Controls: All controls are 120 volts. Equip each starter with a control power transformer fused on the primary and secondary. Provide starter and overload relay auxiliary contacts for red run light, green stop light and amber overload light on the enclosure door. Provide one spare normally open starter auxiliary contact, and door mounted start-stop pushbuttons or hand-off- auto selector switch as indicated.
- D. Combination Starters: Molded case circuit breaker rated 22,000 AIC.
- E. Enclosure: As indicated. NEMA 4/4X enclosures are stainless steel.

F. Acceptable Manufacturers: Equal to Eaton, General Electric, Siemens or Square D.

2.4 CONTACTORS

- A. Control Relays: NEMA A600; heavy duty, machine tool type convertible contacts; electrically held 120 volt coil. Equal to Allen-Bradley Bulletin 700 Type P.
- B. General Purpose Contactors: NEMA ICS-2; electrically held; 2-wire control; 120 volt coil. Size and number of contacts as indicated.
- C. Lighting Contactors: NEMA ICS-2; mechanically held; 3 wire control; 120 volt coil. Size and number of contacts as indicated.
- D. Enclosure: NEMA ICS-6; Type 1 unless otherwise noted.
- E. Acceptable Manufacturers: Equal to General Electric, Square D, or ASCO.

2.5 CONTROL STATIONS

- A. Pushbuttons, Selectors and Pilot Lights: 600 volt, heavy duty, factory sealed.
- B. Enclosure: Stainless steel meeting NEMA 4X and NEC Class I, Division 2, Group C and D requirements.
- C. Acceptable Manufacturers: Equal to Allen-Bradley Bulletin 800T.
- D. Hazardous Areas: Where Division 1 classified areas are indicated, provide control stations equal to Crouse-Hinds EFS/EFD series.

2.6 FUSES

- A. Fuses: Current limiting, non-renewable type, rated 200,000 AIC, with rejection feature; Class J for ratings 600 amp and below and Class L for ratings 601 amp and above.
- B. Acceptable Manufacturers: Equal to Bossman, Chase-Shawmut, or Littelfuse.

2.7 PLYWOOD BACKBOARDS

- A. Backboards: Grade BC plywood, 3/4-inch thick. Paint with two coats of flat black paint.

2.8 SUPPORTING DEVICES

- A. Support Channel: Galvanized or painted steel. Use stainless steel in areas indicated NEMA 4X.
- B. Hardware: Corrosion resistant. Use stainless steel in areas indicated NEMA 4X.

2.9 ELECTRICAL IDENTIFICATION

- A. Nameplates: Engraved three-layer laminated plastic, black letters on white background.
- B. Wire and Cable Markers: Plastic, split sleeve or tubing type.

3 EXECUTION

3.1 BOXES

- A. Provide boxes as shown on the Drawings and as required for splices, taps, wire pulling and equipment connections. Support boxes independently of conduit. Provide knockout closures for unused openings.

- B. Box locations shown on the Drawings are approximate unless dimensioned. Coordinate mounting heights and locations of outlets mounted above counters, benches, backsplashes and other furnishings. Locate outlet boxes to permit handicap access per ANSI A117.1. Where receptacles are indicated 18-inches above finished floor, dimension is to the bottom of the box. At the option of the Owner's representative, any outlet may be relocated by up to 10 feet before it is permanently installed, without incurring additional cost. Install adjacent devices at the same elevation in a common box with on face plate. Install adjacent devices at different elevations in one vertical line.
- C. Unless otherwise noted, use only cast outlet boxes. Sheet metal boxes may be used where concealed above ceilings or in dry walls, exposed in electrical closets, and for telephone wiring.
- D. Field drill conduit holes in tap, junction and pull boxes so as to afford the maximum bending radius for the conductors.

3.2 DISCONNECT SWITCHES

- A. Provide switches with voltage, ampere, and number of poles as indicated on the Drawings.
- B. Switches are non-fused type, unless Drawings note otherwise, or the switch is used as a disconnect for an item of equipment with a maximum fuse size designated on the nameplate. In such cases, provide fusible type with appropriate fuse. If fusible switches protect conductors with an ampacity less than the rating of the switch, provide a nameplate on the inside front cover of the switch designating the maximum allowable fusing.
- C. Install switches so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a plywood backboard secured to the studs with the switch secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal ½-inch separation from concrete walls in wet or damp locations.
- D. For disconnect switches serving motors with space heaters, provide lamecoid nameplate engraved "WARNING - Motor space heater energized with switch open".

3.3 INDIVIDUAL MOTOR STARTERS

- A. Select and install heater elements in motor starters to match installed motor characteristics. Do not use NEC motor full load ampere data for heater selection.
- B. Provide a typed label inside each motor starter enclosure door identifying the motor served and listing the motor nameplate data. Provide an engraved nameplate on the exterior of the enclosure door identifying the motor served, the horsepower, voltage and phase rating.
- C. Install starters so they are rigidly supported and readily accessible. Where mounted on stud walls, provide a plywood backboard secured to the studs with the starter secured to the backboard. Provide stainless steel mounting channel or phenolic spacers to give nominal ½-inch separation from concrete walls in wet or damp locations.

3.4 CONTACTORS

- A. Install timer and lighting controls for contactors as indicated.
- B. Install indicator lights in enclosure door as indicated

3.5 CONTROL STATIONS

Install control station so they are rigidly supported and located so as not to impair access to equipment for maintenance.

3.6 FUSES

Equip all fusible devices with fuses. Replace all brown fuses up to final acceptance of the Project. At the completion of the Project, turn over to the Owner spare fuses for each type and size installed; six each for ratings 60 amps and below, and three each for ratings above 60 amps.

3.7 PLYWOOD BACKBOARDS

Provide plywood backboards for surface mounted electrical distribution equipment in areas such as mechanical rooms, electrical closets, and equipment rooms. Secure backboards to the building structure and paint with two coats of flat black paint.

3.8 SUPPORTING DEVICES

- A. Fasten hangar rods, support stands, conduit clamps, etc. to building structure using expansion anchors or beam clamps.
- B. Do not fasten supports to piping, ductwork, mechanical equipment or conduit. Do not use powder actuated fastening devices. Do not drill structural steel members.

3.9 ELECTRICAL IDENTIFICATION

Provide nameplates for all switchboards, panelboards, transformers, disconnect switches, individual motor starters and other items of electrical distribution equipment. Engrave with the equipment identification as indicated; and the voltage, current and interrupting rating. Attach nameplates with screws or rivets; adhesives are not acceptable. Exception: Two-part epoxy glue may be used for NEMA 4/4X enclosures.

END OF SECTION

SECTION 16111
CONDUIT

1 GENERAL

1.1 SCOPE

- A. Rigid metal conduit and fittings.
- B. Intermediate metal conduit and fittings.
- C. Flexible metal conduit and fittings.
- D. Liquidtight flexible metal conduit and fittings.
- E. Non-metallic conduit and fittings.

1.2 SUBMITTALS

- A. Submit product data.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Conduit: Allied, Republic, Triangle or Wheatland.
- B. PVC Conduit: Amoco, Carlon or Certainteed. PVC Coated Rigid Steel Conduit: Permacote, Robroy, Ocal, Inc., or approved equal.
- C. Flexible Conduit: Anaconda, Thomas & Betts, Electrical Flex or Triangle.
- D. Fittings: Appleton, Crouse-Hinds, Oz or Thomas & Betts.
- E. Substitutions: Products equal to those listed.

2.2 RIGID METAL CONDUIT AND FITTINGS

- A. Aluminum Conduit: UL 6; ANSI C80.1; aluminum; minimum size 3/4-inch.
- B. PVC Coated Rigid Steel Conduit: NEMA RN-1; galvanized rigid steel conduit with factory applied external 40 mil PVC coating and urethane interior coating. Prior to coating, treat conduit with a heat polymerizing adhesive so the bond between metal and coating is greater than the tensile strength of the coating. Minimum size 3/4-inch.
- C. Fittings and Conduit Bodies: NEMA FB-1; zinc coated; taper-threaded type, material to match conduit. Where PVC coated rigid steel conduits are indicated all couplings, fittings, conduit bodies, pipe straps, U bolts, beam clamps, and other accessories shall have factory applied PVC coating of the same standards as the straight sections of conduit Or stainless steel. This includes, but not limited to fittings, hangars, supports, fasteners and hardware. All metallic conduit bodies, fittings, boxes, etc. in Class 1, Division 1 hazardous areas shall be explosion proof / NEMA 7 (in strict accordance with NEC Chapter 5).

2.3 INTERMEDIATE METAL CONDUIT (IMC) AND FITTINGS

- A. IMC: UL 1242; hot dip galvanized; minimum size 3/4-inch.

- B. Fittings and Conduit Bodies: Use fittings and conduit bodies specified above for rigid steel conduit.

2.4 FLEXIBLE METAL CONDUIT AND FITTINGS

- A. Conduit: UL 1; FS WW-C-566; single steel continuous strip with galvanized coating; minimum size 3/4-inch.
- B. Fittings and Conduit Bodies: NEMA FB-1; malleable iron squeeze type.

2.5 LIQUIDTIGHT FLEXIBLE CONDUIT AND FITTINGS

- A. Conduit: UL listed liquidtight consisting of an extruded thermoplastic cover over a galvanized steel core. Minimum size 3/4-inch. Exception: Where connected to devices with manufacturer supplied 1/2 or 3/8-inch hubs, match conduit size to hub size.
- B. Fittings and Conduit Bodies: NEMA FB-1; galvanized steel compression type with O-ring. Where PVC coated conduits are indicated, provide PVC coated fittings for flex connections.

2.6 RIGID NONMETALLIC CONDUIT AND FITTINGS

- A. Conduit: NEMA TC-2; Schedule 40 PVC, minimum size 1".
- B. Fittings and Conduit Bodies: NEMA TC-3.

2.7 EXPLOSION PROOF FLEXIBLE COUPLINGS

- A. Explosion-proof Couplings shall have a flexible brass inner core and outer bronze braid covering attached to threaded fittings, and shall be rated for the hazardous area. The metallic braid and fittings shall be shipped completely factory assembled.
- B. The Couplings shall be capable of withstanding internal explosive pressures. Couplings shall have conductivity on a similar length basis, equal to rigid steel conduit.

2.8 SEALING FITTINGS

- A. Provide seal fittings in conduit runs in hazardous areas, use manufacturer's recommended fiber filler and cement.
- B. Sealing fittings shall comply with UL 886 and shall be suitable for Class I, Div. 1 & Div. 2, Group D, Hazardous installations.

2.9 LIQUIDTIGHT FLEXIBLE NON-METALLIC CONDUIT AND FITTINGS

- A. Conduit: UL listed, liquidtight consisting of a hand PVC spiral with flexible PVC covering. Minimum size is 3/4-inch.
- B. Fittings: UL listed, molded from high-strength, glass-filled thermoplastic.

3 EXECUTION

3.1 CONDUIT TYPES

- A. Unless noted otherwise, all conduit shall conform to the following schedule:

1. All exterior exposed conduit shall be rigid aluminum (except for Class I, Division 1 and 2 areas).
 2. Class I, Division 1 and 2 areas - All exposed conduits shall be PVC coated rigid galvanized steel.
 3. Chemical Rooms - All conduits shall be PVC schedule 80.
 4. Underground – All underground conduits shall be PVC Schedule 40 with rigid aluminum elbows.
- B. Use liquidtight flexible steel conduit for connections to motors, transformers and other vibrating equipment.
 - C. Non-jacketed flexible steel conduit may be used for connections to lighting fixtures in suspended ceilings.
 - D. Rigid nonmetallic conduit may be used for underground, concrete encased duct banks and in or below slab on grade. Exception: Use rigid steel or IMC conduit for analog signal circuits; 4 to 20 mA and AC or DC signals less than 25 volts.
 - E. Where PVC conduit is indicated, make a transition to rigid steel below grade or slab and continue above with rigid steel conduit. Exception: PVC may enter switchboards, motor control centers or other floor standing electrical equipment enclosures. Provide bell ends or socket end bell at enclosure entry.

