
**Contract Documents
for
Tarbell Hill Pump Station Improvements
Town of Moriah
Port Henry, New York
Contract No. 1 – General**

PREPARED BY:



Environmental Design & Research, Landscape Architecture,
Engineering & Environmental Services, D.P.C.
217 Montgomery Street, Suite 1000
Syracuse, New York 13202



It is a violation of the New York State Education Law for any person unless he is acting under the direction of a licensed professional engineer, to alter an item on this specification in any way. If an item is altered, the altering engineer shall affix to the item his seal and the notation "altered by" followed by his signature and the date of such alteration, and a specific description of the alteration.

2020

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INVITATION TO BID
TARBELL HILL PUMP STATION IMPROVEMENTS
TOWN OF MORIAH
PORT HENRY, NEW YORK

Sealed Bids for construction of Tarbell Hill Pump Station Improvements Project for the Town of Moriah in Port Henry, NY will be received by the Town in their office at 38 Park Place, No. 1, Port Henry, NY until 1 p.m. local time on February 11th, 2020 and at that place and time will be publicly opened and read aloud.

Separate sealed Bids will be received for the following:

Contract No. 1 - General

The work consists of rehabilitation of the existing Tarbell Hill Pump Station, complete with all equipment and accessories, in accordance with the Bidding Documents heretofore prepared by Environmental Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR).

The Contract Documents may be examined at the following locations:

EDR
217 Montgomery Street, 10th Floor
Syracuse, NY 13202

Town of Moriah – Town Hall
38 Park Place, No. 1
Port Henry, NY 12974

Eastern Contractors Association, Inc.
6 Airline Drive
Albany, NY 12205330

Construction Contractors Association
of the Hudson Valley, Inc.
Meadow Avenue
Newburgh, NY 12550

Copies of Bidding Documents are available electronically (via email) upon request. Paper copies of the Bidding Documents will not be provided.

All other questions shall be submitted via e-mail to Cosimo Pagano, PE at cpagano@edrdpc.com. The subject heading for all e-mails shall be:

Subject: Tarbell Hill Pump Station Improvements

No response will be given to questions received less than 7 business days before the Bid opening date.

Bidders shall review and acknowledge all Addenda on the Bid Form.

A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price and in the form of a certified check, bank money order, or a Bid Bond (on the form included in the Bidding Documents) issued by a surety meeting the requirements of paragraphs 5.01 and 5.02 of the General Conditions.

If, upon acceptance of a Bid, a Bidder fails to enter into a Contract with the Town of Moriah of Port Henry, NY, the bid security shall be forfeited to and become the property of the Town.

No Bidder may withdraw its Bid within 60 days after the date of the Bid opening. The successful Bidder must furnish a 100% Performance Bond and a 100% Payment Bond with a surety company satisfactory to the Town of Moriah and conforming to the prerequisite requirements of Article 5 of the General Conditions.

The Town of Moriah reserves the right to waive any informalities or to reject any or all Bids.

Bidders are required to certify, under penalty of perjury, that Bids have been prepared without collusion with other Bidders, subcontractors, suppliers, etc. This certification is included with the Bid Form and each Bidder must sign in the space provided.

A pre-bid conference will be held at 9 a.m. local time on January 28th, 2020 at 38 Park Place, No. 1, Port Henry, NY, representatives of Engineer are available to discuss the project. Bidders are encouraged to contact Cosimo Pagano as described above.

Town of Moriah

Dated: _____

SECTION 00100

INSTRUCTIONS TO BIDDERS

ARTICLE 1 - DEFINED TERMS

- 1.1 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:
- A. Issuing Office - The office from which the Bidding Documents are to be issued and where the bidding procedures are to be administered.
 - B. Prefixes to Referenced Paragraph Numbers are as follows:

Supplementary Conditions; "SC-____."

ARTICLE 2 - COPIES OF BIDDING DOCUMENTS

- 2.1 Complete sets of the Bidding Documents in the number and for the deposit sum, if any, stated in the advertisement or invitation to bid may be obtained from the Issuing Office. The deposit will be refunded to each document holder of record who returns a complete set of Bidding Documents in good condition within 30 days after opening of Bids.
- 2.2 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.
- 2.3 Owner and Engineer, in making copies of Bidding Documents available on the above terms, do so only for the purpose of obtaining Bids for the Work and do not authorize or confer a license for any other use.

ARTICLE 3 - QUALIFICATIONS OF BIDDERS

- 3.1 To demonstrate Bidder's qualifications to perform the Work, within five days of Owner's and/or Engineer's request, Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data as may be identified herein or requested by Owner and/or Engineer.
- 3.2 Evidence of Bidder's authority to do business in New York State.
- 3.3 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

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

- 4.1 Subsurface and Physical Conditions
- A. The Supplementary Conditions identify:

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Tarbell Hill Pump Station Improvements

00100-1

INSTRUCTIONS TO BIDDERS

1. Those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site.
 2. Those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except underground facilities).
- B. Copies of reports and drawings referenced in Paragraph 4.01.A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents. Bidder is responsible for any interpretation or conclusion Bidder draws from any data, interpretations, opinions or information contained in such reports or shown or indicated in such drawings.

4.2 Underground Facilities

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

4.3 Hazardous Environmental Condition

- A. The Supplementary Conditions identify any reports and drawings known to Owner relating to a Hazardous Environmental Condition identified at the Site.
- B. Copies of such reports and drawings referenced in Paragraph 4.03A will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents. Bidder is responsible for any interpretation or conclusion Bidder draws from any data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings.

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 Bidding Documents due to differing or unanticipated subsurface or physical conditions appear in paragraphs 4.02, 4.03, and 4.04 of the General Conditions. Provisions concerning responsibilities for the adequacy of data furnished to prospective Bidders with respect to a Hazardous Environmental Condition at the Site, if any, and possible changes in the Contract Documents due to any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work appear in paragraph 4.06 of the General Conditions.

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

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

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4.7 Paragraph 6.13.C of the General Conditions indicates that if an Owner safety program exists, it will be noted in the Supplementary Conditions.

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

- A. examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;
- B. visit the Site and become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work;
- C. become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, or performance of the Work;
- D. carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Paragraph 4.02 of the Supplementary Conditions, and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Paragraph 4.06 of the Supplementary Conditions;
- E. consider the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;
- F. agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;
- G. become aware of the general nature of the work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents;
- H. correlate the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;
- I. promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and
- J. determine that the Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work.

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

ARTICLE 5 - PRE-BID CONFERENCE

- 5.1 A pre-Bid conference will be held as indicated in the Invitation to Bid.

ARTICLE 6 - SITE AND OTHER AREAS

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

ARTICLE 7 - INTERPRETATIONS AND ADDENDA

- 7.1 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect. Questions received after the deadline stated at the Pre-Bid Meeting or as modified in subsequent Addenda will not be answered.
- 7.2 Addenda may be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

ARTICLE 8 - BID SECURITY

- 8.1 A Bid must be accompanied by Bid security made payable to Owner in an amount of 5 percent of Bidder's maximum Bid price and in the form of a certified check, bank money order, or a Bid Bond (on the form attached) issued by a surety meeting the requirements of paragraphs 5.01 and 5.02 of the General Conditions.
- 8.2 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award and the Bid Security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until the earlier of seven days after the Effective Date of the Agreement or 61 days after the Bid opening, whereupon Bid security furnished by such Bidders will be returned.

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

ARTICLE 9 - CONTRACT TIMES

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

ARTICLE 10 - LIQUIDATED DAMAGES

- 10.1 Provisions for liquidated damages, if any, are set forth in the Agreement.

ARTICLE 11 - SUBSTITUTE AND "OR-EQUAL" ITEMS

- 11.1 The Contract, if awarded, will be on the basis of materials and equipment specified or described in the Bidding Documents without consideration of possible substitute or "or-equal" items. Whenever it is specified or described in the Bidding Documents that a substitute or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

ARTICLE 12 - SUBCONTRACTORS, SUPPLIERS AND OTHERS

- 12.1 The Bid Form requires identification of Subcontractors on the form provided. In addition, if the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after Bid opening, submit to Owner a list of all such Subcontractors, Suppliers, individuals, or entities proposed for those portions of the Work for which such identification is required. Such list shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such Subcontractor, Supplier, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute, without an increase in the Bid.
- 12.2 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, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General Conditions.
- 12.3 Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

ARTICLE 13 - PREPARATION OF BID

- 13.1 The Bid Form is included with the Bidding Documents. Additional copies may be obtained from Engineer.

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- 13.2 All blanks on the Bid Form shall be completed in ink and the Bid Form signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each Bid Item listed therein. In the case of optional alternatives, the words "No Bid," "No Change," or "Not Applicable" may be entered.
- 13.3 A Bid by a corporation shall be executed in the corporate name by the president or a vice-president or other corporate officer accompanied by evidence of authority to sign. The corporate seal shall be affixed and attested by the secretary or an assistant secretary. The corporate address and state of incorporation shall be shown.
- 13.4 A Bid by a partnership shall be executed in the partnership name and signed by a partner (whose title must appear under the signature), accompanied by evidence of authority to sign. The official address of the partnership shall be shown.
- 13.5 A Bid by a limited liability company shall be executed in the name of the firm by a member and accompanied by evidence of authority to sign. The state of formation of the firm and the official address of the firm must be shown.
- 13.6 A Bid by an individual shall show the Bidder's name and official address.
- 13.7 A Bid by a joint venture shall be executed by each joint venture in the manner indicated on the Bid form. The official address of the joint venture must be shown.
- 13.8 All names shall be printed in ink below the signatures.
- 13.9 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Form.
- 13.10 Postal and e-mail addresses and telephone number for communications regarding the Bid shall be shown.
- 13.11 The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located, or Bidder shall covenant in writing to obtain such authority and qualification prior to award of the Contract and attach such covenant to the Bid. Bidder's state Contractor license number, if any, shall also be shown on the Bid Form.

ARTICLE 14 - BASIS OF BID; COMPARISON OF BIDS

- 14.1 Lump Sum
 - A. Bidders shall submit a Bid on a lump sum basis as set forth in the Bid Form.
- 14.2 Allowances
 - A. For cash allowances the Bid price shall include such amounts as the Bidder deems proper for Contractor's overhead, costs, profit, and other expenses on account of cash allowances, if any, named in the Contract Documents, in accordance with Paragraph 11.02.B of the General Conditions.
- 14.3 Completion Time Comparisons

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- A. Bid prices will be compared after adjusting for differences in the time designated by Bidders for Substantial Completion. The adjusting amount will be determined at the rate set forth in the Contract Documents for liquidated damages for failing to achieve Substantial Completion for each day before or after the desired date appearing in Article 9 above.

ARTICLE 15 - SUBMITTAL OF BID

- 15.1 With each copy of the Bidding Documents, a Bidder is furnished one copy of the Bid Form, and, if required, the Bid Bond Form. The copy of the Bid Form is to be completed and submitted with the Bid security and all required attachments to the Bid stated in the Bid Form.
- 15.2 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the advertisement or invitation to bid and shall be enclosed in a plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate envelope plainly marked on the outside with the notation "BID ENCLOSED."

ARTICLE 16 - MODIFICATION AND WITHDRAWAL OF BID

- 16.1 A Bid may be modified or withdrawn by an appropriate document duly executed in the same manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.
- 16.2 If, within 24 hours after Bids are opened, any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 - OPENING OF BIDS

- 17.1 Bids will be opened at the time and place indicated in the Advertisement or Invitation to Bid and, unless obviously non-responsive, read aloud publicly. An abstract of the amounts of the base Bids and major alternates, if any, will be made available to Bidders after the opening of Bids.

ARTICLE 18 - BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 19 - EVALUATION OF BIDS AND AWARD OF CONTRACT

- 19.1 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to be non-responsible. Owner may also 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. 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.

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- 19.2 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.
- 19.3 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.
- 19.4 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions.
- 19.5 Owner may conduct such investigations as Owner deems necessary to establish the responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, individuals, or entities to perform the Work in accordance with the Contract Documents.
- 19.6 If the Contract is to be awarded, Owner will award the Contract to the Bidder who is in the best interests of the Project.

ARTICLE 20 - CONTRACT SECURITY AND INSURANCE

- 20.1 Article 5 of the General Conditions, as may be modified by the Supplementary Conditions, sets forth Owner's requirements as to performance and payment bonds and insurance. When the Successful Bidder delivers the executed Agreement to Owner, it shall be accompanied by such bonds.

ARTICLE 21 - SIGNING OF AGREEMENT

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

ARTICLE 22 - COPIES OF CONTRACT DOCUMENTS

- 22.1 Owner will furnish copies of Contract Documents to Contractor as follows:
- One set of full-size drawings.
 - One set of bound Contract Documents.

ARTICLE 23 - SALES AND USE TAXES

- 23.1 Owner is exempt from state sales and use taxes on materials and equipment to be incorporated in the Work. Said taxes shall not be included in the Bid. Refer to Paragraph 6.10 of the Supplementary Conditions for additional information.

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ARTICLE 24 - RETAINAGE

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

ARTICLE 25 - STATE WAGE RATES

- 25.1 Contractor must comply with prevailing wage rates as set forth by the New York State Department of Labor (NYSDOL) and outlined in the General Contract Conditions.
- 25.2 Contractor must comply with prevailing wage rates as set forth by the NYSDOL and outlined in the General Conditions. Wage rates for this project are available on the NYSDOL website. To retrieve the Wage Rate Schedule, follow the steps outlined below:
1. Go to www.labor.state.ny.us.
 2. Click the link Prevailing Wage in the quicklinks at the bottom of the page.
 3. To download the schedule, click the link Original Wage Schedule in the upper right of the page.

END OF SECTION

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BID FORM

CONTRACTOR'S BID
FOR
CONSTRUCTION OF CONTRACT NO. 1 - GENERAL
TARBELL HILL PUMP STATION IMPROVEMENTS
TOWN OF MORIAH
PORT HENRY, NEW YORK

ARTICLE 1 - BID RECIPIENT

1.1 THIS BID IS SUBMITTED TO:

Town of Moriah
38 Park Place, No. 1
Port Henry, NY 12974

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

ARTICLE 2 - BIDDER'S ACKNOWLEDGEMENTS

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

ARTICLE 3 - BIDDER'S REPRESENTATIONS

3.1 In submitting this Bid, Bidder represents that:

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

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____

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

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

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in SC-4.02 as containing

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BID FORM

reliable “technical data”, and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in SC-4.06 as containing reliable “technical data.”

- E. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder’s safety precautions and programs.
- F. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.
- G. Bidder is aware of the general nature of work to be performed by others at the Site that relates to the Work as indicated in the Bidding Documents.
- H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.
- I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

ARTICLE 4 - BIDDER’S CERTIFICATION

4.1 Bidder certifies that:

- A. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any collusive agreement or rules of any group, association, organization, or corporation;
- B. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;
- C. Bidder has not solicited or induced any individual or entity to refrain from bidding; and
- D. Bidder has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for the Contract. For the purposes of this Article:
 - 1. “corrupt practice” means the offering, giving, receiving, or soliciting of anything of value likely to influence the action of a public official in the bidding process;
 - 2. “fraudulent practice” means an intentional misrepresentation of facts made (a) to influence the bidding process to the detriment of Owner, (b) to establish bid prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;

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BID FORM

- 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of Owner, a purpose of which is to establish bid prices at artificial, non-competitive levels; and
- 4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

ARTICLE 5 - BASIS OF BID

- 5.1 Bidder will perform the Work in accordance with the Contract Documents for the prices shown in the Bid Schedule that follow.
- 5.2 Bidder acknowledges that Bidder's price(s) constitute Bidder's sole compensation for performing all Work required by the Contract Documents, and if a particular part of the Work is not listed specifically in the Bid Item Descriptions, Bidder has included that part of the Work in the Bid Item Description which it most logically belongs.

CONTRACT NO. 1 - GENERAL

A. Schedule A: Base Bid - General

- 1. Base Bid items include all Work in the Contract Documents except items specifically identified as Allowances.

Bid Item No.	Estimated Quantity	Description	Total Price
A-1	Lump Sum	Mobilization / Demobilization (Cannot exceed 5% of total Contract No. 1)	\$
A-2	Lump Sum	General Construction	\$
A-3	Lump Sum	Record Documents – General	\$
SUBTOTAL SCHEDULE A (Sum of Bid Items A-1 thru A-3)			\$

A. Schedule B: Additive Alternates - General

- 1. Additive Alternate Bid items include all Work as outlined in the Contract Drawings and Specifications.

Bid Item No.	Estimated Quantity	Description	Total Price
B-1	Lump Sum	SCADA System	\$
B-2	Lump Sum	SCADA System Integration	\$
B-3	Lump Sum	Valve Vault Resurfacing	\$
SUBTOTAL SCHEDULE B (Sum of Bid Items B-1 thru B-3)			\$

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BID FORM

B. Schedule C: Total Bid Price - General

1. Determination of the apparent low Bidder shall be based on Schedule A: Base Bid – General Price determined as follows.
2. All mathematical errors will be corrected. In case of a discrepancy between unit prices bid and extended totals, unit prices will govern. In case of discrepancy between the correct sum of individual bid items and the (incorrectly) calculated sum, the correct sum of individual bid items will govern.

Schedule	Total Price
Schedule A: Base Bid - General	\$
Schedule B: Additive Alternates - General	\$
TOTAL BID PRICE - CONTRACT NO. 1	\$

BASE BID - GENERAL PRICE, CONTRACT NO. 1 (in words)

ADDITIVE ALTERNATE - GENERAL PRICE, CONTRACT NO. 1 (in words)

ARTICLE 6 - Not used.

ARTICLE 7 - TIME OF COMPLETION

- 7.1 Bidder agrees that the Work will be substantially completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.
- 7.2 Bidder accepts the provisions of the Agreement as to liquidated damages.

ARTICLE 8 - ATTACHMENTS TO THIS BID

- 8.1 The following documents are submitted with and made a condition of this Bid:
 - A. Required Bid Security in the form of a Bid Bond.
 - B. Statement of Surety's Intent.
 - C. Bidder's Qualification Statement.

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BID FORM

- D. List of Proposed Subcontractors.
- E. Contractor's License No.: _____ or Evidence of Bidder's Ability to Obtain a State Contractor's License.
- F. Non-Collusive Bidding Certification.
- G. Standard Clauses for New York State Department of Environmental Conservation Contracts.
- H. EEO Policy Statement.
- I. Iran Divestment Act Certification.
- J. New York State Vendor Responsibility Questionnaire.
- K. New York State Sexual Harassment Policy and Plans.
- L. New York State Department of Environmental Conservation M/WBE-EEO Utilization Plan

ARTICLE 9 - DEFINED TERMS

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

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BID FORM

ARTICLE 10 - BID SUBMITTAL

This Bid is submitted by:

If Bidder is:

An Individual

Name (typed or printed): _____

By _____
(Individual's Name)

Doing business as: _____

A Partnership

Partnership Name: _____ (SEAL)

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

Name (typed or printed): _____

A Corporation

Corporation Name: _____ (SEAL)

State of Incorporation: _____

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

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

Name (typed or printed): _____

Title: _____

Attest: _____ (CORPORATE SEAL)
(Signature of Corporate Secretary)

Date of Qualification to do business in State where project is located is: _____

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BID FORM

A Joint Venture

Name of Joint Venture: _____

First Joint Venturer Name: _____(SEAL)

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

Name (typed or printed): _____

Title: _____

Second Joint Venturer Name: _____(SEAL)

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

Name (typed or printed): _____

Title: _____

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

Bidder's Business Address _____

Phone No. _____ Fax No. _____

Email _____

SUBMITTED on _____, 20_____

State Contractor License No. _____ if applicable.

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19016

Tarbell Hill Pump Station Improvements

00410-7

BID FORM

BID BOND

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

BIDDER *(Name and Address)*:

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

OWNER *(Name and Address)*:

BID

Bid Due Date:

Description *(Project Name and Include Location)*:

BOND

Bond Number:

Date *(Not earlier than Bid due date)*:

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

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

BIDDER

SURETY

Bidder's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

Note: Above addresses are to be used for giving any required notice. Provide execution by any additional parties, such as joint venturers, if necessary.