3.2 CONDUIT ARRANGEMENT AND SUPPORT

- A. Arrange conduit to maintain headroom and present a neat appearance. Runs exposed conduits parallel or perpendicular to building surfaces and adjacent piping. Group conduit in parallel runs where practical and provide rack space for 25 percent additional conduits. Use concentric bends for parallel runs.
- B. Avoid sources of heat when possible. Where unavoidable, maintain 3-inch clearance when crossing hot pipes and 12-inch clearance between parallel hot pipes, flues, heating appliances and other heat sources.
- C. Support conduits to prevent distortion of alignment by wire pulling operations. Fasten single conduits with one hole malleable iron straps. For multiple runs use channel and clamps. Wire, perforated pipe straps and the like are not acceptable support means.
- D. Support conduit at a maximum of seven feet on center and within three feet of each box, cabinet, or fitting. Hang trapeze assemblies with threaded rods not less than 1/2-inch diameter. Remove all temporary supports prior to pulling conductors.

3.3 CONDUIT INSTALLATION

- A. Cut conduit square using a saw or pipecutter and de-burr cut ends. Paint threads with inc compound. Bring conduit to the shoulder of fittings and couplings and fasten securely. All connections are to be wrench tightened and electrically continuous. No running threads are permitted.
- B. Use conduit hubs for fastening conduit to cast boxes, and for fastening conduit to sheet metal boxes in damp or wet locations. Use conduit bodies to make sharp changes in direction. For sizes 2-inches and larger, use "LD" or similar fittings to permit a straight pull from either direction.
- C. The maximum length between pull points is 400 feet. This length shall be reduced by hundred foot for every ninety degree bend.
- D. Use hydraulic one-shot conduit bender or factory elbows for bends in conduit larger than 2-inch size. Crushed or deformed conduits may not be installed.

- E. Avoid moisture traps where possible; where unavoidable, provide junction box with drain fitting at conduit low point.
- F. Use suitable conduit caps to protect installed conduit against entrance of dirt and moisture. Install threaded PVC end caps on conduits stubbed up for future use.
- G. Provide a 200 pound tensile strength polyolefin line pulled through and tied off at each end of all empty conduits.
- H. Install expansion joints where conduit crosses building expansion or seismic joints and for straight runs in excess of 100 feet.
- I. Where conduit penetrates fire-rated walls and floors, provide mechanical fire-stop fittings with UL listed fire rating equal to wall or floor rating.
- J. Provide watertight seals, equal to OZ type WSK or FSK, where conduit penetrates exterior walls and where conduit passes between spaces normally at different temperatures. Seal duct bank and underground conduit entry with GE or Dow silicone sealant.
- K. In locations where the conduit cannot be turned, provide three piece threaded rigid couplings. Provide clamp backs for conduits on exterior or damp surfaces to prevent the raceway from bearing directly on the damp surface.
- L. Route conduits below the slab.
- M. Protect conduit threads from rust and damage during construction.
- N. PVC Conduit Bends: Do not use methods which will deform or change the physical characteristics of the conduit. Use PVC-coated rigid steel factory elbows for bends in runs longer than 100 feet, and in runs which have more than two bends, regardless of length. Exception: Where concrete encased in slab or ductbank, GRS elbows may be used in lieu of PVC coated.
- O. Wipe plastic conduit clean and dry before joining. Apply full even coat of cement to entire area that will be inserted into fitting. Let joint cure for 20 minutes minimum.
- P. PVC Coated Conduit: Exercise care not to damage the coating during cutting, threading, bending, and assembly. Follow the manufacturer's installation instructions. Use vise jaws, bending equipment, strap wrenches, and other tools which are specifically designed for coated conduits. Do not use chain vise, pipe wrench, channel locks or the like. Nicks or small damaged areas (1/2-inch maximum) may be repaired with a manufacturer approved compound. Replace items if coating is damaged in excess of 1/2-inch.
- Q. Conductor Protection: Provide bushings on metallic and bell ends on PVC conduit unless conduit terminates in a hub for similar fitting.
- R. Where available, bond signal conduits directly to building ground grid.

3.4 UNDERGROUND DUCT BANK INSTALLATION

- A. Install top of duct bank minimum 24-inches below finished grade with plastic warning tape 12-inches below finished grade.
- B. Install conduit with minimum grade of 4-inches per 100 feet.
- C. Terminate conduit in end bell at manhole entries.
- D. Stagger conduit joints in concrete encasement 6-inches minimum.
- E. Provide minimum 3-inch concrete cover at bottom, top, and sides of duct bank. Use suitable separators and chairs installed not greater than four feet on centers to provide conduit spacing as indicated. Securely anchor conduit to prevent movement during concrete placement.
- F. Construct duct banks with 3,000 psi concrete. Provide reinforcing as indicated for all duct banks. Mix red oxide to the concrete.

- G. Where duct bank passes beneath footings or slabs resting on grade excavate to provide a minimum of 6-inch clearance between the conduits and the structure. Backfill to the base of the structure with concrete.
- H. Provide underground marking tape for early detection of buried power and communication lines.

END OF SECTION



SECTION 16120
CONDUCTORS AND CABLES

1 GENERAL

1.1 SECTION INCLUDES

- A. Building wire
- B. Cable.
- C. Wiring connections and terminations.

1.2 SUBMITTALS

- A. Submit product data.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Conductors: Equal to Aetna, Continental, Okonite, Pirelli, Southwire or Triangle.
- B. Signal Circuit Conductors: Equal to Belden, Continental, Dekoron or Penn.
- C. Connectors: Equal to Thomas & Betts, Ideal or OZ.
- D. Pulling Compounds: Water soluble, equal to Polywater J.
- E. Wire and Cable Markers: Plastic, split sleeve or tubing type, equal to Brady Type XC or T & B Type SM.

2.2 EQUIPMENT

A. Building Wire

- 1. Thermoplastic Insulated Building Wire: NEMA WC-5.
- 2. Cross linked polyethylene- insulated.
- 3. Feeder and Branch Circuits: Single stranded conductor; 98% conductivity copper; 75/90°C; 600 volt PVC insulated with nylon jacket; type THWN/THHN. Minimum size #12 AWG.
- 4. Feeder Conductors larger than 250 KCMIL; single stranded conductor copper; 90°C; 600 volt; flame retardant moisture resistant cross linked polyethylene insulated; type XHHW-2; minimum size 300 KCMIL.
- 5. Control Circuits: Same as specified above for feeder and branch circuits, except minimum size #14 AWG.

B. Remote Control And Signal Cable

- 1. Control Cable for Class 1 Remote Control and Signal Circuits: Copper conductor; 600 volt insulation, rated 60 degrees C; individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.
- 2. Control Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, rated 60 degrees C, individual conductors twisted together, shielded, and covered with a PVC jacket; UL listed.

3. Plenum Cable for Class 2 or Class 3 Remote Control and Signal Circuits: Copper conductor, 300 volt insulation, individual conductors twisted together, shielded, and covered with a fluoropolymer jacket; UL listed for use in air handling ducts, hollow spaces used as ducts, and plenums.
4. Instrumentation Signal Cables: #16 AWG stranded tinned copper conductors; 600 volt polyethylene insulation; twisted pair or three conductor construction; 100 percent coverage aluminum polyester shield; #18 stranded tinned copper drain wire; vinyl outer jacket; UL listed.

C. Fiber Optic Cable

1. Fiber optic cable shall be optic multimode, loose tube, all-dielectric cable, Siemens, Nordx/CDT, Belden, or approved equal, and meet the following specifications:

Cladding Diameter	125.0 Microns
Core Diameter	62.5 Microns
Attenuation Range	≤0.8 dB/KM at 1300 NM ≤3.1 dB/KM at 850 NM
Bandwidth Range	≥600 Mhz-KM at 1300 NM ≥200 Mhz at 850 NM
Cable Construction	Splitable outdoor cable
Core Type	Hollow core, filled
Materials	
- basic element	PVC, gray
- strain relief	Kevlar fibers and impregnated glass
- outer sheath/cable color	PVC black
Mechanical Characteristics	
- dimensions of basic element	(3.5 ± 0.2) mm dia
- cable dimensions	(6.3 X 9.8) ± 0.4 mm
- cable weight	approx. 65 kg/km
- permissible tensile load	≤ 500 N (short time)
- bending radii	≥ 100 mm Over flat side only
Permissible Ambient Conditions	
- laying and installation temp.	-5°C to +50°C
- operating temperature	-25°C to +60°C
- storage temperature	-25°C to +70°C

Cable shall be compliant with EIA, ANSI Standards, graded index. All fibers must be color coded for easy identification with all-dielectric construction. All cables shall be of an insulation type rated for the purpose of installation. Where shown on Contract Drawings all fiber optic conduit run shall contain redundant 24 strand fiber optic cables as specified in this section.

2. Connector Type BFOC.
3. Coordinate the exact fiber cable requirement with the SCADA system integrator.

3 EXECUTION

3.1 INSTALLATION

A. General Wiring Methods

1. Use only stranded conductors. Exception: Solid conductors size #12 and #10 AWG may be used for receptacle branch circuit wiring.
2. Use 10 AWG conductor for 20 ampere, 120 volt branch circuit home runs longer than 75 feet, and for 20 ampere, 277 volt branch circuit home runs longer than 200 feet.
3. Place an equal number of conductors for each phase of a circuit in same raceway or cable.
4. Identification: All conductors shall be identified throughout the electrical system. For control and signal conductors use wire markers at all terminals and connections. Color code power circuit conductors as follows:

	120/208 Volt System	277/480 Volt System
Phase A	Black	Brown
Phase B	Red	Orange
Phase C	Blue	Yellow

	120/208 Volt System	277/480 Volt System
Neutral	White	Grey
Ground	Green	Green

5. Do not splice high voltage cables without written approval from Owner's representative.
 6. For conductors #8 AWG and larger color coding may be accomplished with 1-inch wide colored tape applied at each end of the conductor or at points where conductor is accessible so as to be visible inside the enclosure.
 7. Neatly train and lace wiring inside boxes, equipment and panelboards. Support to prevent conductor movement under fault conditions.
 8. Fireproofing: Wrap each 5 kV phase conductor with fireproof tape in manholes and pullboxes.
- B. Wiring Installation In Raceways
1. Unless otherwise indicated, install all conductors in conduit.
 2. Pull all conductors into a raceway at the same time. Thoroughly swab raceway system before installing conductors. Use wire pulling lubricant for all pulls. Do not exceed the manufacturer's pulling tension.
 3. Install wire in raceway after interior of building has been physically protected from the weather and all mechanical work likely to injure conductors has been completed.
- C. Installation In Manholes
1. Rack all cables; straight thru pulls are not acceptable.
 2. Attach cables to rack supports with tie wraps to prevent motion under fault conditions.
- D. Wiring Connections And Terminations
1. Avoid unnecessary splices. Splice only in accessible junction or outlet boxes.
 2. Make connections to circuit breakers, disconnect switches, panel mains, etc. with solderless lugs.
 3. Use mechanical connectors for splices, taps, fixture and motor connections. Exception: Square thread helical spring plastic cap (wire nut) type connectors are acceptable for solid conductor splices and taps.