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

BID SECURITY

(ATTACH BID SECURITY TO THIS PAGE IF CERTIFIED CHECK.)

STATEMENT OF SURETY'S INTENT

(To be completed if Bid Security is to be
Certified or Bank Cashier's Check)

To: _____
(Owner)

We have reviewed the Bid of _____
(Contractor)

of _____
(Address)

for _____
(Project)

Bids for which will be received on _____
(Bid Opening Date)

and wish to advise that should this Bid of the Contractor be accepted and the Contract awarded to him, it is our present intention to become surety on the performance bond and labor and material bond required by the Contract.

Any arrangement for the bonds required by the Contract is a matter between the Contractor and ourselves and we assume no liability to you or third parties if for any reason we do not execute the requisite bonds.

We are duly authorized to do business in the State of _____.

Attest:

Surety's Authorized Signature(s)

Attach Power of Attorney

(Corporate seal if any. If no seal, write "No Seal" across this place and sign.)

(This form must be completed prior to the submission of the bid.)

BIDDER'S QUALIFICATION STATEMENT

To induce the making of this Contract, the Bidder represents to the Owner the following, as evidence of Bidder's Qualifications to perform the work herein specified:

1. How many years has your organization been in business under the name in which you propose to execute this Contract?
 ___ Years

2. What projects of character similar to that proposed has your present organization completed? Give the information indicated by the following tabulations:

NAME, ADDRESS, AND PHONE NO. OF OWNER FOR WHOM WORK WAS DONE	DESCRIPTION OF WORK	APPROXIMATE AMOUNT OF CONTRACT	APPROXIMATE DATE WORK WAS DONE

3. Has your present organization ever failed to complete any work awarded to it? If so, state when, where and why.

4. Do you have, or can you procure the necessary personnel, equipment, facilities and financial resources to immediately undertake and satisfactorily complete the work contemplated in this Contract?

5. (Other requirements as pertinent)

LIST OF PROPOSED SUBCONTRACTORS

This document is an Attachment to the Bid Form and is a legally binding part thereof;

Each Bidder shall complete this "List of Proposed Subcontractors" in its entirety. Failure to do so shall render the Bid Form non-responsive and be grounds for its rejection by Owner. If Bidder intends to self perform the type of work indicates, write "Self Perform" under Subcontractor Name.

Type of Work	Subcontractor Name & Address	Certified Disadvantage Business Enterprise? or applicable terminology	Subcontract Amount	State Contractor License Number
Mechanical				
Electrical				
Dewatering				
Civil/Site				
Masonry				
Painting				
Roofing				
HVAC				
Plumbing				
Concrete				

Total Subcontracted Amount: \$ _____

Percent of Total Contract: _____%

CONTRACTOR'S LICENSE NO.

OR

**EVIDENCE OF BIDDER'S ABILITY TO
OBTAIN STATE CONTRACTOR'S LICENSE**

NON-COLLUSIVE BIDDING CERTIFICATION

Section 103-d of the General Municipal Law requires the following statement subscribed by the bidder as true under the penalties of perjury: Non-Collusive Bidding Certification.

(a) By submission of this bid, each bidder and each person signing on behalf of any bidder certifies, and in a case of a joint bid each party thereto certifies as to its own organization, under penalty of perjury, that to the best of his knowledge and belief:

(1) The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor.

(2) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and

(3) No attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

Section 103-d of the General Municipal Law, as amended by Chapter 675 L 1966, in addition to requiring the above certification, provides as follows:

(b) A bid shall not be considered for award nor shall any award be made where (1), (2) and (3) above have not been complied with; provided however, that if in any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefore. Where (1), (2) and (3) above have not been complied with, the bid shall not be considered for award nor shall any award be made unless the head of the purchasing unit of the political subdivision, public department, agency or official thereof to which the bid is made, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

The fact that a bidder (a) has published price lists, rates or tariffs covering items being procured, (b) has informed prospective customers of proposed or pending publication of new or revised price lists for such items or has sold the same items to other customers at the same prices being bid, does not constitute, without more, a disclosure within the meaning of subparagraph one (a).

Any bid hereafter made to any political subdivision of the state or any public department, agency or official thereof by a corporate bidder for work or services performed or to be performed or goods sold or to be sold, where competitive bidding is required by statute, rule, regulation, or local law, and where such bid contains the certification referred to in subdivision one of this section, shall be deemed to have been authorized by the board of directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bids and the inclusion therein of the certificate as to non-collusion as the act and deed of the corporation.

Dated: _____, 20____

Signed: _____ Name
_____ Title
_____ Company
_____ Address

Corporate Seal

**ATTACHMENT A-1
PROGRAM SPECIFIC TERMS AND CONDITIONS**

**Standard Clauses for All New York State
Department of Environmental Conservation Contracts**

The parties to the attached contract, license, lease, grant, amendment or other agreement of any kind (hereinafter "the contract" or "this contract") agree to be bound by the following clauses which are hereby made a part of the contract. The word "Contractor" herein refers to any party to the contract, other than the New York State Department of Environmental Conservation (hereinafter "Department").

A) AGENCY SPECIFIC TERMS AND CONDITIONS

I. Postponement, suspension, abandonment or termination by the Department: Within 15 days of receipt of notice, the Contractor shall deliver to the Department all data, reports, plans, or other documentation related to the performance of this contract, including but not limited to source codes and specifications, guarantees, warranties, as-built plans and shop drawings. In any of these events, the Department shall make settlement with the Contractor upon an equitable basis as determined by the Department which shall fix the value of the work which was performed by the Contractor prior to the postponement, suspension, abandonment or termination of this contract. This clause shall not apply to this contract if the contract contains other provisions applicable to postponement, suspension or termination of the contract.

II. Conflict of Interest

(a) Organizational Conflict of Interest - To the best of the Contractor's knowledge and belief, the Contractor warrants that there are no relevant facts or circumstances which could give rise to an organizational conflict of interest, as herein defined, or that the Contractor has disclosed all such relevant information to the Department.

(1) An organizational conflict of interest exists when the nature of the work to be performed under this contract may, without some restriction on future activities, impair or appear to impair the Contractor's objectivity in performing the work for the Department.

(2) The Contractor agrees that if an actual, or potential organizational conflict of interest is discovered at any time after award, whether before or during performance, the Contractor will immediately make a full disclosure in writing to the Department. This disclosure shall include a description of actions which the Contractor has taken or proposes to take, after consultation with the Department, to avoid, mitigate, or minimize the actual or potential conflict.

(3) To the extent that the work under this contract requires access to personal, proprietary or confidential business or financial data of persons or other companies, and as long as such data remains proprietary or confidential, the Contractor shall protect such data from unauthorized use and disclosure and agrees not to use it to compete with such companies.

(b) Personal Conflict of Interest - The following provisions with regard to management or professional level employee personnel performing under this contract shall apply until the earlier of the termination date of the affected employee(s) or the duration of the contract.

(1) A personal conflict of interest is defined as a relationship of an employee, subcontractor employee, or consultant with an entity that may impair or appear to impair the objectivity of the employee, subcontractor employee, or consultant in performing the contract work. The Contractor agrees to notify the Department immediately of any actual or potential personal conflict of interest with regard to any such person working on or having access to information regarding this contract, as soon as Contractor becomes aware of such conflict. The Department will notify the Contractor of the appropriate action to be taken.

(2) The Contractor agrees to advise all management or professional level employees involved in the work of this contract, that they must report any personal conflicts of interest to the Contractor. The Contractor must then advise the Department which will advise the Contractor of the appropriate action to be taken.

(3) Unless waived by the Department, the Contractor shall certify annually that, to the best of the Contractor's knowledge and belief, all actual, apparent or potential conflicts of interest, both personal and organizational, as defined herein, have been reported to the Department. Such certification must be signed by a senior executive of the Contractor and submitted in accordance with instructions provided by the Department. Along with the annual certification, the Contractor shall also submit an update of any changes in any conflict of interest plan submitted with its proposal for this contract. The initial certification shall cover the one-year period from the date of contract award, and all subsequent certifications shall cover successive annual periods thereafter. The certification is to be submitted no later than 45 days after the close of the previous certification period covered.

(4) In performing this contract, the Contractor recognizes that its employees may have access to data, either provided by the Department or first generated during contract performance, of a sensitive nature which should not be released without Department approval. If this situation occurs, the Contractor agrees to obtain confidentiality agreements from all affected employees working on requirements under this contract including subcontractors and consultants. Such agreements shall contain provisions which stipulate that each employee agrees not to disclose, either in whole or in part, to any entity external to the Department, Department of Health or the New York Department of Law, any information or data provided by the Department or first generated by the Contractor under this contract, any site-specific cost information, or any enforcement strategy without first obtaining the written permission of the Department. If a Contractor, through an employee or otherwise, is subpoenaed to testify or produce documents, which could result in such disclosure, the Contractor must provide immediate advance notification to the Department so that the Department can authorize such disclosure or have the opportunity to take action to prevent such disclosure. Such agreements shall be effective for the life of the contract and for a period of five (5) years after completion of the contract.

(c) **Remedies** - The Department may terminate this contract in whole or in part, if it deems such termination necessary to avoid an organizational or personal conflict of interest, or an unauthorized disclosure of information. If the Contractor fails to make required disclosures or misrepresents relevant information to the Department, the Department may terminate the contract, or pursue such other remedies as may be permitted by the terms of Clause I of this Attachment or other applicable provisions of this contract regarding termination.

(d) The Contractor will be ineligible to make a proposal or bid on a contract for which the Contractor has developed the statement of work or the solicitation package

(e) The Contractor agrees to insert in each subcontract or consultant agreement placed hereunder (except for subcontracts or consultant agreements for well drilling, fence erecting, plumbing, utility hookups, security guard services, or electrical services) provisions which shall conform substantially to the language of this clause, including this paragraph (e), unless otherwise authorized by the Department.

III. Dispute Resolution

The parties agree to the following steps, or as many as are necessary to resolve disputes between the Department and the Contractor.

(a) The Contractor specifically agrees to submit, in the first instance, any dispute relating to this contract to the designated individual, who shall render a written decision and furnish a copy thereof to the Contractor.

(1) The Contractor must request such decision in writing no more than fifteen days after it knew or should have known of the facts which are the basis of the dispute.

(2) The decision of the designated individual shall be the final DEC determination, unless the Contractor files a written appeal of that decision with the designated appeal individual ("DAI") within twenty days of receipt of that decision.

(b) Upon receipt of the written appeal, the DAI, will review the record and decision. Following divisional procedures in effect at that time, the DAI will take one of the following actions, with written notice to the Contractor.

(1) Remand the matter to the program staff for further negotiation or information if it is determined that the matter is not ripe for review; or

(2) Determine that there is no need for further action, and that the determination of the designated individual is confirmed; or

(3) Make a determination on the record as it exists.

- (c) The decision of the DAI shall be the final DEC decision unless the Contractor files a written appeal of that decision with the Chair of the Contract Review Committee ("CRC") within twenty days of receipt of that decision.

The designated individual to hear disputes is:

Joe DiMura, Director, Bureau of Water Compliance
New York State Department of Environmental Conservation
625 Broadway, 4th Floor, Albany, New York 12233-3506
(518) 402-8117

The designated appeal individual to review decisions is:

Alan Fuchs, Director, Bureau of Flood Protection and Dam Safety
New York State Department of Environmental Conservation
625 Broadway, 4th Floor, Albany, New York 12233-3504
(518) 402-8185

The Chair of the Contract Review Committee is:

Department of Environmental Conservation
Nancy W. Lussier, Chair
Contract Review Committee
625 Broadway
Albany, NY 12233-5010
Telephone: (518) 402-9228

- (d) Upon receipt of the written appeal, the Chair of the CRC, in consultation with the members of the CRC and the Office of General Counsel, will take one of the following actions, or a combination thereof, with written notice to the Contractor.
- (1) Remand the matter to program staff for additional fact finding, negotiation, or other appropriate action; or
 - (2) Adopt the decision of the DAI; or
 - (3) Consider the matter for review by the CRC in accordance with its procedures.
- (e) Following a decision to proceed pursuant to (d) 3, above, the Chair of the CRC shall convene a proceeding in accordance with the CRC's established contract dispute resolution guidelines. The proceeding will provide the Contractor with an opportunity to be heard.
- (f) Following a decision pursuant to (d) 2 or (d) 3, the CRC shall make a written recommendation to the Deputy Commissioner for Administration who shall render the final DEC determination.
- (g) At any time during the dispute resolution process, and upon mutual agreement of the parties, the Office of Hearings and Mediation Services (OHMS) may be requested to provide mediation services or other appropriate means to assist in resolving the dispute. Any findings or recommendations made by the OHMS will not be binding on either party.
- (h) Final DEC determinations shall be subject to review only pursuant to Article 78 of the Civil Practice Law and Rules.
- (i) Pending final determination of a dispute hereunder, the Contractor shall proceed diligently with the performance of the Contract in accordance with the decision of the designated individual. Nothing in this Contract shall be construed as making final the decision of any administrative officer upon a question of law.
- (j)(1) Notwithstanding the foregoing, at the option of the Contractor, the following shall be subject to review by the CRC: Disputes arising under Article 15-A of the Executive Law (Minority and Women Owned Business participation), the Department's determination with respect to the adequacy of the Contractor's Utilization Plan, or the Contractor's showing of good faith efforts to comply therewith. A request for a review before the CRC should be made, in writing,

within twenty days of receipt of the Department's determination.

- (2) The CRC will promptly convene a review in accordance with Article 15-A of the Executive Law and the regulations promulgated thereunder.

IV. Tax Exemption

Pursuant to Tax Law Section 1116, the State is exempt from sales and use taxes. A standard state voucher is sufficient evidence thereof. For federal excise taxes, New York's registration Number 14740026K covers tax-free transactions under the Internal Revenue Code.

V. Litigation Support

In the event the Department becomes involved in litigation related to the subject matter of this contract, the Contractor agrees to provide background support and other litigation support, including but not limited to depositions, appearances, and testimony. Any compensation paid to the Contractor under this paragraph will be negotiated and based on the rates established in the contract, or as may otherwise be provided in the contract. No compensation for such support will be paid if the litigation is the result of the Contractor's misconduct, negligence or omissions.

VI. Inventions or Discoveries

The Scope of work of this agreement shall not include any inventions. If however, an invention results from this project it shall be owned as follows:

Any invention or discovery first made or conceived and reduced to practice in the performance of this Contract solely by the Contractor shall remain with the Contractor; provided that the Contractor shall grant to the Department and the State a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for on behalf of the Department and the State the subject copyright throughout the world, where the Contractor is able to do so.

Any invention or discovery made or conceived and reduced to practice in the performance of this Contract solely by Department or State shall remain with the State; provided that the Department or State shall grant to the Contractor a nonexclusive, nontransferable, irrevocable, paid-up license to use for non-commercial research, educational, and public service purposes.

Any invention or discovery made or conceived and reduced to practice in the performance of this Contract jointly by Contractor and Department or State in the performance of this work shall be jointly held by the Contractor and Department or State.

VII. Intellectual Property and Copyright Materials

- (a) Title to, and the right to determine the disposition of any copyrights, or copyrightable material, first produced or created solely by Contractor in the performance of this work shall remain with the Contractor; provided that the Contractor shall grant to the Department and the State a nonexclusive, nontransferable, irrevocable, paid-up license to practice or have practiced for on behalf of the Department and the State the subject copyright throughout the world, where the Contractor is able to do so.

Title to, and the right to determine the disposition of any copyrights, or copyrightable material, first produced or created solely by Department or State in the performance of this work shall remain with the State; provided that the Department or State shall grant to the Contractor a nonexclusive, nontransferable, irrevocable, paid-up license to use for non-commercial research, educational, and public service purposes.

Title to, and the right to determine the disposition of any copyrights, or copyrightable material, first produced or created jointly by Contractor and Department or State in the performance of this work shall be jointly held by the Contractor and Department or State.

VIII. Patent and Copyright Protection

If any patented or copyrighted material is involved in or results from the performance of this Contract, this Article shall apply.

- (a) The Contractor shall, at its expense, defend any suit instituted against the Department and indemnify the Department against any award of damages and costs made against the Department by a final judgment of a court of last resort based on the claim that any of the products, services or consumable supplies furnished by the Contractor under this Contract

infringes any patent, copyright or other proprietary right; provided the Department gives the Contractor:

- (1) prompt written notice of any action, claim or threat of infringement suit, or other suit, and
- (2) the opportunity to take over, settle or defend such action at the Contractor's sole expense, and
- (3) all available information, assistance and authority necessary to the action, at the Contractor's sole expense.

The Contractor shall control the defense of any such suit, including appeals, and all negotiations to effect settlement, but shall keep the Department fully informed concerning the progress of the litigation.

- (b) If the use of any item(s) or parts thereof is held to infringe a patent or copyright and its use is enjoined, or Contractor believes it will be enjoined, the Contractor shall have the right, at its election and expense to take action in the following order of precedence:
 - (1) procure for the Department the right to continue using the same item or parts thereof;
 - (2) modify the same so that it becomes non-infringing and of at least the same quality and performance;
 - (3) replace the item(s) or parts thereof with noninfringing items of at least the same quality and performance;
 - (4) if none of the above remedies are available, discontinue its use and eliminate any future charges or royalties pertaining thereto. The Contractor will buy back the infringing product(s) at the State's book value, or in the event of a lease, the parties shall terminate the lease. If discontinuation or elimination results in the Contractor not being able to perform the Contract, the Contract shall be terminated.
- (c) In the event that an action at law or in equity is commenced against the Department arising out of a claim that the Department's use of any item or material pursuant to or resulting from this Contract infringes any patent, copyright or proprietary right, and such action is forwarded by the Department to the Contractor for defense and indemnification pursuant to this Article, the Department shall copy all pleadings and documents forwarded to the Contractor together with the forwarding correspondence and a copy of this Contract to the Office of the Attorney General of the State of New York. If upon receipt of such request for defense, or at any time thereafter, the Contractor is of the opinion that the allegations in such action, in whole or in part, are not covered by the indemnification set forth in this Article, the Contractor shall immediately notify the Department and the Office of the Attorney General of the State of New York in writing and shall specify to what extent the Contractor believes it is and is not obligated to defend and indemnify under the terms and conditions of this Contract. The Contractor shall in such event protect the interests of the Department and State of New York and secure a continuance to permit the State of New York to appear and defend its interests in cooperation with Contractor as is appropriate, including any jurisdictional defenses which the Department and State shall have.
- (d) The Contractor shall, however, have no liability to the Department under this Article if any infringement is based upon or arises out of:
 - (1) compliance with designs, plans, or specifications furnished by or on behalf of the Department as to the items;
 - (2) alterations of the items by the Department;
 - (3) failure of the Department to use updated items provided by the Contractor for avoiding infringement;
 - (4) use of items in combination with apparatus or devices not delivered by the Contractor;
 - (5) use of items in a manner for which the same were neither designed nor contemplated; or
 - (6) a patent or copyright in which the Department or any affiliate or subsidiary of the Department has any direct or indirect interest by license or otherwise.
- (e) The foregoing states the Contractor's entire liability for, or resulting from, patent or copyright infringement or claim thereof.

IX. Freedom of Information Requests

In response to a Freedom of Information Law (FOIL) request received by the Department, the Contractor agrees to provide to the Department records generated by the Contractor as a result of this contract's scope of work that are responsive to the FOIL request. The contractor may request that the Department except from disclosure records on the basis that they contain trade secrets or confidential commercial information in accordance with FOIL (Public Officers Law Section 87 and 6 NYCRR Part 616).