4. Use insulated throat, spade type crimp on connectors for strap screw device terminals. Exception: Receptacle back wiring provisions may be used for terminating solid conductors.
5. Where possible use connectors with integral, insulating covers. Otherwise tape uninsulated conductors and connectors to 150 percent of the insulation value of conductor.
6. High Voltage Connections and splices: Performed by a certified cable splicer. Notify the Engineer prior to making high voltage termination or splices. The engineer reserves the right to inspect splicing and termination procedures. Tag all connections with splicers name and date. Ground shield with #6 AWG minimum.
7. Thoroughly clean wires before installing lugs and connectors.
8. Make splices, taps and terminations to carry full ampacity of conductors without perceptible temperature rise.

3.2 FIELD QUALITY CONTROL

- A. Inspect wire and cable for physical damage and proper connection.
- B. Torque test conductor connections and terminations to manufacturer's recommended values.
- C. Continuity Tests: Ring all conductors for continuity and replace any open conductors.
- D. Ground Fault Tests: Meggar all feeder circuits for grounds. Compile and submit a list of meggar readings. Replace all conductors measuring less than 2 megohms to ground.
- E. High Voltage Ground Fault Tests: DC high pot tests performed by an independent testing agency and certified by a professional engineer registered in the State of Georgia. Conduct test at 80 percent of the factory test voltage for five minutes minimum after cable has been brought up to test voltage. Record leakage current at one minute intervals. Replace conductors with leakage current differing significantly from other conductors and conductors with leakage current values which do not fall or fall and level off during the test. Engineer reserves the right to require a re-test if leakage currents are more than twice the values calculated using the manufacturer's data. The system may not be energized at primary voltage until cable test has been approved by the engineer.

END OF SECTION

SECTION 16130

BOXES

1 GENERAL

1.1 SCOPE

- A. Outlet boxes.
- B. Pull and junction boxes.

1.2 SUBMITTALS

Provide product data.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

Boxes shall be equal to Appleton, Crouse Hinds, Raco, or Steel City.

2.2 OUTLET BOXES

- A. Sheet Metal Outlet Boxes: NEMA OS1; galvanized steel, with ½-inch male fixture studs where required.
- B. Nonmetallic Outlet Boxes: NEMA OS-2.
- C. Cast Boxes: Cast ferrous alloy with galvanized or cadmium finish, deep type, gasketed cover, threaded hubs.
- D. Floor Boxes: Full adjustable, cast iron, water and concrete tight.

2.3 PULL AND JUNCTION BOXES

- A. Sheet Metal Boxes: NEMA OS-1; galvanized steel. Boxes larger than 12-inches in any dimension are hinged enclosure as specified under Section 16160.
- B. Cast Metal Boxes: NEMA 250; Type 4, galvanized cast iron box and cover, neoprene gasket, stainless steel cover screws, UL listed as raintight. Provide flat-flanged type for surface mounting and outside flange recessed cover type for underground use. Boxes for sidewalk or other traffic areas to have appropriate duty cover with non-skid finish.
- C. Corrosion Resistant Boxes: UL 508 Type 4X, Type 304 stainless steel equal to Hoffman Bulletin A-51.

3 EXECUTION

3.1 COORDINATION OF BOX LOCATIONS

- A. Provide boxes as shown on Drawings, and as required for splices, taps, wire pulling, and equipment connections.
- B. Box locations shown on the Drawings are approximate unless dimensioned. Verify box locations prior to rough-in. Coordinate mounting heights and locations of outlets mounted above counter, benches, backsplashes, and other furnishings. Locate outlet boxes to permit handicap access per

ANSI A117.1. Any outlet may be relocated by up to 10 feet before it is permanently installed without incurring additional cost.

3.2 INSTALLATION

- A. Do not install boxes back-to-back in walls. Provide minimum 6-inch separation, except provide minimum 24-inch separation in acoustic-rated walls.
- B. Locate boxes in masonry walls to require cutting of masonry unit corner only. Coordinate masonry cutting to achieve neat opening for boxes.
- C. Support boxes independently of conduit. Provide knockout closures for unused openings.
- D. Use multiple-gang boxes where more than one device is mounted together; do not use sectional boxes. Provide barriers to separate wiring of different voltage systems.
- E. In inaccessible ceiling areas, position outlets and junction boxes within 6-inches of recessed luminaire, to be accessible through luminaire ceiling opening.
- F. Provide recessed outlet boxes in finished areas; secure boxes to interior wall and partition studs, accurately positioning to allow for surface finish thickness. Use stamped steel stud bridges for flush outlets in hollow stud wall, and adjustable steel channel fasteners for flush ceiling outlet boxes.
- G. Align wall-mounted outlet boxes for switches, thermostats, and similar devices. Align adjacent devices at different elevations in one vertical line. Set floor boxes level and flush with finish flooring material.
- H. Unless otherwise noted, use only cast outlet boxes. Sheet metal boxes may be used where concealed above ceilings or in dry walls, exposed in electrical closets, and for telephone wiring.
- I. Field drill conduit holes in tap, junction and pull boxes so as to afford the maximum bending radius for the conductors.
- J. Use PVC coated boxes wherever PVC coated conduit is indicated.
- K. Label cover of junction boxes with circuit numbers of conductors in the box.

END OF SECTION

SECTION 16141
WIRING DEVICES

1 GENERAL

1.1 SCOPE

- A. Wall switches.
- B. Wall dimmers.
- C. Receptacles.
- D. Floor mounted service fittings.
- E. Device plates and box covers.

1.2 SUBMITTALS

Submit product data.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Switches and Receptacles: Equal to Arrow Hart, Bryant, GE, Hubbell, Leviton SpecMaster, Pass and Seymour or Sierra.
- B. Dimmers: Equal to Hunt, Lutron, or Prescolite.
- C. Floor Fittings: Equal to Square D, Walker or Hubbell.

2.2 SWITCHES AND RECEPTACLES

- A. Wall Switches: NEMA WD-1; FS W-S-896; 20 amp, 120/277 volt, specifications grade; horsepower rated; quiet type; back and side wiring provisions; toggle handle.
- B. Convenience Receptacles: NEMA WD-1; FS W-C-596: 15 amp, 125 volt, specification grade; impact resistant nylon face; back and side wiring provisions; grounding screw.
- C. Specific Use Receptacles: NEMA WD-1 or WD-5; type as indicated. For branch circuits serving a single device, match device rating to branch circuit rating.
- D. Device Colors: Gray, brown or black or specific use devices, otherwise as selected by the Engineer.

2.3 FLOOR MOUNTED SERVICE FITTINGS

- A. Surface-Type Service Fitting for Convenience Receptacle: Satin aluminum housing with stainless steel device plates for two back-to-back duplex convenience receptacles.
- B. Surface-Type Service Fitting for Communications: Satin aluminum housing with stainless steel plates with two back-to-back 1-inch ID bushed openings.
- C. Flush Covers for Duplex Convenience Receptacle: Brass flush cover suitable for floor box, with duplex flap opening. Provide brass carpet rings.

- D. Flush Covers for Communications: Brass flush cover suitable for floor box, with 2-1/8 x 1-inch combination threaded opening. Provide brass carpet rings.
- E. Poke-Through Fittings: UL Listed as fire-rated poke-through device; include fire stops and smoke barriers in through-floor component. Terminate in 4-inch square by 2-1/2-inch deep junction box.
- F. Floor Boxes: Cast type.

2.4 WALL DIMMERS

- A. Wall Dimmers: NEMA WD-2; linear slide type.
- B. Rating: 600 Watts minimum, larger size to accommodate load shown on the Drawings.

2.5 WALL PLATES

- A. Decorative Cover Plates: Unbreakable nylon, Lexan, or noryl, smooth finish, color to match devices.
- B. Unfinished Area Device Plates: Type 302 stainless steel, 0.030-inch thick minimum, satin finish.
- C. Weatherproof (NEMA 3R and NEMA 4X) Cover Plates: Stainless steel, specification grade, gasketed equal to Sierra WP Series. For heat tape, instruments, or other devices which are continuously plugged in, provide impact resistant polycarbonate, suitable for wet locations while in use, equal to TayMac safety outlet enclosures.

3 EXECUTION

3.1 INSTALLATION

- A. Secure devices to outlet boxes without depending on device plates to pull them tight. Install a bonding jumper between all devices and outlet boxes.
- B. Install switches with off position down; and receptacles with grounding pole on bottom.
- C. Derate ganged dimmers as instructed by manufacturer; do not use common neutral.
- D. For cord and plug connected equipment, coordinate receptacle configuration with equipment supplied.
- E. Corridor Convenience Receptacles: Hospital grade.
- F. Install device plates on switch, receptacle, and blank outlets. Use jumbo size plates for devices installed in masonry walls.

END OF SECTION

SECTION 16160
CABINETS AND ENCLOSURES

1 GENERAL

1.1 SCOPE

- A. Hinged cover enclosures.
- B. Cabinets.
- C. Terminal blocks and accessories.

1.2 SUBMITTALS

- A. Submit product data.
- B. Shop Drawings for Equipment Panels: Include schematic diagram, wiring diagram, outline drawing and construction diagram as described in NEMA ICS-1.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Cabinets and enclosures shall be equal to Stahl, Crouse Hinds, Hoffman or Weigmann.

2.2 HINGED COVER ENCLOSURES

- A. Construction: NEMA 250; 10 gauge steel, no knockouts, wall mounted or free-standing as indicated. Free-standing enclosures are minimum 20-inches deep. Unless otherwise noted, enclosures are NEMA 1A for indoor dry locations, NEMA 12 for indoor process area and NEMA 4X for outdoor, wet or damp locations.
- B. Finish: Baked on enamel over a rust inhibitor.
- C. Covers: Continuous hinge, held closed by hasp and staple for padlock. Furnish three point latch for free standing enclosures.
- D. Panel for Mounting Terminal Blocks or Electrical Components: 14 gauge steel, white enamel finish.

2.3 CABINETS

- A. Cabinet Boxes: Code gage galvanized steel. Provide ¾-inch thick plywood backboard painted matte white, for mounting terminal blocks.
- B. Cabinet Fronts: Steel, surface type with concealed trim clamps, conceal hinge; finish in gray baked enamel.

2.4 TERMINAL BLOCKS AND ACCESSORIES

- A. Terminal Blocks: NEMA ICS-4; UL listed.
- B. Power Terminals: One-piece phenolic closed-back type, with binding screw or stud terminal connectors, rated 600 volts.
- C. Signal and Control Terminals: Modular construction type, channel mounted with marking strip; screw terminals, rated 300 volt.

2.5 FABRICATION

- A. Shop assemble enclosures and cabinets housing terminal blocks or electrical components in accordance with NEMA ICS-6.
- B. Selectors and Indicators: Door mounted for indoor enclosures. For outdoor enclosures provide a separate, hinged, inner door (dead from panel) for device mounting.
- C. Lace conductors with plastic ties to present a neat and orderly appearance. Provide nylon wrapping to protect conductors crossing hinges.
- D. Provide protective pocket inside front cover with control wiring and panel layout diagrams.

3 EXECUTION

3.1 INSTALLATION

- A. Install cabinets and enclosures plumb, anchor securely to wall and structural supports at each corner, minimum.
- B. Provide necessary feet for free-standing equipment enclosures.

END OF SECTION

SECTION 16421 SWITCHBOARDS

1 GENERAL

1.1 SCOPE

- A. Low Voltage Switchboards (up to 600 Volts).

1.2 SUBMITTALS

- A. Shop Drawings: Front and side views of enclosures with overall dimensions shown; conduit entrance locations and requirements; nameplate legends; size and number of bus bars per phase, neutral, and ground; and electrical characteristics including voltage, frame size and trip ratings. And equipment short circuit rating.