X. Article 15-Requirements

PARTICIPATION BY MINORITY GROUP MEMBERS AND WOMEN WITH RESPECT TO STATE CONTRACTS: REQUIREMENTS AND PROCEDURES

(a) General Provisions

- (1) The Department is required to implement the provisions of New York State Executive Law Article 15-A and 5 NYCRR Parts 142-144 ("MWBE Regulations") for all State contracts as defined therein, with a value (1) in excess of \$25,000 for labor, services, equipment, materials, or any combination of the foregoing or (2) in excess of \$100,000 for real property renovations and construction.
- (2) The Contractor to the subject contract (the "Contractor" and the "Contract," respectively) agrees, in addition to any other nondiscrimination provision of the Contract and at no additional cost to the New York State Department (the "Department"), to fully comply and cooperate with the Department in the implementation of New York State Executive Law Article 15-A. These requirements include equal employment opportunities for minority group members and women ("EEO") and contracting opportunities for certified minority and women-owned business enterprises ("MWBEs"). Contractor's demonstration of "good faith efforts" pursuant to 5 NYCRR §142.8 shall be a part of these requirements. These provisions shall be deemed supplementary to, and not in lieu of, the nondiscrimination provisions required by New York State Executive Law Article 15 (the "Human Rights Law") or other applicable federal, state or local laws.
- (3) Failure to comply with all of the requirements herein may result in a finding of non-responsiveness, non-responsibility and/or a breach of contract, leading to the withholding of funds or such other actions, liquidated damages pursuant to Section VII of this Article or enforcement proceedings as allowed by the Contract.

(b) Contract Goals

- (1) For purposes of this procurement, the Department hereby establishes an overall goal of **20%** for Minority and Women-Owned Business Enterprises ("MWBE") participation, (based on the current availability of qualified MBEs and WBEs).
- (2) For purposes of providing meaningful participation by MWBEs on the Contract and achieving the Contract Goals established in Section II-A hereof, Contractor should reference the directory of New York State Certified MWBEs found at the following internet address; <https://ny.newnycontracts.com>

Additionally, the Contractor is encouraged to contact the Division of Minority and Woman Business Development ((518) 292-5250; (212) 803-2414; or (716) 846-8200) to discuss additional methods of maximizing participation by MWBEs on the Contract.

- (3) Where MWBE goals have been established herein, pursuant to 5 NYCRR §142.8, Contractor must document "good faith efforts" to provide meaningful participation by MWBEs as subcontractors or suppliers in the performance of the Contract. In accordance with Section 316-a of Article 15-A and 5 NYCRR §142.13, the Contractor acknowledges that if Contractor is found to have willfully and intentionally failed to comply with the MWBE participation goals set forth in the Contract, such a finding constitutes a breach of contract and the Contractor shall be liable to the Department for liquidated or other appropriate damages, as set forth herein.

(c) Equal Employment Opportunity (EEO)

- (1) Contractor agrees to be bound by the provisions of Article 15-A and the MWBE Regulations promulgated by the Division of Minority and Women's Business Development of the State of Economic Development (the "Division"). If any of these terms or provisions conflict with applicable law or regulations, such laws and regulations shall supersede these requirements. Contractor shall comply with the following provisions of Article 15-A:

- (i) Contractor and Subcontractors shall undertake or continue existing EEO programs to ensure that minority group members and women are afforded equal employment opportunities without discrimination because of race, creed, color, national origin, sex, age, disability or marital status. For these purposes, EEO shall apply in the areas of recruitment, employment, job assignment, promotion, upgrading, demotion, transfer, layoff, or termination and rates of pay or other forms of compensation.
- (ii) The Contractor shall submit an EEO policy statement to the Department within seventy two (72) hours after the date of the notice by Department to award the Contract to the Contractor.
- (iii) If Contractor or Subcontractor does not have an existing EEO policy statement, the Department may provide the Contractor or Subcontractor a model statement. This statement can be found at the link provided in Section 8.
- (iv) The Contractor's EEO policy statement shall include the following language:
 - a. The Contractor will not discriminate against any employee or applicant for employment because of race, creed, color, national origin, sex, age, disability or marital status, will undertake or continue existing EEO programs to ensure that minority group members and women are afforded equal employment opportunities without discrimination, and shall make and document its conscientious and active efforts to employ and utilize minority group members and women in its work force.
 - b. The Contractor shall state in all solicitations or advertisements for employees that, in the performance of the contract, all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, color, national origin, sex, age, disability or marital status.
 - c. The Contractor shall request each employer Department, labor union, or authorized representative of workers with which it has a collective bargaining or other agreement or understanding, to furnish a written statement that such employer Department, labor union, or representative will not discriminate on the basis of race, creed, color, national origin, sex age, disability or marital status and that such union or representative will affirmatively cooperate in the implementation of the Contractor's obligations herein.
 - d. The Contractor will include the provisions of Subdivisions (a) through (c) of this Subsection 4 and Paragraph "E" of this Section III, which provides for relevant provisions of the Human Rights Law, in every subcontract in such a manner that the requirements of the subdivisions will be binding upon each subcontractor as to work in connection with the Contract.
 - e. **EEO Contract Goals** for the purposes of this procurement, the Department hereby establishes a goal of 10% Minority Labor Force Participation, 10% Female Labor Force Participation.
- (v) **Staffing Plan Form**

To ensure compliance with this Section, the Contractor shall submit a staffing plan to document the composition of the proposed workforce to be utilized in the performance of the Contract by the specified categories listed, including ethnic background, gender, and Federal occupational categories. Contractors shall complete the Staffing plan as part of the MWBE Utilization Plan and submit at the time of award of the contract.
- (vi) **Workforce Employment Utilization Report Form ("Workforce Report")**
 - (i) Once a contract has been awarded and during the term of Contract, Contractor is responsible for updating and providing notice to the Department of any changes to the previously submitted Staffing Plan. This information is to be submitted on a quarterly basis during the term of the Contract to report the actual workforce utilized in the performance of the Contract by the specified categories listed including ethnic background, gender, and Federal occupational categories. The Workforce Report must be submitted to report this information.
 - (ii) Separate forms shall be completed by Contractor and any subcontractor performing work on the Contract.
 - (iii) In limited instances, Contractor may not be able to separate out the workforce utilized in the performance of the Contract from Contractor's and/or subcontractor's total workforce. When a separation can be made, Contractor shall submit the Workforce Report and indicate that the information provided related to the actual workforce utilized on

the Contract. When the workforce to be utilized on the contract cannot be separated out from Contractor's and/or subcontractor's total workforce, Contractor shall submit the Workforce Report and indicate that the information provided is Contractor's total workforce during the subject time frame, not limited to work specifically under the Contract.

- (4) Contractor shall comply with the provisions of the Human Rights Law, all other State and Federal statutory and constitutional non-discrimination provisions. Contractor and subcontractors shall not discriminate against any employee or applicant for employment because of race, creed (religion), color, sex, national origin, sexual orientation, military status, age, disability, predisposing genetic characteristic, marital status or domestic violence victim status, and shall also follow the requirements of the Human Rights Law with regard to non-discrimination on the basis of prior criminal conviction and prior arrest.

(d) MWBE Utilization Plan

- (1) The Contractor represents and warrants that Contractor has submitted an MWBE Utilization Plan either prior to, or at the time of, the execution of the contract.
- (2) Contractor agrees to use such MWBE Utilization Plan for the performance of MWBEs on the Contract pursuant to the prescribed MWBE goals, currently at a 30% combined goal, and as set forth in Section X-B-1 of this Attachment.
- (3) Contractor further agrees that a failure to submit and/or use such MWBE Utilization Plan shall constitute a material breach of the terms of the Contract. Upon the occurrence of such a material breach, Department shall be entitled to any remedy provided herein, including but not limited to, a finding of Contractor non-responsiveness.

(e) Waivers

- (1) For Waiver Requests Contractor should use Waiver Request Form.
- (2) If the Contractor, after making good faith efforts, is unable to comply with MWBE goals, the Contractor may submit a Request for Waiver form documenting good faith efforts by the Contractor to meet such goals. If the documentation included with the waiver request is complete, the Department shall evaluate the request and issue a written notice of acceptance or denial within twenty (20) days of receipt.
- (3) If the Department, upon review of the MWBE Utilization Plan and updated Quarterly MWBE Contractor Compliance Reports determines that Contractor is failing or refusing to comply with the Contract goals and no waiver has been issued in regards to such non-compliance, the Department may issue a notice of deficiency to the Contractor. The Contractor must respond to the notice of deficiency within seven (7) business days of receipt. Such response may include a request for partial or total waiver of MWBE Contract Goals.

(f) Quarterly MWBE Contractor Compliance Report

Contractor is required to submit a Quarterly MWBE Contractor Compliance Report Form to the Department by the 10th day following each end of quarter over the term of the Contract documenting the progress made towards achievement of the MWBE goals of the Contract.

(g) Liquidated Damages - MWBE Participation

- (1) Where Department determines that Contractor is not in compliance with the requirements of the Contract and Contractor refuses to comply with such requirements, or if Contractor is found to have willfully and intentionally failed to comply with the MWBE participation goals, Contractor shall be obligated to pay to the Department liquidated damages.
- (2) Such liquidated damages shall be calculated as an amount equaling the difference between:
 - (i) All sums identified for payment to MWBEs had the Contractor achieved the contractual MWBE goals; and
 - (ii) All sums actually paid to MWBEs for work performed or materials supplied under the Contract.
- (3) In the event a determination has been made which requires the payment of liquidated damages and such identified sums have not been withheld by the Department, Contractor shall pay such liquidated damages to the Department within sixty (60) days after they are assessed by the Department unless prior to the expiration of such sixtieth day, the Contractor has filed a complaint with the Director of the Division of Minority and Woman Business Development pursuant to Subdivision 8 of Section 313 of the Executive Law in which event the liquidated damages shall be payable if Director renders a decision in favor of the Department.

(h) Forms

Forms referenced in this Article can be found at <http://www.dec.ny.gov/about/48854.html>

XI. Iran Divestment Act Requirements

By entering into this Agreement, Contractor certifies in accordance with State Finance Law §165-a that it is not on the “Entities Determined to be Non-Responsive Bidders/Offerers pursuant to the New York State Iran Divestment Act of 2012” (“Prohibited Entities List”) posted at: <http://www.ogs.ny.gov/about/regs/docs/ListofEntities.pdf>

Contractor further certifies that it will not utilize on this Contract any subcontractor that is identified on the Prohibited Entities List. Contractor agrees that should it seek to renew or extend this Contract, it must provide the same certification at the time the Contract is renewed or extended. Contractor also agrees that any proposed Assignee of this Contract will be required to certify that it is not on the Prohibited Entities List before the contract assignment will be approved by the State.

During the term of the Contract, should the state agency receive information that a person (as defined in State Finance Law §165-a) is in violation of the above-referenced certifications, the state agency will review such information and offer the person an opportunity to respond. If the person fails to demonstrate that it has ceased its engagement in the investment activity which is in violation of the Act within 90 days after the determination of such violation, then the state agency shall take such action as may be appropriate and provided for by law, rule, or contract, including, but not limited to, imposing sanctions, seeking compliance, recovering damages, or declaring the Contractor in default.

The state agency reserves the right to reject any bid, request for assignment, renewal or extension for an entity that appears on the Prohibited Entities List prior to the award, assignment, renewal or extension of a contract, and to pursue a responsibility review with respect to any entity that is awarded a contract and appears on the Prohibited Entities list after contract award.

XII. Americans With Disabilities Act

In the event the monies defined herein are to be used for the development of facilities, outdoor recreation areas, transportation or written or spoken communication with the public, the Contractor shall comply with all requirements for providing access for individuals with disabilities as established by Article 4A of the New York State Public Buildings Law, Americans with Disabilities Act, and relevant sections of the New York State Uniform Fire Prevention and Building Code. Standards for certain Recreation Facilities are found in the 2010 ADA Standards for Accessible Design while others are found in the Architectural Barriers Act Accessibility Guidelines for Outdoor Recreation Areas, <https://www.access-board.gov/guidelines-and-standards>

XIII. Public Access to Facilities

If applicable to the project, the Contractor agrees to allow public access to any facilities developed with monies defined herein on the same basis to all residents of New York State for a period not less than five (5) years after the date of final payment under this Contract or five (5) years after the date that the final payment was due. Failure to comply with the provisions of this clause shall be considered an abandonment of the Project.

XIV. Project Insurance Considerations

Refer to project insurance requirements as set forth in A-1 (B) Program Specific Terms and Conditions.

XV. Amendment/Extensions

The Contract may be amended and/or extended by mutual written consent of all parties. Amendment forms will be incorporated into this Contract and will not take effect until approved by all applicable State agencies and final approval by the Office of the State Comptroller, if applicable. Contract amendments may be conditioned upon funds being re-appropriated in the State Budget each state fiscal year to the Department.

XVI. Environmental Protection Fund Acknowledgement

If applicable, in recognition of a portion of the Department funds utilized for any work completed under this Contract, the Contractor agrees to acknowledge in any communication to the public, that such funding was provided from the Environmental Protection Fund as administered by the New York State Department of Environmental Conservation.

XVII. Vendor Responsibility

- A. The Contractor shall at all times during the Contract term remain responsible. The Contractor agrees, if requested by the Commissioner or his or her designee, to present evidence of its continuing legal authority to do business in New York State, integrity, experience, ability, prior performance, and organizational and financial capacity.

- B. The Department recommends that vendors file a required Vendor Responsibility Questionnaire online via the New York State VendRep System. To enroll in and use the New York State VendRep System, see the VendRep System Instructions available at http://www.osc.state.ny.us/vendrep/vendor_index.htm or go directly to the VendRep System online at <https://portal.osc.state.ny.us>.
- C. Vendors must provide their New York State Identification Number when enrolling. To request assignment of a Vendor ID or for VendRep System assistance, contact the Office of the State Comptroller's Help Desk at 866-370-4672 or 518-408-4672 or by email at ciohelpdesk@osc.state.ny.us. Vendors opting to complete and submit a paper questionnaire can obtain the appropriate questionnaire from the VendRep website www.osc.state.ny.us/vendrep or may contact the Department of the Office of the State Comptroller's Help Desk for a copy of the paper form.
- D. Upon written notice to the Contractor, and a reasonable opportunity to be heard with appropriate Department officials or staff, the Contract may be terminated by the Commissioner or his or her designee at the Contractor's expense where the Contractor is determined by the Commissioner or his or her designee to be non-responsible. In such event, the Commissioner or his or her designee may complete the contractual requirements in any manner he or she may deem advisable and pursue available legal or equitable remedies for breach.

XVIII. Permits

- A. If applicable, the Contractor agrees to obtain all required permits, including but not limited to, local, state and federal permits prior to the commencement of any project related work. The Contractor agrees that all work performed in relation to the project by the Contractor or its agents, representatives, or contractors will comply with all relevant federal, state and local laws, rules, regulations and standards, zoning and building codes, ordinances, operating certificates for facilities, or licenses for an activity.
- B. With respect to the project, the contractor certifies that is has complied, and shall continue to comply with all requirements of the State Environmental Quality Review Act (SEQRA). The Contractor agrees to provide all environmental documents as may be required by the Department. The Contractor has notified, and shall continue to notify, the Department of all actions proposed for complying with the environmental review requirements imposed by SEQRA.

XIX. Approvals

The Contractor agrees that the project will be performed in accordance with the condition of any applicable administrative, judicial or governmental orders or approvals.

XX. Site Access

If applicable, the Contractor represents it has or will obtain title to or sufficient interest in the project site, including rights-of-way and necessary easements, before the start of the project to ensure undisturbed use and possession for purposes of construction and completion of the project, as well as operation of the project throughout its useful life.

XXI. Cost Overruns

If applicable, any cost overruns will not be paid by the Department and the Department is not committed to seeking additional appropriations or re-appropriation of funds and will not be responsible for the maintenance and operation of any facility which may be developed or equipment which may be purchased with the funds herein identified.

XXII. Construction Plans

It is the Contractor's responsibility (if applicable to the Project) to have all construction contract plans, specifications and cost estimates certified by a professional engineer licensed to practice in the State of New York. All certified plans and specifications shall become part of this Contract and shall be kept on the project site at all times.

XXIII. Payment and Reporting

- A. The Contractor agrees to fully fund the Project and then seek reimbursement from the Department for eligible project costs. The Department will not process final payment for this Contract, until the Department determines that the project was completed satisfactorily and upon receipt of all required final close-out payment documentation in accordance with the direction and requirements described in Attachment D.
- B. The Contractor will be entitled to receive reimbursement payments for work, projects, and/or services rendered as detailed and described in Attachment C and Attachment D of this Contract. Claims for reimbursement must be

accompanied by such receipts and documents verifying expenditures as may be required by the Department and by the Comptroller. Satisfactory documentation shall include, but is not limited to, signed copies of payment vouchers or invoices, canceled checks/or the latest cumulative work-in-place estimate for each construction Contract, and any further documentation as may be required by the Department and/or the Comptroller. The Department reserves the right, in its sole discretion, to determine if the reimbursement request and accompanying documentation submitted by the Contractor is in satisfactory form and substance. A final payment determination will be based upon the Department's review of the Contractor's final voucher submission and reporting as described in Attachment D.

XXIV. On-Site Inspections

The State, Department or authorized representatives will conduct a review of the Project funded from this Contract, which may include on-site inspections, at a time that is satisfactory to the Department.

XXV. Prohibition on Purchase of Tropical Hardwoods

The Contractor certifies and warrants that all wood products to be sued under this contract award will be in accordance with, but not limited to, the specifications and provisions of Section 165 of the State Finance Law, (Use of Tropical Hardwoods) which prohibits purchase and use of tropical hardwoods, unless specifically exempted, by the State of any governmental agency or political subdivision or public benefit corporation. Qualification for an exemption under this law will be the responsibility of the contractor to establish to meet with the approval of the State. In addition, when any portion of this contract involving the use of woods, whether supply or installation, is to be performed by any subcontractor, the prime Contractor will indicate and certify in the submitted bid proposal that the subcontractor has been informed and is in compliance with specifications and provisions regarding use of tropical hardwoods as detailed in § 165 State Finance Law. Any such use must meet with the approval of the State; otherwise, the bid may not be considered responsive. Under bidder certifications, proof of qualification for exemption will be the responsibility of the Contractor to meet with the approval of the State.

B) PROGRAM SPECIFIC TERMS AND CONDITIONS

I. Notices:

The Department's authorized representative for the implementation of this Contract and for approval, direction and receipt of all Project reports called for in this Contract is listed below. Whenever it is provided in this Contract that notice must be given or other communications sent to the Department, the notices or communications must be in writing and delivered or sent to the Department's authorized representative at:

Address: Division of Water Contract Liaison, Fiscal Planning and Management Section
New York State Department of Environmental Conservation
625 Broadway – 4th Floor
Albany, NY 12233-3506
518-402-8219

A copy of all legal notices shall be sent to:

General Counsel
New York State Department of Environmental Conservation
625 Broadway - 14th Floor
Albany, New York 12233-1500

The Contractor's authorized representative for the implementation of this Contract is the person authorized in the Resolution of Support for the contract. Notices or communications regarding this Contract should be in writing and delivered or sent to the Contractor's authorized representative at the address identified on the Face Page, with copies sent to the Contractor's contract administrator as identified in the contract application.

Notices delivered or sent shall be deemed for all purposes as notice to all persons who are Parties to this Contract as Department or Contractor.

II. Project Insurance Considerations

The Contractor agrees to procure and maintain at its own expense and without expense to the Department until final acceptance by the Department of the services covered by this Contract, insurance of the kinds and amounts as determined by the Department and based upon the project work plan. The insurance policies should be provided by insurance companies licensed to do business in the State of New York. Any delay or time lost as a result of the Contractor not having insurance required by the Contract shall not give rise to a delay claim or any other claim against the Department.

Upon execution of this Contract, the Contractor shall furnish to the Department a certificate or certificates, satisfactory to the Department, showing that it has complied with this Article. The insurance documentation shall provide that:

- Liability and protective liability insurance policies shall provide primary and non-contributory coverage to the NYS Department of Environmental Conservation for any claims arising from the Contractor’s Work under this contract, or as a result of Contractor’s activities.
- The State of New York, NYS Department of Environmental Conservation, its officers, agents and employees, Division of Water, 625 Broadway 4th Floor, Albany, New York 12233-3508, shall be listed as Certificate Holder on all liability insurance certificate(s), as additional insureds on endorsements(s) and on additional supporting documentation.
- The policies shall include a waiver of subrogation endorsement in favor of the Department as an additional insured. The endorsement shall be on ISO Form Number CG 24 04 or a similar form with same modification to the policy.
- Policies shall not be changed or canceled until thirty (30) days prior written notice has been given to the Department; as evidenced by an endorsement or declarations page.
- Insurance documentation shall disclose any deductible, self-insured retention, aggregate limit or any exclusion to the policy that materially changes the coverage required by the Contract.
- Endorsements in writing must be added to and made part of the insurance contract for the purpose of changing the original terms to reflect the revisions and additions as described. A copy of these endorsements must be provided to the Department within a reasonable amount of time.
- Applicable insurance policy number(s) reference on the ACORD form must be referenced in the supporting documentation requested by the Department and supplied by the insurance company (e.g. endorsement page, declarations page, etc.).
- This Contract shall be void and of no effect unless the Contractor procures the required insurance policies and maintains them until completion of the work or acceptance by the Department, whichever event is later.

The kinds and amounts of insurance required are as follows:

- A. Workers’ Compensation coverage must be provided for work to be performed in New York State. The Contractor shall provide and maintain full New York State coverage during the life of this contract for the benefit of such employees as are required to be covered by the New York State Workers’ Compensation Law.

Evidence of Workers’ Compensation and Employers Liability coverage must be provided on one of the following forms specified by the Chairman of the New York State Workers’ Compensation Board:

<u>FORM #</u>	<u>FORM TITLE</u>
C-105.2	Certificate of Workers’ Compensation Insurance
U-26.3	State Insurance Fund Version of the C-105.2 form
SI-12/ GSI-105.2	Certificate of Workers’ Compensation Self-Insurance
CE-200	Certificate of Attestation of Exemption – (no employees)

- B. Disability Benefits coverage must be provided for work to be performed in New York State. The Contractor shall provide and maintain coverage during the life of the contract for the benefit of such employees as are required to be

covered by the New York State Disability Benefits Law. Any waiver of this requirement must be approved by the Department of Environmental Conservation and will only be granted in unique or unusual circumstances.

Evidence of Disability Benefits coverage must be provided on one of the following forms specified by the Chairman of the New York State Workers' Compensation Board:

<u>FORM #</u>	<u>FORM TITLE</u>
DB-120.1	Certificate of Disability Benefit Insurance
DB-155	Certificate of Disability Benefit Self-Insurance
CE-200	Certificate of Attestation of Exemption – (no employees)

An ACORD form is **NOT** an acceptable proof of Workers' Compensation coverage. **ALL OF THE ABOVE REFERENCED FORMS, EXCEPT CE-200, SI-12 & DB-155 MUST NAME** The State of New York and The New York State Department of Environmental Conservation, Division of Water, 625 Broadway 4th Floor, Albany, NY 12233-3508, as the Entity Requesting Proof of Coverage.

Additional information can be obtained at the Worker's Compensation website:

<http://www.wcb.ny.gov/content/main/Employers/Employers.jsp>

Upon review of the scope of work outlined in the Grant Application by the Department, the following types of liability insurance may be required:

- C. Commercial General Liability Insurance with a limit of not less than \$2,000,000 each occurrence, and \$5,000,000 General aggregate. Such insurance shall cover liability arising from premises operations, independent contractors, products-completed operations, broad form property damage, personal and advertising injury, cross liability assumed in a contract (including tort liability of another assumed in a contract). Limits may be provided through a combination of primary and umbrella/excess liability policies. The CGL aggregate shall be endorsed to apply on a per project basis for construction contracts.
- D. Business Automobile Liability with a limit of not less than \$1,000,000 each accident. Such insurance shall cover liability arising out of any registered motor vehicle including owned, leased, hired and non-owned vehicles. If the Contractor does not own, rent or lease any registered vehicles and will not be using any vehicles on State Land proof of Business Automobile Liability Insurance shall not be required for this Contract. The Contractor shall assume full responsibility and liability that owners and operators of any registered vehicles entering State Land to conduct work under this contract carry the same Business Automobile Liability Insurance of the kinds and amounts listed above. NYS Department of Environmental Conservation reserves the right to request proof of the same.
- E. Environmental Liability with a limit of not less than \$1,000,000 providing primary coverage for bodily injury and property damage, including loss of use of damaged property or of property that has not been physically injured. Such policy shall provide coverage for actual, alleged or threatened emission, discharge, dispersal, seepage, release or escape of pollutants, including any loss, cost or expense incurred as a result of any cleanup of pollutants or in the investigation, settlement or defense of any claim, suit, or proceedings against the Department of Environmental Conservation arising from the Contractor's Work.
- F. Professional Liability Insurance includes coverage for its negligent act, error or omission in rendering or failing to render professional services required by this contract arising out of specifications, installation, modification, abatement, replacement or approval of products, materials or processes containing pollutants, and the failure to advise of or detect the existence or the proportions of pollutants. The Contractor, any subcontractor or supplier retained by the Contractor to work on the contract shall procure and maintain during and for a period of three (3) years after completion of this contract, Professional Liability Insurance in the amount of \$1,000,000. The professional liability insurance may be issued on a claims-made policy form, in which case the Contractor shall purchase at its sole expense, extended Discovery Clause coverage of up to three (3) years after work is completed if coverage is cancelled or not renewed.
- G. Marine Protection & Indemnity: Anytime the activity involves work on navigable water or the work is connected to water related activities, the Contractor shall procure Marine Protection & Indemnity and Hull and Machinery

coverage, if available. Hull and Machinery coverage shall be provided for the total value of the watercraft or equipment. The Contractor shall obtain Protective and Indemnity Liability insurance for all marine operations under the contract, with a minimum \$2,000,000 limit.

Should the Contractor engage a subcontractor, the Contractor shall impose the insurance requirements of this document on the subcontractor. Contractor shall determine the required insurance types and limits, commensurate with the work of the Subcontractor. The Contractor will maintain the certificate or certificates and endorsements for all subcontractors hired as part of the Contractor's records.

In addition, for Land Acquisition projects: The contractor will purchase a policy of title insurance in the amount equivalent to the purchase price of the land acquisition, issued by a Title Company licensed by the State of New York and in a form acceptable to the New York State Department of Environmental Conservation, naming the contractor as the insured party.

III. Local Share Requirements as applicable to each program set forth below in (A), (B) and (C):

- A. For Round 14 Non-agricultural Nonpoint Source Abatement and Control, Salt Storage, Land Acquisition for Source Water Protection, Aquatic Habitat Restoration, and Municipal Separate Storm Sewer System projects types, the Contractor must provide an eligible share of least twenty-five percent (25%) of approved project costs of up to the Contract Funding Amount identified on the face page. This percentage will be specified in the Attachment B-1 (Expenditure Budget). The Contractor share cannot be paid with state or federal grant funds.
- B. For Round 14 High Priority Wastewater Treatment Plant projects, the Contractor must provide an eligible share of least fifteen percent (15%) of approved project costs of up to the Contract Funding Amount identified on the face page. This percentage will be specified in the Attachment B-1 (Expenditure Budget). The Contractor share cannot be paid with state or federal grant funds.
- C. For Round 14 General Priority Wastewater Treatment Plant projects, the Contractor must provide an eligible share of least sixty percent (60%) of approved project costs of up to the Contract Funding Amount identified on the face page. This percentage will be specified in the Attachment B-1 (Expenditure Budget). The Contractor share cannot be paid with state or federal grant funds.

IV. Project Implementation

The Contractor agrees to proceed expeditiously with the Project and shall complete the Project in accordance with the performance measures set forth in Attachment C (Work Plan) or any amendments to such Work Plan which are approved by the Department in writing and the Office of State Comptroller when applicable.

V. For Projects Involving Construction (in addition to Attachment A.1.A. Article XXII – Construction Plans)

- A. The Contractor agrees that it shall notify the Department in writing thirty (30) calendar days prior to the start of construction or, if the start of construction began on or after May 1, 2017, upon approval of the Contract the Contractor shall notify the Department in writing thirty (30) calendar days as to the status of any construction
- B. The Contractor agrees that it shall notify the Department in writing thirty (30) days following initial start-up operation of the Project.
- C. The Contractor agrees that it shall cause the Project to be designed and constructed in accordance with the engineering report or facilities plan, and if applicable to the project, the plans and specifications for the Project shall be stamped with the seal of a licensed professional engineer and shall be signed with the personal signature of such engineer in compliance with Education Law §7209(1) and (2), and which have been delivered to and approved by the Department, as well as any amendments thereto.
- D. The Contractor agrees to use NYS Office Office of General Services design and construction specifications for salt storage construction projects. <https://online.ogs.ny.gov/DNC/MasterSpec04/MasterSpecListing.asp?Div=13>

Section 133423 - Rectangular Salt Storage Structure
Section 133424 – Dome Salt Storage Structure

- E. The Contractor agrees that it shall permit the Department to participate in all its meetings and conferences with respect

to the Project. Upon request from the Department, the Contractor must submit to the Department reports, documents, data, contractual documents, administrative records and other information pertinent to the Project.

- F. The Contractor agrees to permit representatives of the Department to have unrestricted access to the Project at all reasonable times, and all contracts of the Contractor for construction or operation of all or a portion of the Project shall contain provisions that permit such access to the Project or work relating to the Project, wherever it is in preparation or progress, and that contractors or subcontractors shall provide proper facilities for such access and inspection and shall permit extracts and copies of Project records to be made by the representatives of the Department.
- G. Within sixty (60) calendar days after the end of the Contract Term, or upon final completion of the Project, the Contractor agrees that it will deliver the following to the Department:
 - 1. A certification stating that the Project has been completed in accordance with this Contract, and constructed per the approved plans and specifications, and any approved amendments thereto.
 - 2. The certified "as built" plans and specifications for the Project. Any work not in accordance with the approved plans and specifications shall be remedied, unless such non-compliance is agreed to be waived by the Department.
 - 3. The Contractor shall retain all as-built plans and specifications for the Project for the useful life of the Project.

VI. Useful Life of Project

A. In Perpetuity (Conservation easements)

For land acquisition or conservation easements obtained for the protection of water supplies, the useful life is in perpetuity.

B. 30 Years (wastewater treatment, and other capital projects such as salt storage facilities)

The Contractor agrees that it is fully responsible for ensuring the proper and efficient monitoring, operation and maintenance of the Project satisfactory to the Department, including, but not limited, to retaining a sufficient number of qualified staff and ensuring performance of required tests and requirements. After completion of the Project, the Contractor shall, for a period of thirty (30) years unless another period of time is specified in the attached Work Plan (the useful life of the Project as provided in the State Finance Law §61]), operate the Project or otherwise cause the Project to be operated properly in a sound and economical manner and shall maintain, preserve and keep the Project, or cause the Project to be maintained, preserved and kept, in good repair, working order and condition and shall make, or cause to be made, all necessary and proper repairs, replacements and renewals from time to time, so that at all times the Project may be operated properly in a manner consistent with the Project performance standards contained in the engineering report of facilities plan for the Project, with this Contract and with the requirements of any related permit or other governmental approval of the Project.

C. 20 Years (other nonpoint source and aquatic habitat restoration projects)

SFL §61 provides useful life expectancies for things such as culverts and environmental restoration projects. Here the Contractor agrees that it is fully responsible for ensuring the proper and efficient monitoring, operation and maintenance of the Project satisfactory to the Department. After completion of the Project, the Contractor shall, for a period of twenty (20) years unless another period of time is specified in the attached Work Plan (the useful life of the Project as provided in the State Finance Law §61]), operate the Project or otherwise cause the Project to be operated properly in a sound and economical manner and shall maintain, preserve and keep the Project, or cause the Project to be maintained, preserved and kept, in good repair, working order and condition and shall make, or cause to be made, all necessary and proper repairs, replacements and renewals from time to time, so that at all times the Project may be operated properly in a manner consistent with the Project performance standards contained in the engineering report of facilities plan for the Project, with this Contract and with the requirements of any related permit or other governmental approval of the Project.

D. 5 years ("other" projects not covered in A. of B., e.g., hydro-seeding)

SFL §61 provides useful life expectancies for projects not otherwise specified. Any work of construction, improvement, or purpose not covered by other provisions of SFL§16 have a five-year useful life. Here the Contractor agrees that it is fully responsible for ensuring the proper and efficient monitoring, operation and maintenance of the Project satisfactory to the Department. After completion of the Project, the Contractor shall, for a period of five (5) years unless another period of time is specified in the attached Work Plan (the useful life of the Project as provided in the State Finance Law

§61]), operate the Project or otherwise cause the Project to be operated properly in a sound and economical manner and shall maintain, preserve and keep the Project, or cause the Project to be maintained, preserved and kept, in good repair, working order and condition and shall make, or cause to be made, all necessary and proper repairs, replacements and renewals from time to time, so that at all times the Project may be operated properly in a manner consistent with the Project performance standards contained in the engineering report of facilities plan for the Project, with this Contract and with the requirements of any related permit or other governmental approval of the Project.

VII. Signage

In addition to requirements in A.1.A.XVI (Environmental Protection Fund Acknowledgement), the Department may require the installation of a project sign which identifies the EPF / Clean Water Infrastructure Act as a source of funding as outlined in the requirements and specifications attached to and made part of this contract as Attachment E.

For projects with multiple funding sources the Contractor acknowledges that a portion of this grant is funded by the Department as a Water Quality Improvement Project. The Contractor agrees to identify the Department as a source of funding for this project in any communications to the public. The Department may require the installation of a project sign which identifies it as a source of funding as outlined in the requirements and specifications attached to and made part of this contract as Attachment E.

VIII. Period of Eligible Costs

Only those eligible project related costs incurred on or after May 1, 2017 will be eligible for reimbursement of grant funding. The eligibility of project costs for each project type is defined in the request for applications for each project type.

IX. Planning and Design costs

Planning and design costs for nonpoint source control and abatement projects, salt storage facilities, and aquatic habitat restoration projects may be considered eligible if they are associated with implementing a project. Planning and design costs cannot exceed 20% of the award amount.

X. Nonpoint Source Pollutant Load Reduction

For Nonpoint Source Pollution reduction projects and salt storage facilities, prior to contract execution, the Contractor shall provide a report of estimates of pollutant load reduction as required by the Department.

XI. MS4 Lead Applicant Self-Certification

For Municipal Separate Storm Sewer System (MS4) projects that involve more than one municipality, the lead applicant must certify that an Inter-Municipal Agreement or a signed commitment exists between the Lead Applicant and each participating MS4 stating the participating MS4's commitment and willingness to deliver each output attributed to them in the contract work plan as described in Attachment F.

XII. Land Acquisition Projects for source water protection pursuant to Title 33 of Article 15 of the Environmental Conservation Law.

- A. "Land acquisition projects" mean open space acquisition projects undertaken with willing sellers including, but not limited to, the purchase of conservation easements, undertaken by a municipality, a not-for-profit corporation, or purchase of conservation easements by a soil and water conservation district.
- B. All land acquisition projects shall be undertaken in the state of New York.
- C. The commissioner is authorized to provide state assistance to municipalities, not-for-profit corporations and soil and water conservation districts to undertake land acquisition projects for source water protection, in cooperation with willing sellers. Land acquisition projects for source water protection shall support, expand or enhance drinking water quality protection, including but not limited to aquifers, watersheds, reservoirs, lakes, rivers and streams.
- D. 1. Any buffer encumbered by a conservation easement acquired pursuant to ECL §15-3303 that encumbers lands used in agricultural production as defined in section three hundred one of the agriculture and markets law in a county designated state certified agricultural district created under section three hundred three of the agriculture and markets law may allow agricultural activity that qualifies such lands, provided such activity on such lands does not impair

drinking water and complies with an agricultural environmental management program plan developed by the state soil and water conservation committee, in partnership with the department.

2. Notwithstanding any limitations provided herein on lands acquired pursuant to ECL Article 15 Title 33 a license or easement may be granted by the owner of such property to a public utility for a public purpose.

E. 1. No state assistance may be provided pursuant to ECL §15-3303 to fund any land acquisition project which is undertaken by eminent domain unless such process is undertaken with a willing seller.

2. The department shall not provide funding pursuant to ECL §15-3303 for any land acquisition project for source water protection by a not-for-profit corporation, if any town, village or city within which such a project is located, by resolution, within ninety days of notification by such corporation of its interest in acquiring such projects, objects to such acquisition.

- a. A not-for-profit contractor shall notify any town, village or city within which such a project is located of its interest in acquiring such project and inform them they have 90 days to object by resolution.
- b. A not-for-profit contractor shall provide the Department with copies of such notifications and all responses received from any town, village or city, or certify to the Department that no responses were received within 90days.

F. Real property acquired, developed, improved, restored or rehabilitated by or through a municipality or not-for-profit corporation with funds made available pursuant to ECL Article 15 Title 33 shall not be sold, leased, exchanged, donated or otherwise disposed of or used for other than the public purposes of ECL Article 15 Title 33 without the express authority of an act of the legislature, which shall provide for the substitution of other lands of equal environmental value and fair market value and reasonably equivalent usefulness and location to those to be discontinued, sold or disposed of, and such other requirements as shall be approved by the commissioner.

G. If the state acquires a real property interest in land purchased by a municipality or not-for-profit with funds made available pursuant to ECL Article 15 Title 33, the state shall pay the fair market value of such interest less the amount of funding provided by the state pursuant to ECL §15-3303.

H. Contractor agrees to provide the Department with a shape file suitable for locating acquired parcels on a geographical information system platform.

I. Land Purchase and Conservation Easement Requirements

The Department will thoroughly review all documentation and only reimburse for land purchases and Conservation Easements that provide for the protection of source water as set forth in Title 33 of Article 15 of the Environmental Conservation Law (ECL). The following are conditions of land acquisitions:

- a. Easement document must include all necessary requirements to fulfill the objective of ECL Article 15, Title 33.
- b. Lands currently protected by a federal or state easement program are not eligible for funding under this grant.
- c. Conservation Easements must be acquired in perpetuity.
- d. Conservation easements must be acquired pursuant to Article 49, Title 3 of the New York State Environmental Conservation Law.
- e. If the property is used for activities which interfere with the accomplishment of approved purposes, the violating activities must cease and any resulting adverse effects must be remedied.
- f. Contractor must describe in detail protocols for stewardship, monitoring and enforcement of properties or easements as part of their work plan.
- g. Monitoring and enforcement of properties or easements obtained with funding from this contract may be performed by a subcontractor. The subcontractor's role and responsibilities must be outlined in this contract's work plan.
- h. Public access will be reviewed and approved by DEC on a case-by-case basis. The contractor must provide written documentation that public access would not have an impact to the drinking water supply. In the case of a municipality, this documentation is to be provided at the earliest date practicable but not later than 120 days prior to closing. In the case of a Not-for-Profit or Soil and Water Conservation District, documentation shall be provided concurrently with notification of the municipality of its interest in acquiring such projects.