1.3 RECORD DRAWINGS

- A. Shop Drawings: As listed in Article 1.2, corrected to reflect the equipment as-built.
- B. Operation and Maintenance Data: Spare parts data listing; source and current prices of replacement parts and supplies; and recommended maintenance procedures and intervals.

1.4 DELIVERY, STORAGE AND HANDLING

- A. Arrange shipping splits as required for installation. Individually wrap each section and mount on shipping skids.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle in accordance with NEMA PB-2.1 and manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to switchboard internal components, enclosure, and finish.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Switchboards shall be manufactured by General Electric, Square D, Eaton, Siemens, or equal.

2.2 SWITCHBOARD CONSTRUCTION AND RATINGS

- A. Switchboard: Factory-assembled; dead front; metal-enclosed; self-supporting switchboard assembly conforming to NEMA PB-2; complete from incoming line terminals to load-side terminations. US-2 is front and near access, other switchboards are front access only.
- B. Switchboard Electrical Ratings and Configurations: As indicated.
- C. Main Section Device: Individually mounted.
- D. Distribution Section Devices: Individually mounted in US-2, panel mounted in other switchboards.
- E. Bus: Copper, sized in accordance with NEMA PB-2. Provide a copper ground bus through the length of the switchboard.

- F. Enclosure: US-2 is outdoor, non walk in close coupled to substation transformer. Other switchboards are NEMA PB-2 Type 1 - General Purpose. Sections align at the rear for mounting against a wall.
- G. Finish: Manufacturer's standard light gray enamel over external surfaces. Coat internal surfaces with minimum coat corrosion-resisting pain, or plate with cadmium or zinc.
- H. Surge Protection Device (SPD): UL listed in accordance with UL 1449, suitable for medium exposure level per ANSI C62.41, status indicating lights, and a minimum of 150 kA per phase rating. Connect to main bus with a circuit breaker sized per SPD manufacturer's recommendation.

2.3 SWITCHING AND OVERCURRENT PROTECTIVE DEVICES

- A. Feeder Circuit Breakers: NEMA AB-1; molded case type with true RMS sensing. Provide Integral solid state trip device with adjustable current setting (50-100 percent of frame size), long time delay, and instantaneous pick-up. Where indicated, provide zero ground fault with adjustable pick-up and time delay and an integral 3-phase ammeter with LCD display.
- B. Main Circuit Breakers: NEMA AB-1; insulated case; two-step stored energy operating mechanism; manually operated; stationary mounted; 600 amp minimum frame size. Provide integral solid state trip device with adjustable current setting (50-100 percent of frame size), long time delay, short time pick-up, short time delay and fixed (hi-set) instantaneous. Provide zero sequence ground fault with adjustable pick-up and time delay.

3 EXECUTION

3.1 INSTALLATION

- A. Install switchboard in locations shown on Drawings, in accordance with manufacturer's written instructions and NEMA PB2.1.
- B. Tighten accessible bus connections and mechanical fasteners after placing switchboard.

3.2 FIELD QUALITY CONTROL

- A. Inspect completed installation for physical damage, proper alignment, anchorage and grounding.
- B. Measure insulation resistance of each bus section phase to phase and phase to ground for one minute each. Test voltage shall be 1,000 volts, and minimum acceptable value for insulation resistance is 2 megohms.
- C. Check tightness of accessible bolted bus joints using a calibrated torque wrench. Tightness shall be in accordance with manufacturer's recommended values.
- D. Touch up scratched or marred surfaces to match original finish.

END OF SECTION

SECTION 16446
LOW VOLTAGE MOTOR CONTROL CENTERS

1 GENERAL

1.1 SECTION INCLUDES

- A. Low voltage motor control centers.

1.2 SUBMITTALS

- A. Submit shop drawings in accordance with NEMA classification as noted above and additional information as noted in the following paragraphs.
- B. Elementary Diagrams: Provide a separate elementary diagram for each starter unit following the format shown on the Drawings and showing numbered terminal points and interconnections to the first level of remote devices.
- C. Reference Data: Submit one set of full size (11 x 14-inch) time current curves for all overcurrent protective devices. Exception: A tabulation of heater sizes or elements versus motor current rating may be submitted in lieu of time current curves for overload relays.

1.3 QUALITY ASSURANCE

- A. Provide motor control centers manufactured and tested in accordance with NEMA ICS-2 and UL 845.
- B. Provide a UL label where applicable, on each unit and each vertical section. If a unit or section cannot be UL labeled so note on submittals along with reasons for same.
- C. NEMA Classification: Class I, type B wiring.
- D. Record Drawings:
 - 1. Shop drawings; as listed in Article 1.03 corrected to reflect the equipment as-built.
 - 2. Operation and maintenance data including recommended maintenance procedures and intervals, spare parts listing, and instruction books for the equipment and components.

1.4 DELIVERY, STORAGE, AND HANDLING

- A. Arrange shipping splits as required for installation. Individually wrap each section and mount on shipping skids.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris and traffic.
- C. Handle in accordance with manufacturer's written instructions. Lift only with lugs provided for the purpose. Handle carefully to avoid damage to motor control center components, enclosure and finish.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Motor control centers shall be Eaton, General Electric, Square D or Allen-Bradley.

2.2 EQUIPMENT

A. Spare Parts:

1. Starter Contacts: One set for each NEMA size furnished.
2. Starter Coils: One for each NEMA size furnished.
3. Control Circuit Fuses: Three for each rating furnished. Provide one fuse puller.
4. Pilot Light Lamps: Standard lot cartons equal to 10 percent of the number of lights furnished, one carton minimum.
5. Touch-Up Paint: One can.

2.3 SOURCE QUALITY CONTROL

A. Ratings:

1. Service: 480/277 Volt, 3 Phase, 4 Wire, 60 Hz (unless noted otherwise on the drawings).
2. Short Circuit: Unless otherwise indicated on the drawings, device interrupting rating and bus bracing is 100,000 amperes rms symmetrical. Provide fully rated devices; series ratings are not acceptable.
3. Ampacity: 300 amps minimum for vertical bus, as indicated for horizontal bus. Rating to be in accordance with UL standards for temperature rise.

3 EXECUTION

3.1 INSTALLATION

- A. Install in accordance with the manufacturer's instructions.
- B. Install control centers on a 4-inch concrete pad and secure to sills imbedded in the concrete with ½-inch threaded bolts and nuts.
- C. Touch up paint scratches and vacuum to remove construction debris and dirt. Install all doors, wire-way covers etc., and plug any unused device holes.

3.2 CONSTRUCTION

- A. Equipment consists of the required number of vertical sections to accommodate all devices indicated and specified herein, each nominally 90-inches high and 20-inches deep. Sections are bolted together to form a rigid free standing, front accessible, dead front assembly.
- B. Provide each section with isolated horizontal wire-ways at the top and bottom and isolated vertical wireways with hinged door and cable tie supports. Unused spaces are to have bussing for future units and blank door covers.
- C. Indoor enclosures are NEMA 1A gasketed painted in the manufacturer's standard gray over a rust inhibitor treatment unless shown otherwise on the drawings.
- D. Surge Protection: UL listed in accordance with UL1449, Edition 3, suitable for high exposure level per ANSI C62.41, Surge Current: 120 kA per phase, 60 kA per mode. Provide with status indicating lights. Connect to main bus with a circuit breaker sized per SPD manufacturer's recommendation.
- E. Incoming Mains:
 1. Provide incoming main lugs or circuit breaker as indicated. Main breaker is molded case type meeting UL 489 and NEMA AB-1. Equip with solid state trips with adjustable long time, short time and ground fault pick-up and delay, and high-set instantaneous pickup.

2. Arrange main breaker or lugs for top or bottom cable entry as indicated without requiring 90 degree bends in the incoming conductors.
3. Where motor control centers serve as service entrance equipment provide a UL service entrance label on the incoming section.

F. Starter Units:

1. Starters: Circuit breaker combination type rated in accordance with NEMA size designations. Fractional sizes and ratings per IEC recommendations are not acceptable.
2. Breakers: Adjustable magnetic trip only. Equip with current limiters as required for the interrupting rating noted.
3. Contactors: NEMA ICS-2; NEMA Size 1 minimum; magnetically held; field replaceable coil and contacts; auxiliary contacts field installable and removable, as shown on the drawings. Terminal temperature rise is not to exceed 50 degrees C per NEMA standards.
4. Overload Relays: Solid State overload relays rated for the motor nameplate rating.
5. Units: Constructed to fully compartmentalize the starter and arranged to permit access to starter, control power transformer, fuses and other components without requiring disassembly. NEMA size 1 thru 4 are plug in, size 5 and larger are bolt on. Equip unit door with a defeatable interlock to prevent opening unless the disconnect is open. Use red color to clearly indicate on position; either uncovered when disconnect handle is moved to the on position or disconnect handle itself colored red on the side showing in on position.
6. Terminal Blocks: Pull apart type for power and control to allow unit withdrawal without disconnecting wiring. Use screw type terminals suitable for ring and tongue lugs for control wiring and box lug type for power wiring.
7. Reduced Voltage Starters: Solid state type with adjustable acceleration ramp. Equip with isolation and run bypass contactors. See specification 16485 for details.

G. Feeder Units:

1. Breakers: Molded case type, thermal-magnetic trips meeting UL 489 and NEMA AB-1. Ampere rating and interrupting ratings as noted.
2. Units: Individually compartmentalized with not more than one breaker per unit unless otherwise indicated. Use red color to indicate on position as described above for starter units.

H. Bus:

1. Material: Copper, tin plated at all joints.
2. Isolation: Locate main bus at the top or center, completely compartmentalized with sliding or removable barriers for access to joints. Provide phase isolation for vertical bus by polyester barriers enclosing each phase bar or providing adequate creepage to restrict fault propagation. Plug all holes not used to stab in units. Main bus size as shown on the drawings.
3. Provide ground bus rated 300 amps minimum extending the full length of the lineup. Where three phase, four wire control centers are indicated provide full length neutral bus rated a minimum of 50 percent of the main bus. Where three phase three wire control centers are used as service entrance equipment provide neutral bus in incoming main section only.

I. Metering Relaying and Control Devices:

1. Current Transformers: ANSI C57.13; 5 ampere secondary; bar or window type; with single secondary winding and secondary shorting device; ratio as required; burden and accuracy consistent with connected metering and relay devices; 60 Hertz.
2. Circuit Monitor: Microprocessor-based unit for measuring multiphase variables including amps, volts, VARS, volt-amperes, power factor, demand values and harmonic distortion. Equal to Eaton PXM2260 meter.

3. Indicating Lights and Selectors: Heavy duty, oiltight, industrial grade with octagonal ring. Pilot lights are transformer type; LED for amber, red, and green and incandescent for other colors. Equal to Allen-Bradley bulletin 800T.
4. Control Relays: heavy duty, 600 volt, industrial grade, 10 amp contact rating. Equal to Allen-Bradley bulletin 700 type P.

J. Variable Frequency Drive (VFD): See Section 16489 – Low Voltage Variable Frequency Drives.

3.3 FIELD QUALITY CONTROL

A. TESTS

1. Install overload relay thermal elements based on motor nameplate rating. If capacitors are installed between the relay and motor, select thermal elements based on the measured motor current. Adjust other -overcurrent protective devices to settings per the coordination study.
2. Meggar each bus, phase-to-phase and phase-to-ground.

END OF SECTION

SECTION 16455 GROUNDING

1 GENERAL

1.1 SCOPE

- A. Power system grounding.
- B. Communication system grounding.
- C. Electrical equipment and raceway grounding and bonding.