- i. Documentation must contain a thorough description and maps showing access points, proposed activities, and proximity to the water supply
 - i. Contractor agrees to provide a summary of existing property conditions prior to acquisition signed by both seller and Contractor.
 - j. Appraisals are required prior to reimbursement. Appraisals must be completed by a state general certified appraiser following the Uniform Standards of Professional Appraisal Practice (USPAP). Two appraisals are required when appraised value is over \$300,000.
 - k. Boundary surveys and maps are required for all properties and shall identify the protected property and any exclusion areas that are not protected. Surveys must be completed by a professional land surveyor licensed to practice in New York and must be recorded in the County Clerk's office prior to the recording of a conservation easement in the County Clerk's office.
 - l. .
 - i. Appraisals, surveys, titles and easement language (if applicable) will be reviewed by DEC. No reimbursement will be made until the final approval is given by the Department
 - m. Final approval from the Department is required
 - i. prior to closing; or
 - ii. in the event that the closing has already taken place, immediately following execution of this contract. DEC will have a minimum of 120 days to review and approve or disapprove the parcel(s) being proposed
- J. Riparian Buffer Requirements (Surface Water Supplies only)
- a. Riparian buffers must be vegetated using only native trees, shrubs and grasses appropriate for site conditions.
 - b. Riparian buffers must have a minimum average width of 100 feet, measured from the edge of the streambank, if they are adjacent to tributaries.
 - c. Riparian buffers must have a minimum average width of 300 feet, measured from the edge of the shoreline, if they are adjacent to reservoirs, lakes or ponds.
 - d. For newly created or restored buffers, the contractor must develop and implement a maintenance plan during the buffer establishment period, defined as 3-5 years after planting of vegetation.
 - e. Streambanks must be stable prior to creation or restoration of riparian buffers.
 - f. Selective cutting of trees, removal of invasive species, or supplemental planting of trees, shrubs, or grasses are allowed provided they improve habitat and function of the riparian buffer or remove, mitigate, or warn against unreasonable harm to people, property or health of native species on or around the defined riparian buffer area.
 - g. Disturbances that compromise the ecological condition of the riparian buffer area, including, but not limited to, livestock access to the riparian buffer, wood or timber harvesting, excessive mowing and recreational vehicular use must be prohibited, except as allowed by Article X11.D above.
- K. Wetland Requirements (Surface Water Supplies only)
- a. Project work plan must describe how the work in and near wetlands will protect drinking water supplies and provide improved wetland function.
 - b. Work within or immediately adjacent to existing wetlands must be limited to activities that will improve wetland function. Disturbances that compromise ecological functions are ineligible for funding.
 - c. Projects cannot mitigate for impacts to regulated wetlands. Wetland mitigation projects are ineligible for funding.
 - d. The contractor must develop and implement a maintenance plan for any wetland creation or enhancement. The maintenance plan must include protocols for addressing problems for a minimum of 3 years following creation or enhancement.
- L. Eligible expenses include administrative and transactional costs (e.g. property surveys, land appraisals, staff time devoted to the project) and the value of the land or development rights to be acquired by the grantee.
- a. The value of the land or development rights being acquired, provided such value associated with the purchase of the property or purchase of a conservation easement is from an appraisal deemed acceptable by DEC. DEC may reimburse for purchase of land or development rights above fair market value in the limited circumstances where it can be demonstrated that the property has a unique resource value. This approach recognizes the fact that outside independent appraisals will not take into account the unique resource value of a particular parcel. In such circumstances, the outside independent appraisals may be merely a bench mark for determining the fair market value of the property. DEC has the discretion and may reimburse at a price above the highest approved independent appraisal provided: 1) the price was the result of documented negotiations between the

Grantee and the seller and 2) the Grantee demonstrated the unique resource value and how it accomplishes the objective of this program.

- b. Transactional costs acceptable by DEC, provided they result in final acquisition of land or perpetual conservation easement and/or restoration of new riparian buffers and are limited to: title reports, title insurance, property surveys, appraisals, certified appraisal review, easement holder and landowner's legal fees to negotiate/close the conservation easement transaction and to review title reports and, as necessary, prepare title curatives, filing fees, or other Department-approved closing costs, map and GIS/remote sensing data, environmental assessments, baseline documentation reports, stewardship or management plans, easement stewardship fee, project specific defense liability insurance fees, property taxes, and State or local real estate transfer taxes.
- c. Staff salaries directly devoted to or connected to the program, excluding indirect (overhead/operating) expenses (Grantees will be required to document time works, tasks, pay ratio and payment, and itemize salaries according to job title and roles/responsibilities on the program).
- d. Riparian buffer or wetland restoration costs deemed acceptable by DEC. "Soft" streambank stabilization practices including but not limited to, live staking, contour wattling, erosion control matting, and root wads, are eligible for funding as part of riparian buffer restoration. Streambank stabilization costs cannot exceed 25% of the award amount.
- e. Value of contractual services provided by professional and technical personnel and consultants (i.e. engineering and architectural services, surveys, plans and specifications, research, design and development of a project, consultant and legal services directly related to a project, feasibility study for a property, etc.). Planning and design costs cannot exceed 20% of the award amount.
- f. Supplies and materials directly necessary to implement individual projects.
- g. Travel Costs (within New York State) directly associated and required to implement the program.

M. Ineligible costs:

- a. Out-of-state travel costs, and any travel not directly required to implement the program;
- b. Program costs funded from other state and/or federal funding sources;
- c. Indirect costs, including overhead/operating expenses (space, rent, utilities);
- d. Costs incurred prior to a grant award or outside of the contract term;
- e. Endowment funds;
- f. Major capital expenditures, such as equipment or computers;
- g. Any fee or other contribution deposited to a legal defense fund other than a conservation easement defense liability insurance policy;
- h. Restoration projects that include hard armoring of streambanks, including stone rip rap;
- i. Wetland mitigation projects;
- j. Projects with planning and design in excess of 20% of the award amount;
- k. Construction oversight;
- l. Improvements to public access;
- m. Interest payments; and
- n. Forest management plans.

EQUAL EMPLOYMENT OPPORTUNITY POLICY STATEMENT

I, _____, am the authorized representative of _____.
Name of Representative Name of Contractor/Service Provider
I hereby certify that _____ will abide by the equal employment
Name of Contractor/Service Provider
opportunity (EEO) policy statement provisions outlined below.

- (i) The Contractor will not discriminate on the basis of race, creed, color, national origin, sex, age, disability, or marital status against any employee or applicant for employment, will undertake or continue existing programs of affirmative action to ensure that minority group members and women are afforded equal employment opportunities without discrimination and will make and document its conscientious and active efforts to employ and utilize minority group members and women in its work force on Contracts relating to NYS funded projects in compliance with NYS Article 15-A.
- (ii) The Contractor shall state in all solicitations or advertisements for employees that, in the performance of the Contract relating to this Water Grant project, all qualified applicants will be afforded equal employment opportunities without discrimination because of race, creed, color, national origin, sex, age, disability or marital status.
- (iii) The Contractor shall request each employment agency, labor union, or authorized representative of workers with which it has a collective bargaining or other agreement or understanding, to furnish a written statement that such employment agency, labor union, or representative will not discriminate on the basis of race, creed, color, national origin, sex, age, disability or marital status, and that such union or representative will affirmatively cooperate in the implementation of the Contractor's obligations herein.
- (iv) The Contractor shall comply with the provisions of the Human Rights Law (Article 15 of the Executive Law), including those relating to non-discrimination on the basis of prior criminal conviction and prior arrest, and with all other State and federal statutory and constitutional non-discrimination provisions. The Contractor and Subcontractors shall not discriminate against any employee or applicant for employment because of race, creed (religion), color, sex, national origin, sexual orientation, military status, age, disability, predisposing genetic characteristic, marital status or domestic violence victim status.
- (v) The Contractor will include the provisions of subdivisions (i) through (iv) in every Subcontract in such a manner that the requirements of these subdivisions will be binding upon each Subcontractor as to work in connection with the Contract.

X

Contractor/Service Provider Representative

IRAN DIVESTMENT ACT CERTIFICATION

As a result of the Iran Divestment Act of 2012 (Act), Chapter 1 of the 2012 Laws of New York, a new provision has been added to the State Finance Law (SFL), § 165-a, effective April 12, 2012. Under the Act, the Commissioner of the Office of General Services (OGS) will be developing a list (prohibited entities list) of “persons” who are engaged in “investment activities in Iran” (both are defined terms in the law). Pursuant to SFL § 165-a(3)(b), the initial list is expected to be issued no later than 120 days after the Act’s effective date, at which time it will be posted on the OGS website.

By submitting a bid in response to this solicitation or by assuming the responsibility of a Contract awarded hereunder, Bidder/Contractor (or any assignee) certifies that once the prohibited entities list is posted on the OGS website, it will not utilize on such Contract any subcontractor that is identified on the prohibited entities list.

Additionally, Bidder/Contractor is advised that once the list is posted on the OGS website, any Contractor seeking to renew or extend a Contract or assume the responsibility of a Contract awarded in response to the solicitation, must certify at the time the Contract is renewed, extended or assigned that it is not included on the prohibited entities list.

During the term of the Contract, should the New York State Education Department (AGENCY) receive information that a person is in violation of the above-referenced certification, AGENCY will offer the person an opportunity to respond. If the person fails to demonstrate that it has ceased its engagement in the investment which is in violation of the Act within 90 days after the determination of such violation, then AGENCY shall take such action as may be appropriate including, but not limited to, imposing sanctions, seeking compliance, recovering damages, or declaring the Contractor in default.

AGENCY reserves the right to reject any bid or request for assignment for an entity that appears on the prohibited entities list prior to the award of a contract, and to pursue a responsibility review with respect to any entity that is awarded a contract and appears on the prohibited entities list after contract award.

Signature: _____

Print Name: _____

Title: _____

Company Name: _____

Date: : _____

**NEW YORK STATE
VENDOR RESPONSIBILITY QUESTIONNAIRE
FOR-PROFIT BUSINESS ENTITY**

You have selected the For-Profit Non-Construction questionnaire which may be printed and completed in this format or, for your convenience, may be completed online using the New York State VendRep System.

COMPLETION & CERTIFICATION

The person(s) completing the questionnaire must be knowledgeable about the vendor's business and operations. An owner or officer must certify the questionnaire and the signature must be notarized.

NEW YORK STATE VENDOR IDENTIFICATION NUMBER (VENDOR ID)

The Vendor ID is a ten-digit identifier issued by New York State when the vendor is registered on the Statewide Vendor File. This number must now be included on the questionnaire. If the business entity has not obtained a Vendor ID, contact the IT Service Desk at ITServiceDesk@osc.state.ny.us or call 866-370-4672.

DEFINITIONS

All underlined terms are defined in the "New York State Vendor Responsibility Definitions List," found at www.osc.state.ny.us/vendrep/documents/questionnaire/definitions.pdf. These terms may not have their ordinary, common or traditional meanings. Each vendor is strongly encouraged to read the respective definitions for any and all underlined terms. By submitting this questionnaire, the vendor agrees to be bound by the terms as defined in the "New York State Vendor Responsibility Definitions List" existing at the time of certification.

RESPONSES

Every question must be answered. Each response must provide all relevant information which can be obtained within the limits of the law. However, information regarding a determination or finding made in error which was subsequently corrected is not required. Individuals and Sole Proprietors may use a Social Security Number but are encouraged to obtain and use a federal Employer Identification Number (EIN).

REPORTING ENTITY

Each vendor must indicate if the questionnaire is filed on behalf of the entire Legal Business Entity or an Organizational Unit within or operating under the authority of the Legal Business Entity and having the same EIN. Generally, the Organizational Unit option may be appropriate for a vendor that meets the definition of "Reporting Entity" but due to the size and complexity of the Legal Business Entity, is best able to provide the required information for the Organizational Unit, while providing more limited information for other parts of the Legal Business Entity and Associated Entities.

ASSOCIATED ENTITY

An Associated Entity is one that owns or controls the Reporting Entity or any entity owned or controlled by the Reporting Entity. However, the term Associated Entity does not include "sibling organizations" (i.e., entities owned or controlled by a parent company that owns or controls the Reporting Entity), unless such sibling entity has a direct relationship with or impact on the Reporting Entity.

STRUCTURE OF THE QUESTIONNAIRE

The questionnaire is organized into eleven sections. Section I is to be completed for the Legal Business Entity. Section II requires the vendor to specify the Reporting Entity for the questionnaire. Section III refers to the individuals of the Reporting Entity, while Sections IV-VIII require information about the Reporting Entity. Section IX pertains to any Associated Entities, with one question about their Officials/Owners. Section X relates to disclosure under the Freedom of Information Law (FOIL). Section XI requires an authorized contact for the questionnaire information.

**NEW YORK STATE
VENDOR RESPONSIBILITY QUESTIONNAIRE
FOR-PROFIT BUSINESS ENTITY**

I. LEGAL BUSINESS ENTITY INFORMATION			
<u>Legal Business Entity Name*</u>		<u>EIN</u>	
Address of the <u>Principal Place of Business</u> (street, city, state, zip code)		<u>New York State Vendor Identification Number</u>	
		Telephone ext.	Fax
Email		Website	
Additional <u>Legal Business Entity</u> Identities: If applicable, list any other <u>DBA</u> , <u>Trade Name</u> , <u>Former Name</u> , Other Identity, or <u>EIN</u> used in the last five (5) years and the status (active or inactive).			
Type	Name	EIN	Status
1.0 <u>Legal Business Entity</u> Type – Check appropriate box and provide additional information:			
<input type="checkbox"/> <u>Corporation</u> (including <u>PC</u>)		Date of Incorporation	
<input type="checkbox"/> <u>Limited Liability Company</u> (<u>LLC</u> or <u>PLLC</u>)		Date of Organization	
<input type="checkbox"/> <u>Partnership</u> (including <u>LLP</u> , <u>LP</u> or <u>General</u>)		Date of Registration or Establishment	
<input type="checkbox"/> <u>Sole Proprietor</u>		How many years in business?	
<input type="checkbox"/> Other		Date Established	
If Other, explain:			
1.1 Was the <u>Legal Business Entity</u> formed or incorporated in New York State?			<input type="checkbox"/> Yes <input type="checkbox"/> No
If 'No,' indicate jurisdiction where <u>Legal Business Entity</u> was formed or incorporated and attach a <u>Certificate of Good Standing</u> from the applicable jurisdiction or provide an explanation if a <u>Certificate of Good Standing</u> is not available.			
<input type="checkbox"/> United States State _____			
<input type="checkbox"/> Other Country _____			
Explain, if not available:			
1.2 Is the <u>Legal Business Entity</u> publicly traded?			<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," provide <u>CIK Code</u> or Ticker Symbol			
1.3 Does the <u>Legal Business Entity</u> have a <u>DUNS</u> Number?			<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," Enter <u>DUNS</u> Number			

*All underlined terms are defined in the "New York State Vendor Responsibility Definitions List," which can be found at www.osc.state.ny.us/vendrep/documents/questionnaire/definitions.pdf.

**NEW YORK STATE
VENDOR RESPONSIBILITY QUESTIONNAIRE
FOR-PROFIT BUSINESS ENTITY**

I. LEGAL BUSINESS ENTITY INFORMATION		
1.4 If the <u>Legal Business Entity's Principal Place of Business</u> is not in New York State, does the <u>Legal Business Entity</u> maintain an office in New York State? (Select "N/A," if <u>Principal Place of Business</u> is in New York State.)		<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> N/A
If "Yes," provide the address and telephone number for one office located in New York State.		
1.5 Is the <u>Legal Business Entity</u> a New York State certified <u>Minority-Owned Business Enterprise (MBE)</u> , <u>Women-Owned Business Enterprise (WBE)</u> , <u>New York State Small Business (SB)</u> or a federally certified <u>Disadvantaged Business Enterprise (DBE)</u> ? If "Yes," check all that apply: <ul style="list-style-type: none"> <input type="checkbox"/> New York State certified <u>Minority-Owned Business Enterprise (MBE)</u> <input type="checkbox"/> New York State certified <u>Women-Owned Business Enterprise (WBE)</u> <input type="checkbox"/> <u>New York State Small Business (SB)</u> <input type="checkbox"/> Federally certified <u>Disadvantaged Business Enterprise (DBE)</u> 		<input type="checkbox"/> Yes <input type="checkbox"/> No
1.6 Identify <u>Officials</u> and <u>Principal Owners</u> , if applicable. For each person, include name, title and percentage of ownership. Attach additional pages if necessary. If applicable, reference to relevant SEC filing(s) containing the required information is optional.		
Name	Title	Percentage Ownership <i>(Enter 0% if not applicable)</i>

**NEW YORK STATE
VENDOR RESPONSIBILITY QUESTIONNAIRE
FOR-PROFIT BUSINESS ENTITY**

II. REPORTING ENTITY INFORMATION	
<p>2.0 The <u>Reporting Entity</u> for this questionnaire is:</p> <p>Note: Select only one.</p> <p><input type="checkbox"/> <u>Legal Business Entity</u></p> <p><i>Note: If selecting this option, "Reporting Entity" refers to the entire Legal Business Entity for the remainder of the questionnaire. (SKIP THE REMAINDER OF SECTION II AND PROCEED WITH SECTION III.)</i></p> <p><input type="checkbox"/> <u>Organizational Unit within and operating under the authority of the Legal Business Entity</u></p> <p>SEE DEFINITIONS OF "<u>REPORTING ENTITY</u>" AND "<u>ORGANIZATIONAL UNIT</u>" FOR ADDITIONAL INFORMATION ON CRITERIA TO QUALIFY FOR THIS SELECTION.</p> <p><i>Note: If selecting this option, "Reporting Entity" refers to the Organizational Unit within the Legal Business Entity for the remainder of the questionnaire. (COMPLETE THE REMAINDER OF SECTION II AND ALL REMAINING SECTIONS OF THIS QUESTIONNAIRE.)</i></p>	
IDENTIFYING INFORMATION	
a) <u>Reporting Entity</u> Name	
Address of the <u>Primary Place of Business</u> (street, city, state, zip code)	Telephone ext.
b) Describe the relationship of the <u>Reporting Entity</u> to the <u>Legal Business Entity</u>	
c) Attach an <u>organizational chart</u>	
d) Does the Reporting Entity have a <u>DUNS</u> Number?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," enter <u>DUNS</u> Number	
e) Identify the designated manager(s) responsible for the business of the <u>Reporting Entity</u> . <i>For each person, include name and title. Attach additional pages if necessary.</i>	
Name	Title

**NEW YORK STATE
VENDOR RESPONSIBILITY QUESTIONNAIRE
FOR-PROFIT BUSINESS ENTITY**

INSTRUCTIONS FOR SECTIONS III THROUGH VII

For each "Yes," provide an explanation of the issue(s), relevant dates, the government entity involved, any remedial or corrective action(s) taken and the current status of the issue(s). For each "Other," provide an explanation which provides the basis for not definitively responding "Yes" or "No." Provide the explanation at the end of the section or attach additional sheets with numbered responses, including the Reporting Entity name at the top of any attached pages.

III. LEADERSHIP INTEGRITY	
<i>Within the past five (5) years, has any current or former reporting entity official or any individual currently or formerly having the authority to sign, execute or approve bids, proposals, contracts or supporting documentation on behalf of the reporting entity with any government entity been:</i>	
3.0 <u>Sanctioned</u> relative to any business or professional permit and/or license?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Other
3.1 <u>Suspended, debarred, or disqualified</u> from any government contracting process?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Other
3.2 The subject of an <u>investigation</u> , whether open or closed, by any <u>government entity</u> for a civil or criminal violation for any business-related conduct?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Other
3.3 Charged with a misdemeanor or felony, indicted, granted immunity, convicted of a crime or subject to a <u>judgment</u> for: a) Any business-related activity; or b) Any crime, whether or not business-related, the underlying conduct of which was related to truthfulness?	<input type="checkbox"/> Yes <input type="checkbox"/> No <input type="checkbox"/> Other
For each "Yes" or "Other" explain:	

IV. INTEGRITY – CONTRACT BIDDING	
<i>Within the past five (5) years, has the reporting entity:</i>	
4.0 Been <u>suspended</u> or <u>debarred</u> from any <u>government contracting process</u> or been <u>disqualified</u> on any government procurement, permit, license, concession, franchise or lease, including, but not limited to, <u>debarment</u> for a violation of New York State Workers' Compensation or Prevailing Wage laws or New York State Procurement Lobbying Law?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.1 Been subject to a denial or revocation of a government prequalification?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.2 Been denied a contract award or had a bid rejected based upon a <u>non-responsibility finding</u> by a <u>government entity</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.3 Had a low bid rejected on a <u>government contract</u> for failure to <u>make good faith efforts</u> on any <u>Minority-Owned Business Enterprise, Women-Owned Business Enterprise or Disadvantaged Business Enterprise goal or statutory affirmative action requirements</u> on a previously held contract?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.4 Agreed to a voluntary exclusion from bidding/contracting with a <u>government entity</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
4.5 Initiated a request to withdraw a bid submitted to a <u>government entity</u> in lieu of responding to an information request or subsequent to a formal request to appear before the <u>government entity</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
For each "Yes," explain:	

**NEW YORK STATE
VENDOR RESPONSIBILITY QUESTIONNAIRE
FOR-PROFIT BUSINESS ENTITY**

V. INTEGRITY – CONTRACT AWARD	
<i>Within the past five (5) years, has the reporting entity:</i>	
5.0 Been <u>suspended</u> , cancelled or <u>terminated for cause</u> on any <u>government contract</u> including, but not limited to, a <u>non-responsibility finding</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5.1 Been subject to an <u>administrative proceeding</u> or civil action seeking specific performance or restitution in connection with any <u>government contract</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
5.2 Entered into a formal monitoring agreement as a condition of a contract award from a <u>government entity</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
For each “Yes,” explain:	

VI. CERTIFICATIONS/LICENSES	
<i>Within the past five (5) years, has the reporting entity:</i>	
6.0 Had a revocation, <u>suspension</u> or <u>disbarment</u> of any business or professional permit and/or license?	<input type="checkbox"/> Yes <input type="checkbox"/> No
6.1 Had a denial, decertification, revocation or forfeiture of New York State certification of <u>Minority-Owned Business Enterprise</u> , <u>Women-Owned Business Enterprise</u> or federal certification of <u>Disadvantaged Business Enterprise</u> status for other than a change of ownership?	<input type="checkbox"/> Yes <input type="checkbox"/> No
For each “Yes,” explain:	

VII. LEGAL PROCEEDINGS	
<i>Within the past five (5) years, has the reporting entity:</i>	
7.0 Been the subject of an <u>investigation</u> , whether open or closed, by any <u>government entity</u> for a civil or criminal violation?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.1 Been the subject of an indictment, grant of immunity, <u>judgment</u> or conviction (including entering into a plea bargain) for conduct constituting a crime?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.2 Received any OSHA citation and Notification of Penalty containing a violation classified as <u>serious or willful</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.3 Had a <u>government entity</u> find a willful prevailing wage or supplemental payment violation or any other willful violation of New York State Labor Law?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.4 Entered into a consent order with the New York State Department of Environmental Conservation, or received an enforcement determination by any <u>government entity</u> involving a violation of federal, state or local environmental laws?	<input type="checkbox"/> Yes <input type="checkbox"/> No
7.5 Other than previously disclosed: a) Been subject to fines or penalties imposed by <u>government entities</u> which in the aggregate total \$25,000 or more; or b) Been convicted of a criminal offense pursuant to any administrative and/or regulatory action taken by any <u>government entity</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
For each “Yes,” explain:	

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VIII. FINANCIAL AND ORGANIZATIONAL CAPACITY	
8.0 Within the past five (5) years, has the <u>Reporting Entity</u> received any <u>formal unsatisfactory performance assessment(s)</u> from any <u>government entity</u> on any contract?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," provide an explanation of the issue(s), relevant dates, the <u>government entity</u> involved, any remedial or corrective action(s) taken and the current status of the issue(s). Provide answer below or attach additional sheets with numbered responses.	
8.1 Within the past five (5) years, has the <u>Reporting Entity</u> had any <u>liquidated damages</u> assessed over \$25,000?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," provide an explanation of the issue(s), relevant dates, contracting party involved, the amount assessed and the current status of the issue(s). Provide answer below or attach additional sheets with numbered responses.	
8.2 Within the past five (5) years, have any <u>liens</u> or <u>judgments</u> (not including UCC filings) over \$25,000 been filed against the <u>Reporting Entity</u> which remain undischarged?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," provide an explanation of the issue(s), relevant dates, the Lien holder or Claimant's name(s), the amount of the <u>lien(s)</u> and the current status of the issue(s). Provide answer below or attach additional sheets with numbered responses.	
8.3 In the last seven (7) years, has the <u>Reporting Entity</u> initiated or been the subject of any bankruptcy proceedings, whether or not closed, or is any bankruptcy proceeding pending?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," provide the bankruptcy chapter number, the court name and the docket number. Indicate the current status of the proceedings as "Initiated," "Pending" or "Closed." Provide answer below or attach additional sheets with numbered responses.	
8.4 During the past three (3) years, has the <u>Reporting Entity</u> failed to file or pay any tax returns required by <u>federal</u> , state or local tax laws?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," provide the taxing jurisdiction, the type of tax, the liability year(s), the tax liability amount the <u>Reporting Entity</u> failed to file/pay and the current status of the tax liability. Provide answer below or attach additional sheets with numbered responses.	
8.5 During the past three (3) years, has the <u>Reporting Entity</u> failed to file or pay any New York State unemployment insurance returns?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes," provide the years the <u>Reporting Entity</u> failed to file/pay the insurance, explain the situation and any remedial or corrective action(s) taken and the current status of the issue(s). Provide answer below or attach additional sheets with numbered responses.	
8.6 During the past three (3) years, has the <u>Reporting Entity</u> had any <u>government audit(s)</u> completed?	<input type="checkbox"/> Yes <input type="checkbox"/> No
a) If "Yes," did any audit of the <u>Reporting Entity</u> identify any reported significant deficiencies in internal control, fraud, illegal acts, significant violations of provisions of contract or grant agreements, significant abuse or any <u>material disallowance</u> ?	<input type="checkbox"/> Yes <input type="checkbox"/> No
If "Yes" to 8.6 a), provide an explanation of the issue(s), relevant dates, the <u>government entity</u> involved, any remedial or corrective action(s) taken and the current status of the issue(s). Provide answer below or attach additional sheets with numbered responses.	

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<p>IX. ASSOCIATED ENTITIES</p> <p><i>This section pertains to any entity(ies) that either controls or is controlled by the reporting entity. (See definition of “associated entity” for additional information to complete this section.)</i></p>	
<p>9.0 Does the <u>Reporting Entity</u> have any <u>Associated Entities</u>?</p> <p>Note: All questions in this section must be answered if the <u>Reporting Entity</u> is either:</p> <ul style="list-style-type: none"> - An <u>Organizational Unit</u>; or - The entire <u>Legal Business Entity</u> which controls, or is controlled by, any other entity(ies). <p>If “No,” SKIP THE REMAINDER OF SECTION IX AND PROCEED WITH SECTION X.</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>9.1 Within the past five (5) years, has any <u>Associated Entity Official</u> or <u>Principal Owner</u> been charged with a misdemeanor or felony, indicted, granted immunity, convicted of a crime or subject to a <u>judgment</u> for:</p> <ul style="list-style-type: none"> a) Any business-related activity; or b) Any crime, whether or not business-related, the underlying conduct of which was related to truthfulness? 	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>If “Yes,” provide an explanation of the issue(s), the individual involved, his/her title and role in the <u>Associated Entity</u>, his/her relationship to the <u>Reporting Entity</u>, relevant dates, the <u>government entity</u> involved, any remedial or corrective action(s) taken and the current status of the issue(s).</p>	
<p>9.2 Does any <u>Associated Entity</u> have any currently undischarged <u>federal</u>, New York State, New York City or New York local government <u>liens</u> or <u>judgments</u> (not including UCC filings) over \$50,000?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>If “Yes,” provide an explanation of the issue(s), identify the <u>Associated Entity</u>’s name(s), <u>EIN</u>(s), primary business activity, relationship to the <u>Reporting Entity</u>, relevant dates, the Lien holder or Claimant’s name(s), the amount of the <u>lien</u>(s) and the current status of the issue(s). Provide answer below or attach additional sheets with numbered responses.</p>	
<p>9.3 Within the past five (5) years, has any <u>Associated Entity</u>:</p>	
<p>a) Been <u>disqualified</u>, <u>suspended</u> or <u>debarred</u> from any <u>federal</u>, New York State, New York City or other New York local <u>government contracting process</u>?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>b) Been denied a contract award or had a bid rejected based upon a <u>non-responsibility finding</u> by any <u>federal</u>, New York State, New York City, or New York local <u>government entity</u>?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>c) Been <u>suspended</u>, <u>cancelled</u> or <u>terminated for cause</u> (including for <u>non-responsibility</u>) on any <u>federal</u>, New York State, New York City or New York local <u>government contract</u>?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>d) Been the subject of an <u>investigation</u>, whether open or closed, by any <u>federal</u>, New York State, New York City, or New York local <u>government entity</u> for a civil or criminal violation with a penalty in excess of \$500,000?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>e) Been the subject of an indictment, grant of immunity, <u>judgment</u>, or conviction (including entering into a plea bargain) for conduct constituting a crime?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>f) Been convicted of a criminal offense pursuant to any administrative and/or regulatory action taken by any <u>federal</u>, New York State, New York City, or New York local <u>government entity</u>?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>g) Initiated or been the subject of any bankruptcy proceedings, whether or not closed, or is any bankruptcy proceeding pending?</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>For each “Yes,” provide an explanation of the issue(s), identify the <u>Associated Entity</u>’s name(s), <u>EIN</u>(s), primary business activity, relationship to the <u>Reporting Entity</u>, relevant dates, the <u>government entity</u> involved, any remedial or corrective action(s) taken and the current status of the issue(s). Provide answer below or attach additional sheets with numbered responses.</p>	

**NEW YORK STATE
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X. FREEDOM OF INFORMATION LAW (FOIL)

<p>10. Indicate whether any information supplied herein is believed to be exempt from disclosure under the Freedom of Information Law (FOIL). Note: A determination of whether such information is exempt from FOIL will be made at the time of any request for disclosure under FOIL.</p>	<input type="checkbox"/> Yes <input type="checkbox"/> No
<p>If "Yes," indicate the question number(s) and explain the basis for the claim.</p>	

XI. AUTHORIZED CONTACT FOR THIS QUESTIONNAIRE

Name	Telephone	Fax
	ext.	
Title	Email	

**NEW YORK STATE
VENDOR RESPONSIBILITY QUESTIONNAIRE
FOR-PROFIT BUSINESS ENTITY**

Certification

The undersigned: (1) recognizes that this questionnaire is submitted for the express purpose of assisting New York State government entities (including the Office of the State Comptroller (OSC)) in making responsibility determinations regarding award or approval of a contract or subcontract and that such government entities will rely on information disclosed in the questionnaire in making responsibility determinations; (2) acknowledges that the New York State government entities and OSC may, in their discretion, by means which they may choose, verify the truth and accuracy of all statements made herein; and (3) acknowledges that intentional submission of false or misleading information may result in criminal penalties under State and/or Federal Law, as well as a finding of non-responsibility, contract suspension or contract termination.

The undersigned certifies that he/she:

- is knowledgeable about the submitting Business Entity’s business and operations;
- has read and understands all of the questions contained in the questionnaire;
- has not altered the content of the questionnaire in any manner;
- has reviewed and/or supplied full and complete responses to each question;
- to the best of his/her knowledge, information and belief, confirms that the Business Entity’s responses are true, accurate and complete, including all attachments, if applicable;
- understands that New York State government entities will rely on the information disclosed in the questionnaire when entering into a contract with the Business Entity; and
- is under an obligation to update the information provided herein to include any material changes to the Business Entity’s responses at the time of bid/proposal submission through the contract award notification, and may be required to update the information at the request of the New York State government entities or OSC prior to the award and/or approval of a contract, or during the term of the contract.

Signature of Owner/Official _____

Printed Name of Signatory _____

Title _____

Name of Business _____

Address _____

City, State, Zip _____

Sworn to before me this _____ day of _____, 20__;

_____ Notary Public

CERTIFICATION OF COMPLIANCE WITH THE IRAN DIVESTMENT ACT

As a result of the Iran Divestment Act of 2012 (the "Act"), Chapter 1 of the 2012 Laws of New York, a new provision has been added to State Finance Law (SFL) § 165-a and New York General Municipal Law § 103-g, both effective April 12, 2012. Under the Act, the Commissioner of the Office of General Services (OGS) will be developing a list of "persons" who are engaged in "investment activities in Iran" (both are defined terms in the law) (the "Prohibited Entities List"). Pursuant to SFL § 165-a(3)(b), the initial list is expected to be issued no later than 120 days after the Act's effective date at which time it will be posted on the OGS website.

By submitting a bid in response to this solicitation or by assuming the responsibility of a Contract awarded hereunder, each Bidder/Contractor, any person signing on behalf of any Bidder/Contractor and any assignee or subcontractor and, in the case of a joint bid, each party thereto, certifies, under penalty of perjury, that once the Prohibited Entities List is posted on the OGS website, that to the best of its knowledge and belief, that each Bidder/Contractor and any subcontractor or assignee is not identified on the Prohibited Entities List created pursuant to SFL § 165-a(3)(b).

Additionally, Bidder/Contractor is advised that once the Prohibited Entities List is posted on the OGS Website, any Bidder/Contractor seeking to renew or extend a Contract or assume the responsibility of a Contract awarded in response to this solicitation must certify at the time the Contract is renewed, extended or assigned that it is not included on the Prohibited Entities List.

During the term of the Contract, should the County receive information that a Bidder/Contractor is in violation of the above-referenced certification, the County will offer the person or entity an opportunity to respond. If the person or entity fails to demonstrate that he/she/it has ceased engagement in the investment which is in violation of the Act within 90 days after the determination of such violation, then the County shall take such action as may be appropriate including, but not limited to, imposing sanctions, seeking compliance, recovering damages or declaring the Bidder/Contractor in default.

The County reserves the right to reject any bid or request for assignment for a Bidder/Contractor that appears on the Prohibited Entities List prior to the award of a contract and to pursue a responsibility review with respect to any Bidder/Contractor that is awarded a contract and subsequently appears on the Prohibited Entities List.

I, _____, being duly sworn, deposes and says that he/she is the _____ of the _____ Corporation and that neither the Bidder/Contractor nor any proposed subcontractor is identified on the Prohibited Entities List.

SIGNED

SWORN to before me this _____ day of _____, 20__

Notary Public

NON-COLLUSIVE BIDDING CERTIFICATION

1. By submission of this bid, the undersigned bidder and each person signing on behalf of such bidder certifies and in the case of a joint bid each party thereto certifies as to its own organization — UNDER PENALTY OF PERJURY, that to the best of the undersigned’s knowledge and belief:

- (a) The prices in this bid have been arrived at independently without collusion, consultation, communication, or agreement, for the purpose of restricting competition, as to any matter relating to such prices with any other bidder or with any competitor;
- (b) Unless otherwise required by law, the prices which have been quoted in this bid have not been knowingly disclosed by the bidder and will not knowingly be disclosed by the bidder prior to opening, directly or indirectly, to any other bidder or to any competitor; and
- (c) No attempt has been made or will be made by the bidder to induce any other person, partnership or corporation to submit or not to submit a bid for the purpose of restricting competition.

2. The undersigned acknowledges and agrees that a bid shall not be considered for award nor shall any award be made where any of the above have not been complied with; provided however, that if in any case the bidder cannot make the foregoing certification, the bidder shall so state and shall furnish with the bid a signed statement which sets forth in detail the reasons therefor. Where one or more of the above has/have not been complied with, the bid shall not be considered for award nor shall any award be made unless the political subdivision, public department, agency or official thereof to which the bid is made, or his designee, determines that such disclosure was not made for the purpose of restricting competition.

3. The undersigned also acknowledges and agrees that the fact that a bidder (a) has published price lists, rates, or tariffs covering items being procured, (b) has informed prospective customers of proposed or pending publication of new or revised price lists for such items, or (c) has sold the same items to other customers at the same prices being bid, does not constitute, without more, a disclosure within the meaning of paragraph 1 above.

4. The undersigned further acknowledges and agrees that any bid hereafter made to any political subdivision of the state or any public department, agency or official thereof by a bidder which is a corporation or a limited liability company for work or services performed or to be performed or goods sold or to be sold, where competitive bidding is required by statute, rule, regulation, or local law, and where such bid contains the certification referred to in paragraph 1 of this certificate, shall be deemed to have been authorized by the board of directors of the bidder, and such authorization shall be deemed to include the signing and submission of the bid and the inclusion therein of the certificate as to non-collusion as the act and deed of the corporation or limited liability company.

Name of Bidder: _____
(print full legal name)

Date Signed: _____ Signature: _____

Name of Person Signing Certificate: _____
(print full legal name of signer)

Bidder is (check one): an individual, a limited liability partnership, a limited liability company,
 other entity (specify): _____

BIDDER'S CERTIFICATION

Name of Bid: _____

In submitting this Bid, BIDDER represents, as more fully set forth in this Bid, that:

- a) BIDDER acknowledges that they have read, understand, and agree to all aspects of the terms and specifications as presented without reservation or alteration.
- b) When awarded, the bid package becomes the "Contract Document".
- c) That the organization, its principals, and sub-recipients are not currently suspended or debarred from doing business with the Federal Government.
- d) The BIDDER has implemented a written policy addressing sexual harassment prevention in the workplace and provides annual sexual harassment prevention training to all of its employees in accordance with New York State Labor Law §201-g.

Date: _____

Vendor: _____

Authorized Signature: _____

Print Name: _____

Subscribed to and sworn to before me

this _____ day of _____, 20__

Notary Public

Introduction

New York State is a national leader in the fight against sexual harassment and is partnering with employers across the state to further our commitment to ending sexual harassment in the workplace.

This toolkit will provide you step-by-step guidance to implementing the required training and sexual harassment policy, directing you to resources available through New York State and the relevant state agencies.

These resources are all available on the State's Combating Sexual Harassment in the Workplace website: www.ny.gov/programs/combating-sexual-harassment-workplace.

What are the New Requirements?

The 2019 New York State Budget includes the nation's strongest and most comprehensive sexual harassment package, including new resources and requirements for employers. There are two key components under this law:

Policy (see pages 2-4)

Under the new law, every employer in New York State is **required to establish a sexual harassment prevention policy**. The Department of Labor in consultation with the Division of Human Rights has established a model sexual harassment prevention policy for employers to adopt, available at www.ny.gov/programs/combating-sexual-harassment-workplace. Or, employers may adopt a similar policy that meets or exceeds the minimum standards of the model policy (www.ny.gov/combating-sexual-harassment-workplace/employers#model-sexual-harassment-policy).

Training (see pages 5-6)

In addition, every employer in New York State is **required to provide employees with sexual harassment prevention training**. The Department of Labor in consultation with the Division of Human Rights has established this model training for employers to use. Or, employers may use a training program that meets or exceeds the minimum standards of the model training (www.ny.gov/combating-sexual-harassment-workplace/employers#training-requirements).

Policy: Implementation

All employers must adopt and provide a sexual harassment prevention policy to all employees by **October 9, 2018**.

If you want to adopt the State Model Policy:

- The State Model Policy contains fields for you to list your business name and the name/contact information for the individual(s) you have designated to receive sexual harassment complaints. Fill in those fields and apply whatever branding (e.g., logos, etc.) you like. You may choose to modify the policy to reflect the work of your organization and industry specific scenarios or best practices.
- Distribute the policy to all employees in writing or electronically. Employers are also encouraged to have employees acknowledge receipt of the policy, and to post a copy of the policy where employees can easily access it.

If you already have a policy and do NOT want to adopt the State Model Policy:

- Use the checklist on the next page to ensure your policy meets or exceeds the required minimum standards.
- If it already meets those standards, ensure it already has been or will be distributed to employees by October 9, 2018. All future new employees should receive the policy before commencing work.
- Ensure your complaint form and process are up to date and that employees are made aware of it as part of the policy.
- If you do not have a complaint form, a model is available online: www.ny.gov/combating-sexual-harassment-workplace/employers#model-complaint-form
- Review the online FAQs, which outline numerous common questions that may arise: www.ny.gov/combating-sexual-harassment-workplace/combating-sexual-harassment-frequently-asked-questions
- Distribute a copy of your finalized policy to all employees in writing. This may be done electronically, for example, by email. Employers are also encouraged to have employees acknowledge receipt of the policy, and to post a copy of the policy where employees can easily access it.
- You are also encouraged to provide the policy and training to anyone providing services in the workplace.