1.2 SYSTEM DESCRIPTION

- A. The system consists of ground grids for building grounding; ground clusters for supplemental electrodes; and connections thereto of structures, equipment and electrical systems.
- B. This Section is intended to supplement the requirements of the NEC, particularly Article 250, and to differentiate among options allowed by the NEC. This Section is not intended to reiterate explicit requirements of the NEC.
- C. Within this Section the following definitions apply:
 - 1. Ground Grid: A horizontal loop, electrically and mechanically continuous; routed approximately three feet outside the building perimeter. Where any building dimension exceeds 100 feet provide cross ties spaced not farther than 50 feet apart connected to the perimeter loop and to each other at all points of intersection to form a grid.
 - 2. Ground Cluster: An assembly of three or more driven ground rods; spaced not closer than eight feet apart; each rod connected to the others in a closed delta configuration; and providing a resistance to ground of not more than 10 ohms.
 - 3. Connect or Bond: For underground or otherwise inaccessible locations - a permanent connection made by exothermic welding, brazing, or similar process. For exposed and accessible locations - a connection made with clamps, bolts or similar fittings approved for the purpose.
 - 4. Ground Ring: A horizontal loop of bare copper; electrically and mechanically continuous; routed exposed on the inside of the building or area approximately five feet above the finished floor, with elevation changes as necessary to avoid doors, windows and other obstructions. The ground ring is connected to all structural steel columns which it intersects, and to the ground grid at intervals not exceeding 50 feet.

1.3 SUBMITTALS

- A. Submit product data.
- B. Indicate layout of ground grid and routing of grounding electrode conductors.

2 PRODUCTS

2.1 MATERIALS

- A. Bare Conductors: ASTM B-8; stranded; hard drawn copper. Size unless otherwise noted is #4/0 AWG.

- B. Ground Rods: UL 425H; 5/8-inch x 10 feet; high strength steel core with metallicly bonded copper jacket. Rods shall have threaded type removable caps so that extension rods of same diameter and length may be added where necessary.

3 EXECUTION

3.1 INSTALLATION

- A. Except as noted, use insulated ground conductors only where installed in a raceway. Use bare conductors for the ground grid, ground rod connections, and bonding of buildings, structures etc. Where a bare conductor is installed in a raceway use only non-metallic raceways; do not install bare conductors in metallic raceways.
- B. Either embed the ground grid in the concrete building foundation 2 to 4-inches from the bottom or bury the grid three feet deep in the earth. For each 100 feet or fraction thereof of ground grid conductor provide connections to earth by one of the following:
 - 1. Where deep column footings (more than eight feet below grade) are used provide a vertical tap from the grid to the bottom of the footing.
 - 2. Where only shallow footings are available connect the ground grid to a driven ground rod.
- C. Drive ground rods so the top is 3 to 6-inches below finished grade. If rock is encountered then rods may be driven at an angle or grounding plates, as approved by the Engineer, may be used.
- D. Construct ground clusters as follows: Start with three driven ground rods and measure the resistance to ground of each rod. If the parallel combination exceeds 10 ohms then add sections and drive the rods deeper, or drive additional rods until the specified value is obtained. Connect each rod to every other rod in the cluster. Exception: not more than three additional rods or sections (six total) are required for any one cluster.
- E. Where bare conductors emerge from concrete encasement, provide a 4-inch length of Schedule 40 PVC conduit set in the concrete to protect the conductor.

3.2 SERVICE ENTRANCE EQUIPMENT

- A. Bond service entrance equipment ground bus to the ground grid with a #4/0 conductor.
- B. Provide on ground cluster outside the building at the closest practical location to the service entrance equipment and bond to ground bus with a #4/0 conductor.
- C. Bond to electrodes required by NEC Article 250-50.
- D. Prior to energizing the system remove the neutral link and meggar the system neutral. Repair any grounds then replace the neutral link.

3.3 BUILDINGS

- A. Bond all steel building columns to the ground grid.
- B. Provide outside access to the ground grid ever 100 feet (two locations minimum) by means of a 48-inch coiled pigtail buried approximately 18-inches below grade. Note locations on the as-built drawings.

3.4 SEPARATELY DERIVED SYSTEMS

- A. Ground transformer enclosures and, where solidly grounded systems are indicated, the secondary neutral to one of the following:
 - 1. The ground grid where transformer is located.

2. A ground riser or ground ring where available.
3. The building steel.
4. Other electrode as permitted by NEC if none of the above are available.

3.5 DIGITAL EQUIPMENT

- A. Provide a logic ground for PLC based local control panel separate from the power system ground. Route a #1/0 insulated copper conductor in a 3/4-inch conduit to a ground cluster outside the building.

3.6 UNDERGROUND DISTRIBUTION SYSTEM

- A. Route a bare conductor through each duct bank. Connect to building ground grid, equipment frame or ground pad as applicable.
- B. Provide a driven ground rod at each electrical manhole. Connect to duct bank ground conductor accessible in the manhole.
- C. Provide two ground clusters at opposite corners of pad transformers. Connect to transformer secondary compartment grounding lug. Bond primary and secondary ground lugs and duct bank grounding conductor.

3.7 FIELD QUALITY CONTROL

- A. Inspect grounding and bonding system conductors and connections for tightness and proper installation.
- B. Notify the Owner's representative at least one week in advance that the ground grid for each building is ready for inspection. Obtain written notice to proceed before filling trenches, pouring slabs, or otherwise covering the work.
- C. Compile and submit a list of ground resistance measurements for each ground rod in ground clusters. Measure and submit resistance to ground of service equipment ground bus.
- D. Make resistance to ground measurement in normal, dry weather conditions not less than 24 hours after rainfall. Make measurements using the fall of potential method per IEEE Standard No. 142.
- E. Ground measurement more than 2 ohms shall be reached by adding extra rods.

END OF SECTION



SECTION 16461
DRY TYPE TRANSFORMERS

1 GENERAL

1.1 SCOPE

- A. Dry type two winding transformers.

1.2 SUBMITTALS

- A. Submit product data. Include outline and support point dimensions of enclosures and accessories, unit weight, voltage, kVA, and impedance ratings and characteristics, loss data, efficiency at 25, 50, 75 and 100 percent rated load, sound level, tap configurations, insulation system type, and rated temperature rise.

1.3 DELIVERY, STORAGE AND HANDLING

- A. Store in a warm, dry location with uniform temperature. Cover ventilating openings to keep out dust.
- B. Handle transformers using only lifting eyes and brackets provided for that purpose. Protect units against entrance of rain, sleet, or snow if handled in inclement weather.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. Dry type transformers shall be equal to General Electric, Siemens, Square D, or Eaton.

2.2 DRY TYPE TRANSFORMERS

- A. Dry Type Transformers: NEMA ST-20; factory-assembled, air cooled dry type transformers; ratings as indicated. Transformers are two winding power type. Three phase units are connected delta primary and wye secondary. Scott or Tee connections and autotransformers are not acceptable.
- B. Insulation: 220 degrees C, 150 degree C rise for ratings 30 kVA and larger; 185 degrees C, 115 degrees C rise for ratings below 30 kVA.
- C. Taps: Two, 5 percent below rated primary for ratings 15 kVA and smaller; six, 2-1/2 percent two above and four below rated primary for ratings larger than 15 kVA.
- D. Ground core and coil assembly to enclosure by means of a visible flexible copper grounding strap.
- E. Mounting: Transformers 75 KVA and less shall be suitable for wall, floor, or trapeze mounting; transformers larger than 75 KVA shall be suitable for floor trapeze mounting.
- F. Isolate core and coil from enclosure using vibration-absorbing mounts.

3 EXECUTION

3.1 INSTALLATION

- A. Set transformer plumb and level. Clear walls and ceilings at least 6-inches to allow for air circulation.

- B. Use flexible conduit, two foot minimum length, for connections to transformer case. Make conduit connections to side panel of enclosure.
- C. Mount transformers on vibration isolating pads suitable for isolating the transformer noise from the building structure.

3.2 FIELD QUALITY CONTROL

- A. Check for damage and tight connections prior to energizing transformer.
- B. Measure secondary voltage under normal load conditions and make appropriate tap adjustments.

END OF SECTION

SECTION 16470
PANELBOARDS

1 GENERAL

1.1 SCOPE

A. Panelboards.

1.2 SUBMITTALS

A. Submit shop drawings.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. Equipment shall be manufactured by General Electric, Siemens, Square D, Eaton, or equal.

2.2 PANELBOARDS

A. Panelboards: NEMA PB-1; UL 67.

B. Rating: Voltage and ampere ratings are shown on the Drawings. Unless otherwise indicated interrupting ratings (RMS symmetrical) are 14,000 amps for 480 volt panelboards and 10,000 amps for 240 and 208 volt panelboards.

C. Boxes: Code gauge galvanized steel; sized to accommodate devices indicated and afford wire bending space in accordance with NEC requirements.

D. Fronts: Surface or flush as indicated, door-in-door construction, finished in light grey enamel over a rust inhibitor. Furnish flush lock for fronts less than 48-inches high and vault type handle with three point catch for fronts 48-inches and higher. Key all locks alike.

E. Bus: Copper, arranged for bolt-on circuit breakers. Furnish insulated neutral bus and ground bus with main lug bonded to the box.

F. Circuit Breakers: NEMA AB-1; molded case type, thermal-magnetic trip with internal common trip on multipole breakers. Provide breaker fully rated for interrupting ratings noted; series ratings are not acceptable.

G. Where fusible switch type panelboards are indicated provide panel fronts without doors and individual doors for switch units. Switches: NEMA KS-1; quick-make, quick-break, load interrupter type, horsepower and i²t rated, and equipped with Class J rejection fuse clips.

H. Provide engraved nameplates giving the voltage rating and panel designation as indicated. Provide a UL service entrance label for panelboards used as service entrance equipment.

I. Two Section Panels: Box and from same height each section.

J. Surge Protection: Where indicated, provide transient voltage surge suppressors equal to Advanced Protection Technologies TE Thousand Series (main and distribution panels) and TE Hundred Series (branch circuit panels). Mount in the panel gutter unless space does not permit or panel UL label is voided - in which case furnish loose for installation by the Contractor adjacent (less than five feet) to the panel. Connect to load side of main breaker and do not fuse.

3 EXECUTION

3.1 INSTALLATION

- A. Install boxes so they are rigidly supported and correctly aligned. Select mounting height so that operating handles are not higher than 6 feet 6-inches nor lower than 24-inches above the floor.
- B. For flush mounted panels provide a ¼-inch empty raceway for each three unused spaces and spare poles. Terminate in a junction box located above the ceiling or other approved accessible location for future extension.
- C. Prior to energizing panelboards clean out construction dirt and debris. Paint any scratches on trims or dead front barriers. Meggar each phase to phase ground to insure that no short circuits exist.
- D. Adjust panel barriers so that no opening occur between them and the panel front. Provide filler plates and plugs as necessary to maintain dead front integrity.
- E. Type directory cards with circuit loads and/or area served. Note spare circuits in pencil.

3.2 FIELD QUALITY CONTROL

- A. Measure steady state load currents at each panelboard feeder. Should the difference at any panelboard between phases exceed 20 percent, rearrange circuits in the panelboard to balance the phase loads within 20 percent. Take care to maintain proper phasing for multi-wire branch circuits.