If you do NOT yet have a policy:

- Download the model policy, available online: www.ny.gov/combating-sexual-harassment-workplace/employers#model-sexual-harassment-policy
- Customize the document by filling in the employer name, person or office designated to receive complaints and appropriate contact information, as highlighted throughout.
- You may choose to modify the policy to reflect the work of your organization and industry specific scenarios or best practices.
- Review the online FAQs, which outline numerous common questions that may arise: www.ny.gov/combating-sexual-harassment-workplace/combating-sexual-harassment-frequently-asked-questions
- Distribute a copy of your finalized policy to all employees in writing. This may be done electronically, for example, by email. Employers are also encouraged to have employees acknowledge receipt of the policy, and to post a copy of the policy where employees can easily access it.
- You are also encouraged to provide the policy and training to anyone providing services in the workplace.

Policy: Minimum Standards Checklist

An employer that does not use the State model policy -- developed by the State Department of Labor and State Division of Human Rights -- must ensure their policy meets or exceeds the following minimum standards.

The policy **must**:

- Prohibit sexual harassment consistent with guidance issued by the Department of Labor in consultation with the Division of Human Rights;
- Provide examples of prohibited conduct;
- Include information concerning the federal and state statutory provisions concerning sexual harassment, remedies available to victims of sexual harassment, and a statement that there may be applicable local laws;
- Include a complaint form;
- Include a procedure for the timely and confidential investigation of complaints that ensures due process for all parties;
- Inform employees of their rights of redress and all available forums for adjudicating sexual harassment complaints administratively and judicially;
- Clearly state that sexual harassment is considered a form of employee misconduct and that sanctions will be enforced against individuals engaging in sexual harassment and against supervisory and managerial personnel who knowingly allow such behavior to continue; and
- Clearly state that retaliation against individuals who complain of sexual harassment or who testify or assist in any investigation or proceeding involving sexual harassment is unlawful.

Training: Instructions for Employers

All employers are required to train current employees by October 9, 2019. New employees should be trained as quickly as possible. In addition, all employees must complete sexual harassment prevention training at least once per year. This may be based on calendar year, anniversary of each employee's start date or any other date the employer chooses.

If you already have a training:

- Use the checklist on the next page to ensure your training meets or exceeds the required minimum standards.
- If your existing training does not, it should be updated to include all the listed elements. You may also provide supplemental training to employers who have already completed the training to ensure they have received training that meets or exceeds the minimum standards.
- Review the online FAQs, which outline numerous common questions that may arise: www.ny.gov/combating-sexual-harassment-workplace/combating-sexual-harassment-frequently-asked-questions

If you do NOT yet have a training:

- Download the model training, available online: www.ny.gov/combating-sexual-harassment-workplace/employers#training-requirements.
 - You may execute this training in a variety of ways, including live in person, via webinar or on an individual basis, with feedback as outlined in the training guidance document.
 - Depending on how you choose to present your training, you may utilize different available resources. For example, if you do a live presentation, you should download the PowerPoint and read the script that appears in the "Notes" of each slide.
 - If you choose to train employees with the video, you may direct them to watch it online or download it and show to a group, after which you would provide them a mechanism for feedback, as outlined in the training guidance document.
- Customize the training document(s) and modify them to reflect the work of your organization, including industry specific scenarios or best practices.
- The training should detail any internal process employees are encouraged to use to complain and include the contact information for the specific name(s) and office(s) with which employees alleging harassment should file their complaints.
- You may wish to include additional interactive activities as part of the training, including an opening activity, role playing or group discussion(s).
- Review the online FAQs, which outline numerous common questions that may arise: www.ny.gov/combating-sexual-harassment-workplace/combating-sexual-harassment-frequently-asked-questions

Training: Minimum Standards Checklist

An employer that does not use this model training -- developed by the State Department of Labor and State Division of Human Rights -- must ensure their training meets or exceeds the following minimum standards.

The training **must**:

- Be interactive (*see the model training guidance document for specific recommendations*);
- Include an explanation of sexual harassment consistent with guidance issued by the Department of Labor in consultation with the Division of Human Rights;
- Include examples of unlawful sexual harassment;
- Include information concerning the federal and state statutory provisions concerning sexual harassment and remedies available to targets of sexual harassment;
- Include information concerning employees' rights of redress and all available forums for adjudicating complaints; and
- Include information addressing conduct by supervisors and additional responsibilities for supervisors.

New York State Department Of Environmental Conservation

Division of Management and Budget Services - Minority and Women's Business Program

625 Broadway, 10th Floor, Albany, New York 12233-5028

Phone: 518.402.9240 Fax: 518.402.9023

Website: www.dec.ny.gov Email: MWBE@dec.ny.gov



Version 7

Consultant / Contractor Detailed M/WBE-EEO Utilization Plan

Contractor Name:

NYSDEC Contract No: Contractor Federal ID:

Contract Start Date: Contract End Date: Date Submitted:

Contractor Address:

City: State: Zip Code

Contractor E-mail: Contractor Phone Number:

Contract Type:

Project County:

Authorized Representative Name:

Authorized Representative Title:

M/WBE Contract Summary	%	Amount	EEO Contract Summary	%	No of Employees
1. NYSDEC Contract Amount	(A)	<input type="text"/>	7. Total Employees in this project	100 %	<input type="text"/>
2. Recipient Share (If Applicable)	(B)	<input type="text"/>	8. Total Goal -Minority Employees %	<input type="text" value="10"/>	<input type="text"/>
3. Total Project Amount (A + B) *	100 %	<input type="text"/>	9. Total Goal - Female Employees %	<input type="text" value="10"/>	<input type="text"/>
4. MWBE Project Goal %	<input type="text"/>	<input type="text" value="\$.00"/>	10. EEO Combined Totals %	<input type="text"/>	<input type="text"/>
5. (Only if needed) N/A	<input type="text"/>	<input type="text" value="\$.00"/>	Please note: The overall goal for MWBE Participation is 30%. The actual participation between MBE and WBE will vary depending on statewide availability.		
6. MWBE Total %	<input type="text"/>	<input type="text" value="\$.00"/>			

Section II - EEO Information: In order to achieve the EEO Goals, Minorities and Females are expected to be employed in the following job categories. Please provide breakdown of **Minority and Female Employees assigned to this project only**. If the EEO goals are not met, please provide an explanation in the comments area.

Job Categories	Total Count of Minority Employees	Breakdown of Total Count of Minority Employees by Gender		Breakdown of Total Count of Minority Employees by Ethnicity				
		Male	Female	African American	Asian	Native American	Hispanic	White
Officials/Managers								
Professionals								
Technicians								
Sales Workers								
Office/Clerical								
Craftsman								
Laborers								
Service / Workers								
Totals								

Comments:

Please don't remove previous comments

Section III - M/WBE Information: In order to achieve the M/WBE Goals, New York State Certified Minority/Women-owned firms are expected to participate in the following manner:

Important: If there is no M/WBE Vendor participation, please provide brief summary of Good Faith Efforts in the comments section on page 2. Do not enter NA or NONE in Vendor Name.

M/WBE Vendor Name	Federal ID	Vendor Status	Subcontract Amount	Start Date	End Date	Payment Date	Work Description
	Total Subcontract Amount						

By printing name below, Contractor: 1.Certifies that the above information is true and complete as of this date. 2. If required, will provide Good Faith Effort documentation to NYSDEC.

Important: Please don't attach this form manually to E-Mail, instead Click "Submit by E-mail" button to send form via E-Mail.

Authorized Representative Signature (Print Name)

FOR NYSDEC MWBE UNIT USE ONLY

Approved By:

Approved Date:

AGREEMENT

THIS AGREEMENT is by and between the Town of Moriah (Owner) and _____(Contractor).

Owner and Contractor, hereby agree as follows:

ARTICLE 1 - WORK

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

- A. Rehabilitation of the Tarbell Hill Pump Station located in the Town of Moriah, including the following:
 - 1. Manhole rehabilitation
 - 2. Replacement of pumps, piping, valves, and ancillary accessories.
 - 3. Architectural and site improvements
 - 4. Electrical and controls improvements including the installation of a new generator, accessories, control panels, etc.
 - 5. Associated appurtenances and ancillary equipment.

ARTICLE 2 - THE PROJECT

2.1 The project for which the work under the Contract Documents may be the whole or only a part is generally described as follows:

Rehabilitation of the Tarbell Hill Pump Station in accordance with the plans and specifications heretofore prepared by Engineering Design & Research, Landscape Architecture, Engineering & Environmental Services, D.P.C. (EDR).

ARTICLE 3 - ENGINEER

3.1 The Project has been designed by EDR (Engineer), which is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

ARTICLE 4 - CONTRACT TIMES

4.1 Time of the Essence

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

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4.2 Days to Achieve Substantial Completion and Final Payment

- A. The Work shall be substantially completed within 270 calendar days from Notice to Proceed, and completed and ready for final payment in accordance with paragraph 14.07 of the General Conditions within 300 calendar days.

4.3 Liquidated Damages

- A. Contractor and Owner recognize that time is of the essence as stated in Paragraph 4.01 above of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in paragraph 4.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), Contractor shall pay Owner \$2,000 for each day that expires after the time specified in Paragraph 4.02 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, Contractor shall pay Owner \$2,500 for each day that expires after the time specified in Paragraph 4.02 above for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 5 - CONTRACT PRICE

5.1 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the amounts determined pursuant to the following:

- A. For all work, at the prices stated in the Bid Form attached hereto as an exhibit.

ARTICLE 6 - PAYMENT PROCEDURES

6.1 Submittal and Processing of Payments

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

6.2 Progress Payments; Retainage

- A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on or about the 15th day of each month during performance of the Work as provided in the following subparagraph. All such payments will be measured by the Schedule of Values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no Schedule of Values, as provided in the General Requirements.
 - 1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.
 - a. 95% of the Work completed (with the balance being retained) and 95% of the value of undamaged materials and equipment not incorporated in the Work but delivered,

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suitably stored, and accompanied by documentation satisfactory to Owner in accordance with Paragraph 14.02 of the General Conditions and Supplementary Conditions, less in each case the aggregate of payments previously made, and less such amounts which may be lawfully deducted.

- B. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100% of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions and less 200% of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion.

6.3 Final Payment

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

ARTICLE 7 - Not used

ARTICLE 8 - CONTRACTOR'S REPRESENTATIONS

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

- A. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.
- B. Contractor has visited the Site and become familiar with and is satisfied as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.
- C. Contractor is familiar with and is satisfied as to all federal, state, and local laws and regulations that may affect cost, progress, and performance of the work.
- D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) , if any, that have been identified in Paragraph SC-4.02 of the Supplementary Conditions as containing reliable "technical data", and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph SC-4.06 of the Supplementary Conditions as containing reliable "technical data".
- E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, or performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; (3) Contractor's safety precautions and programs.
- F. Based on the information and observations referred to in the previous paragraph , Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary

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for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

- G. Contractor is aware of the general nature of work to be performed by others at the Site that relates to the Work as indicated in the Contract Documents.
- H. Contractor has given Engineer written notice of all conflicts errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.
- I. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

ARTICLE 9 - CONTRACT DOCUMENTS

9.1 Contents

- A. The Contract Documents consist of the following:
 - 1. This Agreement (pages 1 to 7, inclusive).
 - 2. Performance Bond (pages 1 to 3, inclusive).
 - 3. Payment Bond (pages 1 to 3, inclusive).
 - 4. General Conditions (pages 1 to 63, inclusive).
 - 5. Supplementary Conditions (pages 1 to 13, inclusive).
 - 6. Specifications as listed in the table of contents of the Project Manual.
 - 7. Drawings consisting of __ sheets with each sheet bearing the following general title: "Tarbell Hill Pump Station Improvements"
 - 8. Addenda (Nos. ____ to _____, inclusive).
 - 9. Exhibits to this Agreement (enumerated as follows):
 - a. Bid Form (pages ___ to ___, inclusive).
 - b. Documentation submitted by Contractor prior to Notice of Award (pages ____ to ____, inclusive).
 - 10. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:
 - a. Notice to Proceed (pages ___ to ___, inclusive).
 - b. Work Change Directives.
 - c. Change Orders.

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- B. There are no Contract Documents other than those listed herein.
- C. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

ARTICLE 10 - MISCELLANEOUS

10.1 Terms

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

10.2 Assignment of Contract

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

10.3 Successors and Assigns

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

10.4 Severability

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

10.5 Contractor's Certifications

- A. Contractor certifies that it has not engaged in corrupt, fraudulent, collusive, or coercive practices in competing for or in executing the Contract. For the purposes of this Paragraph 10.05:
 1. "corrupt practice" means the offering, giving, receiving, or soliciting of any thing of value likely to influence the action of a public official in the bidding process or in the Contract execution;
 2. "fraudulent practice" means an intentional misrepresentation of facts made (a) to influence the bidding process or the execution of the Contract to the detriment of Owner, (b) to establish Bid or Contract prices at artificial non-competitive levels, or (c) to deprive Owner of the benefits of free and open competition;
 3. "collusive practice" means a scheme or arrangement between two or more Bidders, with or without the knowledge of owner, a purpose of which is to establish Bid prices at artificial, non-competitive levels; and

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4. "coercive practice" means harming or threatening to harm, directly or indirectly, persons or their property to influence their participation in the bidding process or affect the execution of the Contract.

(continued)

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

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

Owner _____

Contractor _____

By _____

By _____

Title: _____

Title: _____

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

Attest _____

Attest _____

Title _____

Title _____

Address for giving notices: Address for giving notices:

License No. _____
(where applicable)

If Owner is a corporation, attach evidence of authority to sign. If Owner is a public body, attach evidence of authority to sign and resolution or other documents authorizing execution of Owner-Contractor Agreement.

END OF SECTION

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19016

Tarbell Hill Pump Station Improvements

00520-7

AGREEMENT

EXHIBIT A

**NOTICE OF AWARD
NOTICE TO PROCEED**

Notice of Award

Date: _____

Project: _____

Owner: _____

Owner's Contract No.: _____

Contract: _____

Engineer's Project No.: _____

Bidder: _____

Bidder's Address: *[send Notice of Award Certified Mail, Return Receipt Requested]*

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

[Indicate total Work, alternates, or sections of Work awarded.]

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

[Insert appropriate data if unit prices are used. Change language for cost-plus contracts.]

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

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

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

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

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

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

Owner

By: _____
Authorized Signature

Title

Copy to Engineer

Notice to Proceed

Date: _____

Project: _____

Owner: _____

Owner's Contract No.: _____

Contract: _____

Engineer's Project No.: _____

Contractor: _____

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

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

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

Also, before you may start any Work at the Site, you must:

_____ *[add other requirements]*.

Owner

Given by:

Authorized Signature

Title

Date

Copy to Engineer

EXHIBIT B

**PERFORMANCE BOND
AND PAYMENT BOND**

PERFORMANCE BOND

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

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

OWNER (*Name and Address*):

CONTRACT

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

BOND

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

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

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

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

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner for the performance of the Contract, which is incorporated herein by reference.
2. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 2.1.
3. If there is no Owner Default, Surety's obligation under this Bond shall arise after:
 - 3.1 Owner has notified Contractor and Surety, at the addresses described in Paragraph 9 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor, and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and
 - 3.2 Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 2.1; and
 - 3.3 Owner has agreed to pay the Balance of the Contract Price to:
 1. Surety in accordance with the terms of the Contract; or
 2. Another contractor selected pursuant to Paragraph 3.3 to perform the Contract.
4. When Owner has satisfied the conditions of Paragraph 2, Surety shall promptly, and at Surety's expense, take one of the following actions:
 - 4.1 Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or
 - 4.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or
 - 4.3 Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 5 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or
 - 4.4 Waive its right to perform and complete, arrange for completion, or obtain a new contractor, and with reasonable promptness under the circumstances:
 1. After investigation, determine the amount for which it may be liable to Owner and, as soon as practicable after the amount is determined, tender payment therefor to Owner; or
 2. Deny liability in whole or in part and notify Owner citing reasons therefor.
5. If Surety does not proceed as provided in Paragraph 3 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 3.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.
6. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 3.1, 3.2, or 3.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To the limit of the amount of this Bond, but subject to commitment by Owner

of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

- 6.1 The responsibilities of Contractor for correction of defective Work and completion of the Contract;
- 6.2 Additional legal, design professional, and delay costs resulting from Contractor's Default, and resulting from the actions of or failure to act of Surety under Paragraph 3; and
- 6.3 Liquidated damages, or if no liquidated damages are specified in the Contract, actual damages caused by delayed performance or non-performance of Contractor.

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

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

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

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

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

12. Definitions.

- 12.1 Balance of the Contract Price: The total amount payable by Owner to Contractor under the Contract after all proper adjustments have been made, including allowance to Contractor of any amounts received or to be received by Owner in settlement of insurance or other Claims for damages to which Contractor is entitled, reduced by all valid and proper payments made to or on behalf of Contractor under the Contract.
- 12.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
- 12.3 Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.
- 12.4 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or otherwise comply with the other terms thereof.

FOR INFORMATION ONLY – *(Name, Address and Telephone)*

Surety Agency or Broker:

Owner's Representative *(Engineer or other party)*:

PAYMENT BOND

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

CONTRACTOR (*Name and Address*):

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

OWNER (*Name and Address*):

CONTRACT

Effective Date of Agreement:

Amount:

Description (*Name and Location*):

BOND

Bond Number:

Date (*Not earlier than Effective Date of Agreement*):

Amount:

Modifications to this Bond Form:

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

CONTRACTOR AS PRINCIPAL

SURETY

Contractor's Name and Corporate Seal (Seal)

Surety's Name and Corporate Seal (Seal)

By: _____
Signature

By: _____
Signature (Attach Power of Attorney)

Print Name

Print Name

Title

Title

Attest: _____
Signature

Attest: _____
Signature

Title

Title

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

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.
2. With respect to Owner, this obligation shall be null and void if Contractor:
 - 2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and
 - 2.2 Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.
3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.
4. Surety shall have no obligation to Claimants under this Bond until:
 - 4.1 Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.
 - 4.2 Claimants who do not have a direct contract with Contractor:
 1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
 2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
 3. Not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.
5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.
6. When a Claimant has satisfied the conditions of Paragraph 4, the Surety shall promptly and at Surety's expense take the following actions:
 - 6.1 Send an answer to that Claimant, with a copy to Owner, within 45 days after receipt of the claim, stating the amounts that are undisputed and the basis for challenging any amounts that are disputed.
 - 6.2 Pay or arrange for payment of any undisputed amounts.
7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.
8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

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

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

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

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

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

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

15. Definitions

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

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

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

FOR INFORMATION ONLY – *(Name, Address, and Telephone)*

Surety Agency or Broker:

Owner’s Representative *(Engineer or other)*:

EXHIBIT C

CERTIFICATES OF INSURANCE

EXHIBIT D

IDENTIFICATION OF DRAWINGS

EXHIBIT D

IDENTIFICATION OF DRAWINGS

The Contract Drawings show the character and scope of the work to be performed and have been prepared or approved by ENGINEER. The drawings, all of which constitute an integral part of the Contract Documents as approved for construction on the date so designated on said drawings, carry the ENGINEER's identifying Job No. 19016 and are listed below by sheet number and title:

CONTRACT NO. 1 - GENERAL

<u>Sheet No.</u>	<u>Title</u>
G-001	Cover Sheet
G-002	Abbreviations, Symbols, Legend and General Notes
G-003	Existing Site Plan, Erosion Control Plan and Details
M-001	Existing Pump Station – Demolition Plans
M-002	Pump Station Plans and Sections
M-003	Standard and Miscellaneous Details
E-001	Electrical Legend and Notes
E-002	Electrical Site Plan
E-003	Electrical Floor Plans
E-004	Electrical Single Line Diagrams
E-005	Electrical Control Riser Diagram
E-006	Electrical Details
E-007	Electrical Schedules
E-008	Electrical Schedules
H-001	Foundation Plan and Details
H-002	Foundation Plan and Details

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

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by

ACEC

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of Civil Engineers

P/E National Society of
Professional Engineers
Professional Engineers in Private Practice

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CONSTRUCTION SPECIFICATIONS INSTITUTE

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

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

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

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

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

39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor’s Applications for Payment.
40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.
41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.
42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.
43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.
44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms “substantially complete” and “substantially completed” as applied to all or part of the Work refer to Substantial Completion thereof.
45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.
46. *Supplementary Conditions*—That part of the Contract Documents which amends or supplements these General Conditions.
47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.
48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.
49. *Unit Price Work*—Work to be paid for on the basis of unit prices.
50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such

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

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

1.02 *Terminology*

- A. The words and terms discussed in Paragraph 1.02.B through F are not defined but, when used in the Bidding Requirements or Contract Documents, have the indicated meaning.