END OF SECTION

SECTION 16473
LOW VOLTAGE SURGE PROTECTION DEVICES

1 GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing labor, materials, and equipment, tools, and incidentals for complete and operable surge protective devices for electrical power panels, motor control centers, and switchboards.
- B. Provide a surge protective device for each Service Entrance and Main Distribution panelboard/switchboard. Other Branch panelboards, switchboards, and motor control centers shall have a surge protective device only when called for on the Contract Drawings.
- C. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 1 Specification Sections, apply to this Section.
- D. Related Sections include but are not limited to:
 - 1. Section 16050 – Basic Electrical Materials and Methods.
 - 2. Section 16455 – Grounding.
 - 3. Section 16141 – Wiring Devices
 - 4. Section 16470 – Panelboards.
 - 5. Section 16446 – Low Voltage Motor Control Centers.

1.2 REFERENCES

- A. Publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by basic designations only.
 - 1. Institute of Electrical and electronics Engineers (IEEE).
 - a. IEEE C62.41 – IEEE Guide for Surge Voltages in Low Voltage AC Power Circuits.
 - b. IEEE C62.45 – IEEE Guide for Surge Suppressor Testing.
 - 2. National Electrical Code (NEC).
 - a. NEC Article 285 – Transient Voltage Surge Suppressors.
 - 3. National Fire Protection Association (NFPA).
 - a. NFPA 70 – National Electrical Code.
 - 4. National Electrical Manufacturers Association (NEMA).
 - a. NEMA LS-1 – Low Voltage Surge Protective Devices.
 - 5. Underwriters Laboratories Inc. (UL).
 - a. UL 1283 – Electromagnetic Interference Filters.
 - b. UL 1449 – Transient Voltage Surge Suppressors.
 - 6. Occupational Safety and Health Administration (OSHA).
 - a. OSHA – Definitions and Requirements for a Nationally Recognized Testing Laboratory.

1.3 SUBMITTALS

- A. Shop drawings, product data, and manufacturer's installation instructions, and shall be submitted for review ten days prior to the bid date for all non-approved manufacturers. Submittals shall be in accordance with the Conditions of Section 01300 - Submittals.
- B. The submittals shall include:
 - 1. Dimensional drawing of each suppressor type.
 - 2. UL Standard 1449 Listing, Standard for Safety, *Transient Voltage Surge Suppressors*, documentation.
 - 3. UL Standard 1283 Listing, *Electromagnetic Interference Filters*, documentation.
 - 4. IEEE C62.41 Category C3 (20kV-1.2/50, 10kA-8/20 μ s waveform) let through voltage test results.

1.4 QUALITY ASSURANCE

- A. Comply with NFPA 70 "National Electrical Code" Article 285 for components and installation.
- B. Listing and Labeling: Provide products specified in this Section that are listed and labeled.
 - 1. The Terms "Listed and Labeled": As defined in the "National Electrical Code," Article 100.
 - 2. Listing and Labeling Agency Qualifications: A "Nationally Recognized Testing Laboratory" (NRTL) as defined in OSHA Regulation 1910.7.
- C. Comply with NECA "Standard of Installation."
- D. Comply with UL 1449 latest edition IEEE C62.41, UL standard for safety for transient voltage surge suppressors.
- E. Comply with NEMA LS1 Low Voltage Surge Protective Devices.
- F. Test per IEEE C62.45, 8 x 20 microsecond current wave test.

2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturers: Subject to compliance with requirements, manufacturers offering Products that may be incorporated in the Work:
 - 1. Square D (SurgeLogic by Schneider Electric).
 - 2. Advanced Protection Technologies.
 - 3. Eaton/Cutler-Hammer.
 - 4. Innovative Technology.
 - 5. Total Protection Solutions.
 - 6. General Electric Co.
 - 7. Phoenix Contact
 - 8. Or approved equal.

2.2 DESIGN

- A. The unit shall consist of metal oxide varistors (MOV's) connected together such that all components shall share surge currents in a seamless, low stress manner. All internal components shall be hardwired utilizing low impedance connections.
- B. The unit shall include a high performance EMI/RFI noise rejection filter. The noise attenuation shall be no less than 45 dB at 100 KHz.
- C. The unit shall have internal fusing, rated at 200 KiloAmperes interrupting capacity for each suppression element. Where indicated, provide integrally mounted disconnect switch.
- D. The unit shall have phase failure indication light emitting diode indicators on the front of the enclosure door. Dry contacts, 10 Amperes at 120 Volts, for remote alarm.
- E. Enclosure shall be a rated enclosure suited for the environment. Reference section on enclosure ratings.

2.3 ELECTRICAL REQUIREMENTS

- A. The operating voltage shall be as shown on Contract Drawings.
- B. Maximum continuous operating voltage shall be greater than 115% of the nominal operating voltage.
- C. The unit shall have either a Delta or Wye configured projection mode.
 - 1. Wye: direct connected suppression elements between the line to neutral, line to ground and neutral to ground conductors.
 - 2. Delta: direct connected suppression elements between the line to line and the line to ground conductors.
- D. Provide units with rated surge current capacity as follows for the types of switchboards/motor control centers/panelboards shown. For purposes of this section, "Service Entrance" is defined as a switchboard or panelboard which receives its supply from a utility service, utility transformer, or substation transformer; "Main Distribution" is defined as a non-utility powered switchboard or panelboard which has multiple branch feeder circuits of 100 amperes or larger; "Branch" is defined as any other switchboard or panelboard.
 - 1. "Service Entrance" Switchboard or Panelboard; SPD (surge arrester) located on the line side of service disconnect: Type 1 SPD (per UL 1449).
 - 2. "Service Entrance" Switchboard or Panelboard; SPD (transient voltage surge suppressor) located on the load side of service disconnect: Type 2 SPD (per UL1449).
 - 3. "Main Distribution" Switchboard or "Main Distribution" Panelboard or Motor Control Center; SPD (transient voltage surge suppressor) located on load side of main overcurrent device: Type 2 SPD (per UL 1449).
 - 4. "Branch" Switchboard or Panelboard: Type 2 SPD (per UL 1449) in switchboard or panelboard.
- E. KiloAmpere Phase and Mode ratings shall meet or exceed the following standards:
 - 1. Type 1 SPD: 240 KiloAmperes per phase, 120 KiloAmperes per mode.
 - 2. Type 2 SPD: 160 KiloAmperes per phase, 80 KiloAmperes per mode.
- F. The surge rating per UL 1449, shall not exceed:

1. Wye: 400 Volts @ 120/208 Volts 800 Volts @ 277/480Volts
 2. Delta: 800 Volts @ 120/208 Volts 1500 Volts @ 277/480 Volts
- G. The maximum let through voltage shall not exceed:
1. 120/208 Volts: 170/500 ANSI/IEEE Category B3/C3
 2. 277/480 Volts: 300/900 ANSI/IEEE Category B3/C3
- H. Provide a five (5) year replacement warranty for all materials.

3 EXECUTION

3.1 EXAMINATION

- A. Examine equipment for compliance with contract documents and other conditions affecting performance of the transient voltage surge suppression system. Do not proceed with installation until unsatisfactory conditions have been corrected.

3.2 INSTALLATION

- A. Install raceways, boxes, enclosures, and cabinets as indicated, according to manufacturer written instructions.
- B. Install as close as physically possible to panel for maximum protection and optimum performance.

3.3 PROTECTION

- A. Provide final protection and maintain conditions, in a manner acceptable to manufacturer and installer, to ensure that coatings, finishes, and cabinets are without damage or deterioration at Substantial Completion.
1. Repair damage to galvanized finishes with zinc-rich paint recommended by manufacturer.
 2. Repair damage to paint finishes with matching touch-up coating recommended by the manufacturer.

3.4 CLEANING

- A. Upon completion of installation of system, inspect exposed finish. Remove burrs, dirt, and construction debris and repair damaged finish, including chips, scratches, and abrasions.

END OF SECTION

SECTION 16484
CONTACTORS

1 GENERAL

1.1 SCOPE

- A. Work described in this Section includes furnishing labor, materials, and equipment, tools, and incidentals for complete and operable contactors.
- B. Work in this Section includes:
 - 1. Lighting contactors.
 - 2. Enclosures.
- C. Related Sections include but are not limited to:
 - 1. Section 16050 – Basic Electrical Materials and Methods.

1.2 REFERENCES

- A. Publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by basic designations only.
 - 1. National Electrical Manufacturers Association (NEMA).
 - a. NEMA ICS-2 – Standard for Industrial Control Devices, Controllers and Assemblies.
 - b. NEMA ICS-6 – Industrial Control and System Enclosures.

1.3 SUBMITTALS

- A. Submit product data. Include outline drawings with dimensions, and equipment ratings for voltage, capacity, and poles.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. General Electric.
- B. Square D.
- C. Westinghouse.
- D. Siemens
- E. Or approved equal.

2.2 LIGHTING CONTACTORS

- A. Contactors: NEMA ICS-2; mechanically held, unless otherwise indicated.
- B. Coil Operating Voltage: 120 volts, 60 Hertz.
- C. Contacts: as indicated, minimum of 4.

D. Enclosure: NEMA ICS-6; Type 1.

E. Controls:

1. 480-volt contactors to include 480-120 volt control power transformer with HOA switch and red indicating light mounted on contactor door in MCC.
2. 120-volt contactors to be furnished with HOA switch and red indicating light mounted on contactor enclosure door.

F. Provide solderless pressure wire terminals.

3 EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

END OF SECTION

SECTION 16489
LOW VOLTAGE VARIABLE FREQUENCY DRIVES

1 GENERAL

1.1 SCOPE

- A. The Contractor shall furnish and install complete and operable low voltage variable frequency drives (VFDs), by-pass motor starters, and isolation phase shifting transformers as described in this specification and as detailed on the applicable drawings.
- B. Work included in this Section.
 - 1. Variable Frequency Drives (VFDs)
 - 2. By-Pass Motor Starters
 - 3. Isolation / phase shifting transformers
- C. Related Sections include but are not limited to:
 - 1. Section 16050 – Basic Electrical Materials and Methods.
 - 2. Section 16455 – Grounding.
 - 3. Section 16473 – Low Voltage Surge Protection Devices.
 - 4. Section 16446 – Low Voltage Motor Control Centers.
- D. The Contractor shall be responsible for the installation, and start-up of the equipment covered by this Specification.
- E. Complete drawings shall be furnished for approval and shall consist of master wiring diagrams, elementary or control schematics, including coordination with other electrical control devices operating in conjunction with each VFD. Suitable outline drawings showing details necessary to locate conduit stub ups and field wiring shall be furnished for approval before proceeding with manufacturer.
- F. The VFDs shall be UL certified and shall comply with the latest applicable standards of ANSI, IEEE and NEMA. The VFDs shall be rated as shown on the Drawings. As a minimum the full load output current of the controller shall be equal to the equivalent motor horsepower as listed by National Electrical Code Table 430-150.
- G. The manufacturer shall furnish to the Engineer a factory test report for each VFD. Refer to Part 3 - Execution, of this Section.
- H. Line voltage notching limits shall be as specified in Table 1 below during normal operation. The points of voltage measurement shall be at the main switchboard.

Table 1			
Class	Notch Depth	A_N	DF_{VN}
General System	20%	22,800	5%
<p>Notch Depth = $Z1 / (Z1 + Z2)$ where $Z2$ is the impedance between the converter and point of common-coupling (PCC) and $Z1$ is the short circuit impedance at PCC. This is equivalent to $1/p$.</p> <p>DF_{VN} = Voltage distortion factor from notching</p> <p>A_N = Notch Area (Voltmicroseconds)</p>			

- I. Electromagnetic Interference Limitations.
 - 1. EMI (electromagnetic interference) and FRI (Radio frequency interference) created by the specified VFDs shall be limited as far as possible to allow proper operation of all Project equipment as well as to prevent interference with any equipment utilized beyond the boundaries of the treatment plant.
 - 2. EMI and RFI produced by the specified VFDs shall be limited by all means possible including filters to limits defined in Federal Communications Commission (FCC) Rules and Regulations Volume 2, Part 15, Subpart J, Class A.
- J. Powerline disturbances shall be limited per requirements of IEEE Standard 519 latest edition including harmonic currents at the high voltage side of utility transformers (point of common coupling - PCC) and Harmonic Voltage distortion at PCC. Point of analysis (POA) shall be the main switchboard.
- K. Contractor shall evaluate all system components, and provide calculations showing dominant harmonics and line notching depths. Contractor shall provide necessary isolation transformers, and other necessary components to comply with IEEE-519, latest edition.
- L. All VFDs shall be pulse width modulated and shall be of the 18-pulse type for motors 100 HP and larger. VFD drives for motors less than 100 HP can be of the 6-pulse type, subject to compliance with IEEE-519 recommended interference limitations.
- M. VFD manufacturers/suppliers shall coordinate the application of the VFDs with the driven mechanical equipment and motors manufacturer/supplier. However, requirement is that the driven equipment manufacturers supply the VFDs in accordance with this Section.
- N. Based on specific application(s), drive manufacturer shall provide output line reactors, as required.
- O. To the extent possible, VFDs rated for control of motors 150 HP and less shall be located in a motor control center. See Section 16481 – Low Voltage Motor Control Centers.

1.2 REFERENCES

- A. Publications listed below form a part of this Section to the extent referenced. The publications are referred to in the text by basic designations only.
 - 1. American National Standards Institute (ANSI).
 - a. ANSI 61 – Drinking Water system Components.

2. Underwriters Laboratories Inc. (UL).
3. Institute of Electrical and Electronics Engineers (IEEE).
 - a. IEEE 519 – Recommended Practices and Requirements for Harmonic Control in Electrical Power Systems.
4. National Electrical Manufacturers Association (NEMA).
5. Federal Communications Commission (FCC).
 - a. FCC – Rules and Regulations Volume 2.
6. National Electrical Code (NEC).
 - a. NEC Table 430-150 – Full Load Current – Three Phase AC Motors.
7. Department of Defense (DOD).
 - a. DOD MIL-I-45208 – Inspection Systems Requirements.
8. Military Specification (MIL).
 - a. MIL-STD-C45662 – Calibration Systems Requirements.
 - b. MIL-STD-45208 – Inspection.
 - c. MIL-STD-105D – Sampling Plan.

1.3 SUBMITTALS

- A. Submittals shall conform to the requirements of Section 01300 – Submittals.
- B. Materials List. The materials list shall be complete and include all products in this section, including the equipment that shall have shop drawings. The list shall include only one manufacturer for each type of product.
- C. Shop Drawings. The shop drawings for the automatic variable frequency drive equipment shall be complete and shall include the following:
 1. Plans showing the floor space requirements, clearance, conduit, and anchor bolt locations.
 2. Details showing the required enlarged views of small parts.
 3. Diagrams showing the equipment, equipment locations, wiring circuits schematics, voltage, wire numbers, and identified terminals.
 4. Connection and schematic wiring diagrams for each equipment showing numbered terminal points and wires and interconnections to other units and/or remote devices.
 5. A complete bill of materials and complete catalog information of all components contained in the equipment including manufacturer's name and model numbers.
 6. Panel layouts including elevation of front, elevation of front with cover open, and nameplate inscriptions. Layout drawings shall be of sufficient size to determine adequacy of equipment.
 7. Dimensions of the equipment.
 8. Weights of the equipment.

- 9. Nameplate data including the nameplate material, height of letters, number of lines, inscriptions, and dimensions.
- D. Technical Data. Submit complete system and equipment description including detailed draft theory of operation and operation data to the Engineer with shop drawings. To be included in the final version in the Operation and Maintenance Manuals.
- E. Parts Lists. Submit to Engineer with the shop drawings a complete, priced list of parts that would be necessary to maintain and service the equipment.
- F. Factory Test Reports. Submit manufacturer's certified factory test reports to the Engineer.
- G. Manufacturer's Certified Reports. Submit a notarized written report from the equipment manufacturer with respect to his equipment certifying that (1) the equipment has been properly installed, wired, and connected under his supervision, (2) the equipment is in accurate alignment, (3) he was present when the equipment was placed in operation, (4) he has checked, inspected, and adjusted the equipment as necessary, (5) the equipment has been operated satisfactorily under all system conditions and (6) the equipment is fully covered under the terms of the guarantee. The manufacturer shall also furnish a certified report indicating compliance with Paragraph 1.01E, F, and G.
- H. Furnish (10) Operation and Maintenance Manuals in accordance with Section 01700 – Contract Closeout.

1.4 QUALITY ASSURANCE

- A. VFD supplier shall have responsibility for the compatibility of the variable frequency drives, motors and isolation / phase shifting transformers (as applicable). The VFD supplier must confirm that his equipment is completely compatible with the pump or fan driven equipment and motors and with the electrical power system at each location. The VFD supplier shall coordinate with the mechanical equipment supplier to determine whether constant torque, variable torque, or other type is the most satisfactory application.
- B. The manufacturer of the VFD shall have a permanent fully factory authorized and trained, service agent employed with a technical staff and an equipped service facility within a 100 mile radius of the project site, having all personnel and all equipment required to maintain, repair, or overhaul the VFD and associated systems supplied herein.
- C. The manufacturer of the VFD system shall use components and subsystems (i.e., circuit breakers, relays, control transformers, etc.) conforming to this specification as listed elsewhere.

1.5 INDIVIDUAL EQUIPMENT REQUIREMENTS

- A. Verification. Verify that the variable frequency drive equipment output speed, horsepower and torque range are adequate and compatible with the motor and driven equipment requirements.
- B. Motors. All Motors run by the FVDs shall be Inverter Duty rated.
- C. Wiring. Wiring for variable speed equipment shall comply with requirements shown on the Drawings.

- D. Instrumentation Equipment. Instrumentation equipment provided and/or required under this Section shall comply with requirements specified herein and Sections of Division 13.
- E. Codes and Standards. Equipment, materials and installation shall conform to the codes and standards that are listed in Section 16010 - General Electrical Requirements, and IEEE 519, latest version. The Variable Frequency Drive shall be UL listed.

1.6 OVERALL SYSTEM REQUIREMENTS

- A. In addition to operating adequately and properly as individual equipment, the drives must operate together as a system such that they do not affect each other or other systems (including the power service company electrical system, programmable logic controllers, control panels, radio and electronics devices, etc.) adversely. To this end the harmonic voltage and current distortions, and line voltage notching, produced by the variable frequency drives at the point of common coupling (PCC) which will be the point of analysis (POA), shall be limited per requirements of IEEE Standard 519 latest edition.

1.7 WARRANTY

- A. With respect to equipment, guarantee shall cover (1) faulty or inadequate design; (2) improper assembly or erection; (3) defective workmanship or materials; and (4) incorrect or inadequate operation, or other failure. For equipment bearing a manufacturer's warranty in excess of 1 year, furnish a copy of the warranty to the Engineer with Owner named as beneficiary.

2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

- A. The VFDs shall be furnished by a single manufacturer who has actively been manufacturing variable frequency drives for a period of at least five (5) years. The VFDs shall be by Allen-Bradley, Square D, Eaton, Danfoss, or approved equal.

2.2 CONSTRUCTION AND CHARACTERISTICS

- A. Each low voltage VFD shall provide constant volts per hertz excitation for its respective motor up to 60 Hertz.
- B. The VFDs shall have a 110% current rating for one minute.
- C. The VFDs shall be capable of converting incoming three phase, 480 V (+10% to -10%), 60 hertz (± 2 hertz) power to a fixed potential dc bus level. The dc voltage shall be inverted to an adjustable frequency output. The controller shall maintain displacement power factor at 95% or greater at any speed or load. The VFDs shall have a minimum efficiency of 96% at rated load.
- D. The VFDs shall operate in an ambient temperature of 0°C to 40°C, and humidity of 0 to 95%.

- E. Each VFD enclosure shall be NEMA 1A gasketed unless otherwise indicated on the Drawings, and the VFDs shall be MCC mounted or floor mounted (stand-alone) as defined herein and/or shown on the Contract Drawings.
- F. All enclosures shall be not less than 16-gauge steel with surfaces thoroughly cleaned and phosphatized prior to painting. They shall be primed with a corrosion-resisting coating. Cabinet finish paint to be ANSI 61 Gray. Provide barriers as required to prevent entrance of vermin and rodents.
- G. The operating handle of the disconnect shall always remain connected to the disconnect and shall not be mounted on the door. The position handle shall indicate On or Off. The handle shall have provisions for padlocking in the off position with at least three padlocks. Interlock provisions shall prevent unauthorized opening or closing of the VFD door with the disconnect handle in the on position.
- H. The following standard basic control features shall be provided on each VFD:
 - 1. Terminations for all required door and/or remote mounted devices.
 - 2. Linear independent time acceleration and deceleration adjustments.
 - 3. Output frequency range of 4-60 hertz, factory set.
 - 4. Frequency stability of 0.5% for 24 hours with voltage regulation of $\pm 2\%$ of maximum rated output voltage.
 - 5. Control power transformer, 480-120 volt for operator devices.
 - 6. All terminals necessary for customer permissive contacts and required interlocking as required by the drawings.
 - 7. Fully digital regulator with microprocessor control of frequency, voltage, and current.
 - 8. The drive shall be designed to protect itself against instantaneous current levels above 150% of its rating.
 - 9. The drive shall not be sensitive to line notching from other drives.
 - 10. The drive shall be capable of riding through a momentary power outage of 5 cycles without causing the drive to shut down.
 - 11. The drive shall actively monitor its output current and frequency and if the motor is in a stall condition the drive will shut down. A stall condition is defined as operating in current limit at or below 10 Hertz for 10 seconds. This definition of stall shall be field adjustable to match the applications.
 - 12. The minimum acceptable efficiency shall be 96% at full load.
 - 13. The deceleration rate shall be constant and independent of motor speed.
 - 14. The inrush current shall be limited to 150% of the full load current.
- I. The following independent adjustments shall be provided on each VFD:
 - 1. Minimum speed - 4 to 40 hertz.
 - 2. Maximum speed - 40 to 90 hertz (factory set for 60 hertz).
 - 3. Acceleration - 5 to 30 hertz per second with ranges of 2-120 seconds for 0-60 Hz.

4. Deceleration - 5 to 30 hertz per second with ranges of 2-120 seconds for 0-60 Hz.
5. Low frequency boost - up to 60 Volts at 4 hertz.
6. Volts per hertz - Adjustable from 3.83 to 11.5 volts per hertz.
7. Stability.
8. Output signal of 4-20 ma dc, proportional to VFD output frequency including gain and bias adjustments.
9. Controller status relay with two Form C relay pairs, rated 2 amps resistive at 115 Volt ac for indication of running condition.
10. Laminated plastic nameplate engraved with customer's identifying name or number of each VFD.

J. The following features shall be furnished with each VFD:

1. Full time adjustable current limit shall sense an overload on the motor when current exceeds a preset limit. Output frequency and therefore motor speed shall be reduced. If current decreases with speed, the speed shall decrease until current drops below the limit. Once current is reduced to normal, the frequency shall return to the original setting.
2. AC output contactor and interposing control logic.
3. Motor overcurrent relay, wired to stop unit upon trip, manually reset.
4. Isolated signal follower for use with grounded input signal (4-20 madc) for control of VFD output frequency.
5. Output load ammeter, voltmeter and speed indicating meters.
6. Door-mounted NEMA 1A gasketed or as indicated operator controls with heavy duty industrial rated devices as shown on drawings.
7. "Hand-Off-Remote" reference selector switch to enable operator to select the speed control means from the plant control system computer (remote) or from the drive (hand).
8. Digital display for monitoring the following functions:
 - a. Drive output frequency.
 - b. Motor Load calibrated in amps.
 - c. Drive output power in Kw.
 - d. Drive output voltage in volts.
 - e. Over current.
 - f. Under voltage
 - g. Over voltage.
 - h. Fault diagnostic messages (system, board, component level).

K. The following protective features shall be provided on each VFD:

1. Suitability for use on an electrical system with 100kA available fault current.

2. Input ac circuit breaker or fused switch disconnect with an interlocked, padlockable handle mechanism.
 3. AC input line current limiting fuses for fault current protection of ac to dc converter section.
 4. Electronic overcurrent trip for instantaneous overload protection.
 5. AC input line undervoltage and phase loss protection.
 6. Over frequency protection.
 7. Over temperature protection.
 8. Over voltage protection.
 9. Low logic supply protection.
 10. Electrical isolation between the power and logic circuits, as well as between the 115 Volt ac control power and the static digital sequencing.
 11. Ability to withstand output terminal line-to-line short circuits without component failure.
 12. Supply voltage phase loss.
 13. For any protective condition, the VFD shall trip and an internal fault relay contact shall close for remote indication.
- L. RFI and EMI. RFI filters as required. The adjustable frequency drive system shall contain all necessary filters and devices, and be constructed and installed in manner, to eliminate significant levels of conducted and radiated electrical noise. The EMI and RFI emissions from the variable frequency drive system shall not exceed the levels specified in FCC Rules and Regulations, Volume 2, Part 15, Subpart J, Class A. If after installation, any interference or noise occurs, the supplier shall take corrective action by installing whatever additional equipment or corrective measures that may be required, at no additional cost to the Owner.
- M. Replaceable Parts. One each of each replaceable part such as printed circuit boards, plug-in modules, module assemblies, etc., and three each of each type of diode, IGBT, SCR or transistor, fuse, light, etc., not mounted on a provided assembly shall be supplied in the manufacturer's original cartons, clearly marked by name and part number as referenced in the maintenance manual. A list of such parts with prices shall be submitted with the shop drawings. The above shall exclude such items as power transformers, chokes, contactors, etc., which shall have a mean time between failures (MTBF) of 100,000 hours minimum.
- N. The drive shall have surge and lightning protection using transient voltage surge suppressors, or approved equal. See section 16473 – Low Voltage Surge Protection Devices, for details.
- O. Parameter Settings
1. The following system configuring settings, shall be provided, without exception, field adjustable through the keypad/display unit or via the serial communication port only.
 - a. Motor Nameplate Data:
 - i. Motor frequency.

- ii. Number of poles.
- iii. Full load speed.
- iv. Motor volts.
- v. Motor full load amps.
- vi. Motor KW.
- vii. Current limit, min.
- viii. Current limit, max.

b. VFD Limits:

- i. Independent accel/decel rates.
- ii. Motor flux build-up delay: time/amount.
- iii. Vmin, Vmax, V/Hz.
- iv. I boost.
- v. Overload trip curve select (inverse or constant).
- vi. Min/Max speed (frequency).
- vii. Auto reset for load or voltage trip select.
- viii. Slip compensation.
- ix. Catch-A Spinning-Load select.
- x. Overload trip time set.

c. c. VFD Parameters:

- i. Voltage loop gain.
- ii. Voltage loop stability.
- iii. Current loop stability.

d. Controller Adjustments:

- i. PID control enable/disable.
- ii. Setpoint select.
- iii. Proportional band select.
- iv. Resent time select.
- v. Rate time select.
- vi. Input signal scaling.
- vii. Input signal select (4-20 mA/0-5 Volts).
- viii. Auto start functions: On/Off, Delay On/Off, Level Select On/Off.
- ix. Speed Profile: Entry, Exit, Pointer Select.
- x. Min, Max Speed Select.

- xi. Inverse profile select (allows VFD speed to vary directly or inversely with input signal).
2. All drive setting adjustments and operation parameters shall be stored in a parameter log which lists allowable maximum and minimum points as well as the present set values. This parameter log shall be accessible via a RS232 serial port and a Profi-Bus DP communication port as well as on the keypad display.

P. Diagnostic Features and Fault Handling

1. The VFD shall include a comprehensive microprocessor based digital diagnostic system which monitors its own control functions and display faults and operating conditions. Microprocessor systems must be products of the same manufacturer as the VFD (to assure single source responsibility, availability of service and access to spare parts).
2. A "FAULT LOG" shall record, store, display and print upon demand, the following for the 10 most recent events:
 - a. VFD mode (Auto/Manual).
 - b. Elapsed time (since previous fault).
 - c. Type of fault.
 - d. Reset mode (Auto/Manual).
3. A "HISTORIC LOG" shall record, store, display and print upon demand, the following control variables at 2 to 8 M/Sec. intervals for the 50 intervals immediately proceeding a fault trip:
 - a. VFD mode (manual/auto/inhibited/tripped/etc.).
 - b. Speed demand.
 - c. VFD output frequency.
 - d. Demand (output) Amps.
 - e. Feedback (motor) Amps.
 - f. VFD output volts.
 - g. Type of fault:
 - i. Br Over Current.
 - ii. Br Under voltage.
 - iii. Br Phase Rotation.
 - iv. Br Fuse Failure.
 - v. Sustained Overload.
 - vi. Manual Trip Test.
 - vii. Power Supply Fail.
 - viii. Output Over Voltage.
 - ix. Inverter Over Temperature.

- x. Thermistor Trip.
- xi. Ground Fault.
 - Br Over Current Power Supply Fail
 - Br Under voltage Output Over Voltage
 - Br Phase Rotation Inverter Over Temperature
 - Br Fuse Failure Thermistor Trip
 - Sustained Overload Ground Fault
 - Manual Trip Test

h. Drive inhibit (On/Off).

4. The fault log record shall be accessible via a RS232 serial link and an Ethernet IP communications port as well as line by line on the keypad display.

Q. Communications

1. Provide each VFD with Ethernet communication module. Interface of data between the VFD and the site-wide control system shall be Ethernet IP. The connection to the VFD shall be an integral option to the VFD and shall be provided by the VFD manufacturer.

R. Drives for blowers, positive displacement pumps and other constant torque loads shall be the constant torque type, subject to supplier obtaining confirmation from the mechanical equipment manufacturer.

3 EXECUTION

3.1 GENERAL

- A. Install the variable speed equipment complete, including wiring installations, and conduct test for the electrical controls as indicated, specified, and required. Assure proper clearance for all equipment and materials in the layout shown on Contract Drawings.
- B. Equipment shall be installed level and securely attached to the concrete floors and foundations with anchor bolts or attached to sills. The sections shall be joined together with bolts, nuts, and washers to form a complete unit assembly.
- C. Wiring Installations shall be complete as indicated and specified.
- D. Nameplates shall be laminated plastic and attached to clean surfaces of the metal enclosures with stainless steel screws.
- E. Grounding shall be provided as shown on the Drawings, and specified in Section 16060 - Grounding and Bonding.

3.2 FACTORY TESTING

- A. The VFD manufacturer shall provide the following quality assurance steps within his factory:
 - 1. Incoming inspection of all components.

2. In-process inspection of assemblies.
 3. Quality Assurance program that meets or exceeds DOD Standard Audit MIL-I-45208.
 4. MIL STD-105D AWL 1% sampling.
 5. MIL STD-C45662 calibration.
 6. 100% test and inspection of power devices.
- B. The VFD manufacturer shall provide certification that the tests have been completed.
 - C. The VFD printed circuit boards shall be tested at 50°C for 50 hours.
 - D. The completed VFD shall be operated on an unloaded motor of suitable horsepower rating.

3.3 START-UP

- A. Perform sequence of operations test to assure proper function of logic, as described.
- B. Site Testing of Each Variable Frequency Drive
 1. Each VFD shall be functionally tested with its designated motor after installation at the site. All VFD parameters including the following shall be tested:
 - a. Input Current - (2 and 3 apply).
 - b. Input voltage - (2 and 3 apply).
 - c. Input Frequency - (3 applies).
 - d. Output Current - (2 and 3 apply).
 - e. Output Voltage - (2 and 3 apply).
 - f. Output Frequency - (3 applies).
 - g. Acceleration Rate.
 - h. Deceleration Rate.
 - i. Power factor at VFD Input.
 2. Each phase shall be tested...
 3. Test at 15 Hz, 30 Hz, 45 Hz, and 60 Hz...
 4. Miscellaneous field tests or check shall include as a minimum, the following:
 - a. Check all terminations.
 - b. Check grounding.
 - c. Bump motor to verify rotation.
 - d. Check all run lights, switches, fail lights, alarm lights, reset buttons, meters, speed potentiometers, etc.
 - e. Check to determine if protective devices and features are functioning.
 5. A typed and signed report of all tests and checks performed shall be provided.
 6. Tests shall be performed by a representative of the VFD manufacturer.

3.4 HARMONICS TESTING OF POWER SYSTEMS

- A. The harmonics analysis shall be provided by an independent firm specializing in this type of analysis.
- B. Testing
 - 1. After installation of VFDs and associated equipment, the 480V power systems shall be tested for harmonics, for line notching and for RFI/EMI in cable circuits and in air.
 - 2. Test shall be performed during normal plant operation.
 - 3. Test shall be performed with each VFD operating at 0 Hz, 30 Hz, and 60 Hz.
 - 4. Test shall be performed with all VFDs operating 0 Hz, 30 Hz, and 60 Hz.
- C. Test Data. The following test data shall be provided for each test condition. Data shall be in the form of copies of print-outs from the testing unit. Test data required is:
 - 1. VFD output voltage for each phase of each drive.
 - 2. VFD output current for each phase of each drive.
 - 3. Distribution switchboard, voltage for each phase.
 - 4. VFD input voltage for each phase (for one VFD of each size) in each location.
 - 5. VFD input current for each phase (for one VFD of each size) in each location.
 - 6. Isolation transformer input current for each phase (for one VFD for each size).
 - 7. Voltage and current for each phase at the input side of the utility transformer.
- D. Special Data
 - 1. Total harmonic distortion of each current and voltage listed above shall be calculated, listed and compared to IEEE Std. 519 requirements.
 - 2. Line notch parameters for each voltage waveform shall be calculated, listed and compared to IEEE Std. 519 requirements.
 - 3. Measurements of EMI/RFI in air and in power cables shall be measured and listed.
- E. Data submission. All test data and special data shall be submitted for review by the Engineer.

3.5 FIELD QUALITY CONTROL

- A. Make the following field tests and checks after installation:
 - 1. Check all terminations.
 - 2. Check all grounding.
 - 3. Verify motor rotation.
 - 4. Check all run lights, switches, fail lights, alarm lights, reset buttons, meters, speed potentiometers, etc.
 - 5. Check protective devices are functioning.
- B. Perform system validation tests as specified in other Sections of the Contract Documents.

3.6 FIELD PAINTING

- A. Touch-up field damaged factory finishes with paint that matches the original equipment finish.

3.7 TRAINING

- A. After the equipment has been installed, tested, adjusted and placed in satisfactory operating conditions, provide the services of a qualified representative of the manufacturer to instruct the operating and maintenance personnel of the Owner in the use and maintenance of the equipment. Schedule the content, duration, and dates of instruction in consultation with the Owner. Include the cost of instruction in the price of the equipment.

3.8 SPARE PARTS

- A. A spare parts list including original device manufacturer's part numbers for cross-referencing purposes shall be furnished. Lists containing only the VFD manufacturer's part numbers are not acceptable.

END OF SECTION