B. *Intent of Certain Terms or Adjectives:*

1. The Contract Documents include the terms “as allowed,” “as approved,” “as ordered,” “as directed” or terms of like effect or import to authorize an exercise of professional judgment by Engineer. In addition, the adjectives “reasonable,” “suitable,” “acceptable,” “proper,” “satisfactory,” or adjectives of like effect or import are used to describe an action or determination of Engineer as to the Work. It is intended that such exercise of professional judgment, action, or determination will be solely to evaluate, in general, the Work for compliance with the information in the Contract Documents and with the design concept of the Project as a functioning whole as shown or indicated in the Contract Documents (unless there is a specific statement indicating otherwise). The use of any such term or adjective is not intended to and shall not be effective to assign to Engineer any duty or authority to supervise or direct the performance of the Work, or any duty or authority to undertake responsibility contrary to the provisions of Paragraph 9.09 or any other provision of the Contract Documents.

C. *Day:*

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

D. *Defective:*

1. The word “defective,” when modifying the word “Work,” refers to Work that is unsatisfactory, faulty, or deficient in that it:
 - a. does not conform to the Contract Documents; or
 - b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

- c. has been damaged prior to Engineer's recommendation of final payment (unless responsibility for the protection thereof has been assumed by Owner at Substantial Completion in accordance with Paragraph 14.04 or 14.05).

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

1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.
 2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.
 3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.
 4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.
- F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

- A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.
- B. *Evidence of Insurance:* Before any Work at the Site is started, Contractor and Owner shall each deliver to the other, with copies to each additional insured identified in the Supplementary Conditions, certificates of insurance (and other evidence of insurance which either of them or any additional insured may reasonably request) which Contractor and Owner respectively are required to purchase and maintain in accordance with Article 5.

2.02 *Copies of Documents*

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

2.03 *Commencement of Contract Times; Notice to Proceed*

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

Agreement. In no event will the Contract Times commence to run later than the sixtieth day after the day of Bid opening or the thirtieth day after the Effective Date of the Agreement, whichever date is earlier.

2.04 *Starting the Work*

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

2.05 *Before Starting Construction*

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

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

- A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.
- B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

- A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to

complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of the Work, nor interfere with or relieve Contractor from Contractor's full responsibility therefor.
2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.
3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

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

3.02 *Reference Standards*

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

employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

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

B. *Resolving Discrepancies:*

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

3.04 *Amending and Supplementing Contract Documents*

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

- B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:
1. A Field Order;
 2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or
 3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

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

3.06 *Electronic Data*

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

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

4.01 *Availability of Lands*

- A. Owner shall furnish the Site. Owner shall notify Contractor of any encumbrances or restrictions not of general application but specifically related to use of the Site with which Contractor must comply in performing the Work. Owner will obtain in a timely manner and pay for easements for permanent structures or permanent changes in existing facilities. If Contractor and Owner are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, as a result of any delay in Owner's furnishing the Site or a part thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.
- B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.
- C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

- A. *Reports and Drawings:* The Supplementary Conditions identify:
 - 1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and
 - 2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 - 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or
 - 2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or
 - 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

- A. *Notice:* If Contractor believes that any subsurface or physical condition that is uncovered or revealed either:
1. is of such a nature as to establish that any “technical data” on which Contractor is entitled to rely as provided in Paragraph 4.02 is materially inaccurate; or
 2. is of such a nature as to require a change in the Contract Documents; or
 3. differs materially from that shown or indicated in the Contract Documents; or
 4. is of an unusual nature, and differs materially from conditions ordinarily encountered and generally recognized as inherent in work of the character provided for in the Contract Documents;

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

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

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor’s cost of, or time required for, performance of the Work; subject, however, to the following:
 - a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and
 - b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.
2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:
 - a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or
 - b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and

contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

- c. Contractor failed to give the written notice as required by Paragraph 4.03.A.
3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

4.04 *Underground Facilities*

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

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and
2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:
 - a. reviewing and checking all such information and data;
 - b. locating all Underground Facilities shown or indicated in the Contract Documents;
 - c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and
 - d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

1. If an Underground Facility is uncovered or revealed at or contiguous to the Site which was not shown or indicated, or not shown or indicated with reasonable accuracy in the Contract Documents, Contractor shall, promptly after becoming aware thereof and before further disturbing conditions affected thereby or performing any Work in connection therewith (except in an emergency as required by Paragraph 6.16.A), identify the owner of such Underground Facility and give written notice to that owner and to Owner and Engineer. Engineer will promptly review the Underground Facility and determine the extent, if any, to which a change is required in the Contract Documents to reflect and document the

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

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

4.05 *Reference Points*

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

4.06 *Hazardous Environmental Condition at Site*

- A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.
- B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the accuracy of the "technical data" contained in such reports and drawings, but such reports and drawings are not Contract Documents. Such "technical data" is identified in the Supplementary Conditions. Except for such reliance on such "technical data," Contractor may not rely upon or make any claim against Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors with respect to:
 1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or
 2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or
 3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

- C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.
- D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.
- E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.
- F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.
- G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is

responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

- H. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.H shall obligate Contractor to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.
- I. The provisions of Paragraphs 4.02, 4.03, and 4.04 do not apply to a Hazardous Environmental Condition uncovered or revealed at the Site.

ARTICLE 5 – BONDS AND INSURANCE

5.01 Performance, Payment, and Other Bonds

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

5.02 Licensed Sureties and Insurers

- A. All bonds and insurance required by the Contract Documents to be purchased and maintained by Owner or Contractor shall be obtained from surety or insurance companies that are duly

licensed or authorized in the jurisdiction in which the Project is located to issue bonds or insurance policies for the limits and coverages so required. Such surety and insurance companies shall also meet such additional requirements and qualifications as may be provided in the Supplementary Conditions.

5.03 *Certificates of Insurance*

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

5.04 *Contractor's Insurance*

- A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:
 - 1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;
 - 2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;
 - 3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;
 - 4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

- a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or
 - b. by any other person for any other reason;
5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and
 6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.
- B. The policies of insurance required by this Paragraph 5.04 shall:
1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;
 2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;
 3. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;
 4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);
 5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and
 6. include completed operations coverage:
 - a. Such insurance shall remain in effect for two years after final payment.
 - b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

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

5.06 *Property Insurance*

- A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:
1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;
 2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.
 3. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);
 4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;
 5. allow for partial utilization of the Work by Owner;
 6. include testing and startup; and
 7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued.
- B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors,

members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

- C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with this Paragraph 5.06 will contain a provision or endorsement that the coverage afforded will not be canceled or materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other loss payee to whom a certificate of insurance has been issued and will contain waiver provisions in accordance with Paragraph 5.07.
- D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property insurance coverage within the limits of such amounts, each may purchase and maintain it at the purchaser's own expense.
- E. If Contractor requests in writing that other special insurance be included in the property insurance policies provided under this Paragraph 5.06, Owner shall, if possible, include such insurance, and the cost thereof will be charged to Contractor by appropriate Change Order. Prior to commencement of the Work at the Site, Owner shall in writing advise Contractor whether or not such other insurance has been procured by Owner.

5.07 *Waiver of Rights*

- A. Owner and Contractor intend that all policies purchased in accordance with Paragraph 5.06 will protect Owner, Contractor, Subcontractors, and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) in such policies and will provide primary coverage for all losses and damages caused by the perils or causes of loss covered thereby. All such policies shall contain provisions to the effect that in the event of payment of any loss or damage the insurers will have no rights of recovery against any of the insureds or loss payees thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for all losses and damages caused by, arising out of or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work; and, in addition, waive all such rights against Subcontractors and Engineer, and all other individuals or entities identified in the Supplementary Conditions as loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) under such policies for losses and damages so caused. None of the above waivers shall extend to the rights that any party making such waiver may have to the proceeds of insurance held by Owner as trustee or otherwise payable under any policy so issued.

- B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:
1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and
 2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.
- C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery against Contractor, Subcontractors, or Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them.

5.08 *Receipt and Application of Insurance Proceeds*

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

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

- A. If either Owner or Contractor has any objection to the coverage afforded by or other provisions of the bonds or insurance required to be purchased and maintained by the other party in accordance with Article 5 on the basis of non-conformance with the Contract Documents, the objecting party shall so notify the other party in writing within 10 days after receipt of the certificates (or other evidence requested) required by Paragraph 2.01.B. Owner and Contractor shall each provide to the other such additional information in respect of insurance provided as the other may reasonably request. If either party does not purchase or maintain all of the bonds

and insurance required of such party by the Contract Documents, such party shall notify the other party in writing of such failure to purchase prior to the start of the Work, or of such failure to maintain prior to any change in the required coverage. Without prejudice to any other right or remedy, the other party may elect to obtain equivalent bonds or insurance to protect such other party's interests at the expense of the party who was required to provide such coverage, and a Change Order shall be issued to adjust the Contract Price accordingly.

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

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

6.02 *Labor; Working Hours*

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

6.03 *Services, Materials, and Equipment*

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

6.04 *Progress Schedule*

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

6.05 *Substitutes and "Or-Equals"*

- A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.
 - 1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements

for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

- a. in the exercise of reasonable judgment Engineer determines that:
 - 1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;
 - 2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and
 - 3) it has a proven record of performance and availability of responsive service.
- b. Contractor certifies that, if approved and incorporated into the Work:
 - 1) there will be no increase in cost to the Owner or increase in Contract Times; and
 - 2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

2. *Substitute Items:*

- a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.
- b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.
- c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.
- d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:
 - 1) shall certify that the proposed substitute item will:
 - a) perform adequately the functions and achieve the results called for by the general design,
 - b) be similar in substance to that specified, and
 - c) be suited to the same use as that specified;

- 2) will state:
 - a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,
 - b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and
 - c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;
- 3) will identify:
 - a) all variations of the proposed substitute item from that specified, and
 - b) available engineering, sales, maintenance, repair, and replacement services; and
- 4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

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

Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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

6.06 *Concerning Subcontractors, Suppliers, and Others*

- A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.
- B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or other individual or entity so identified may be revoked on the basis of reasonable objection after due investigation. Contractor shall submit an acceptable replacement for the rejected Subcontractor, Supplier, or other individual or entity, and the Contract Price will be adjusted by the difference in the cost occasioned by such replacement, and an appropriate Change Order will be issued. No acceptance by Owner of any such Subcontractor, Supplier, or other individual or entity, whether initially or as a replacement, shall constitute a waiver of any right of Owner or Engineer to reject defective Work.
- C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:
1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor
 2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.
- D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.
- E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

- F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.
- G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

6.07 *Patent Fees and Royalties*

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

Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

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

6.09 *Laws and Regulations*

- A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.
- B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such Work. However, it shall not be Contractor's responsibility to make certain that the Specifications and Drawings are in accordance with Laws and Regulations, but this shall not relieve Contractor of Contractor's obligations under Paragraph 3.03.
- C. Changes in Laws or Regulations not known at the time of opening of Bids (or, on the Effective Date of the Agreement if there were no Bids) having an effect on the cost or time of performance of the Work shall be the subject of an adjustment in Contract Price or Contract Times. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any such adjustment, a Claim may be made therefor as provided in Paragraph 10.05.

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full

responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.
 3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.
- B. *Removal of Debris During Performance of the Work:* During the progress of the Work Contractor shall keep the Site and other areas free from accumulations of waste materials, rubbish, and other debris. Removal and disposal of such waste materials, rubbish, and other debris shall conform to applicable Laws and Regulations.
- C. *Cleaning:* Prior to Substantial Completion of the Work Contractor shall clean the Site and the Work and make it ready for utilization by Owner. At the completion of the Work Contractor shall remove from the Site all tools, appliances, construction equipment and machinery, and surplus materials and shall restore to original condition all property not designated for alteration by the Contract Documents.
- D. *Loading Structures:* Contractor shall not load nor permit any part of any structure to be loaded in any manner that will endanger the structure, nor shall Contractor subject any part of the Work or adjacent property to stresses or pressures that will endanger it.

6.12 *Record Documents*

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

6.13 *Safety and Protection*

- A. Contractor shall be solely responsible for initiating, maintaining and supervising all safety precautions and programs in connection with the Work. Such responsibility does not relieve Subcontractors of their responsibility for the safety of persons or property in the performance of their work, nor for compliance with applicable safety Laws and Regulations. Contractor shall

take all necessary precautions for the safety of, and shall provide the necessary protection to prevent damage, injury or loss to:

1. all persons on the Site or who may be affected by the Work;
 2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and
 3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.
- B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.
- C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.
- D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.
- E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).
- F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

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

1. *Shop Drawings:*

- a. Submit number of copies specified in the General Requirements.
- b. Data shown on the Shop Drawings will be complete with respect to quantities, dimensions, specified performance and design criteria, materials, and similar data to show Engineer the services, materials, and equipment Contractor proposes to provide and to enable Engineer to review the information for the limited purposes required by Paragraph 6.17.D.

2. *Samples:*

- a. Submit number of Samples specified in the Specifications.
- b. Clearly identify each Sample as to material, Supplier, pertinent data such as catalog numbers, the use for which intended and other data as Engineer may require to enable Engineer to review the submittal for the limited purposes required by Paragraph 6.17.D.

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

C. *Submittal Procedures:*

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

D. *Engineer's Review:*

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

each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

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

6.18 *Continuing the Work*

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

6.19 *Contractor's General Warranty and Guarantee*

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

6. any inspection, test, or approval by others; or
7. any correction of defective Work by Owner.

6.20 *Indemnification*

- A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .
- B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor, Supplier, or other individual or entity under workers' compensation acts, disability benefit acts, or other employee benefit acts.
- C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:
 1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or
 2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

- A. Contractor will not be required to provide professional design services unless such services are specifically required by the Contract Documents for a portion of the Work or unless such services are required to carry out Contractor's responsibilities for construction means, methods, techniques, sequences and procedures. Contractor shall not be required to provide professional services in violation of applicable law.

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

ARTICLE 7 – OTHER WORK AT THE SITE

7.01 Related Work at Site

- A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:
 - 1. written notice thereof will be given to Contractor prior to starting any such other work; and
 - 2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.
- B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be

affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

- C. If the proper execution or results of any part of Contractor's Work depends upon work performed by others under this Article 7, Contractor shall inspect such other work and promptly report to Engineer in writing any delays, defects, or deficiencies in such other work that render it unavailable or unsuitable for the proper execution and results of Contractor's Work. Contractor's failure to so report will constitute an acceptance of such other work as fit and proper for integration with Contractor's Work except for latent defects and deficiencies in such other work.

7.02 *Coordination*

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

7.03 *Legal Relationships*

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

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

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

8.03 *Furnish Data*

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

8.04 *Pay When Due*

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

8.05 *Lands and Easements; Reports and Tests*

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

8.06 *Insurance*

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

8.07 *Change Orders*

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

8.08 *Inspections, Tests, and Approvals*

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

8.09 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

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

8.12 *Compliance with Safety Program*

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

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

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

9.02 *Visits to Site*

- A. Engineer will make visits to the Site at intervals appropriate to the various stages of construction as Engineer deems necessary in order to observe as an experienced and qualified design professional the progress that has been made and the quality of the various aspects of Contractor's executed Work. Based on information obtained during such visits and observations, Engineer, for the benefit of Owner, will determine, in general, if the Work is proceeding in accordance with the Contract Documents. Engineer will not be required to make exhaustive or continuous inspections on the Site to check the quality or quantity of the Work. Engineer's efforts will be directed toward providing for Owner a greater degree of confidence that the completed Work will conform generally to the Contract Documents. On the basis of such visits and observations, Engineer will keep Owner informed of the progress of the Work and will endeavor to guard Owner against defective Work.
- B. Engineer's visits and observations are subject to all the limitations on Engineer's authority and responsibility set forth in Paragraph 9.09. Particularly, but without limitation, during or as a result of Engineer's visits or observations of Contractor's Work, Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work.

9.03 *Project Representative*

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

9.04 *Authorized Variations in Work*

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

9.05 *Rejecting Defective Work*

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

9.06 *Shop Drawings, Change Orders and Payments*

- A. In connection with Engineer's authority, and limitations thereof, as to Shop Drawings and Samples, see Paragraph 6.17.
- B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.
- C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.
- D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

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

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

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

9.09 *Limitations on Engineer's Authority and Responsibilities*

- A. Neither Engineer's authority or responsibility under this Article 9 or under any other provision of the Contract Documents nor any decision made by Engineer in good faith either to exercise or not exercise such authority or responsibility or the undertaking, exercise, or performance of any authority or responsibility by Engineer shall create, impose, or give rise to any duty in contract, tort, or otherwise owed by Engineer to Contractor, any Subcontractor, any Supplier, any other individual or entity, or to any surety for or employee or agent of any of them.
- B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

- C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.
- D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.
- E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

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

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

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

10.02 *Unauthorized Changes in the Work*

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

10.03 *Execution of Change Orders*

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

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

10.04 *Notification to Surety*

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

10.05 *Claims*

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

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

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

11.01 Cost of the Work

- A. *Costs Included:* The term Cost of the Work means the sum of all costs, except those excluded in Paragraph 11.01.B, necessarily incurred and paid by Contractor in the proper performance of the Work. When the value of any Work covered by a Change Order or when a Claim for an adjustment in Contract Price is determined on the basis of Cost of the Work, the costs to be reimbursed to Contractor will be only those additional or incremental costs required because of the change in the Work or because of the event giving rise to the Claim. Except as otherwise may be agreed to in writing by Owner, such costs shall be in amounts no higher than those prevailing in the locality of the Project, shall not include any of the costs itemized in Paragraph 11.01.B, and shall include only the following items:
1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on Saturday, Sunday, or legal holidays, shall be included in the above to the extent authorized by Owner.

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.
3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.
4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.
5. Supplemental costs including the following:
 - a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.
 - b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.
 - c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.
 - d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.
 - e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.
 - f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of

property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

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

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

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

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

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

11.02 *Allowances*

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

B. *Cash Allowances:*

1. Contractor agrees that:

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

C. *Contingency Allowance:*

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

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

11.03 *Unit Price Work*

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

- D. Owner or Contractor may make a Claim for an adjustment in the Contract Price in accordance with Paragraph 10.05 if:
1. the quantity of any item of Unit Price Work performed by Contractor differs materially and significantly from the estimated quantity of such item indicated in the Agreement; and
 2. there is no corresponding adjustment with respect to any other item of Work; and
 3. Contractor believes that Contractor is entitled to an increase in Contract Price as a result of having incurred additional expense or Owner believes that Owner is entitled to a decrease in Contract Price and the parties are unable to agree as to the amount of any such increase or decrease.

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

12.01 *Change of Contract Price*

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

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

12.02 *Change of Contract Times*

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

12.03 *Delays*

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

- C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the control of Owner, or other causes not the fault of and beyond control of Owner and Contractor, then Contractor shall be entitled to an equitable adjustment in Contract Times, if such adjustment is essential to Contractor's ability to complete the Work within the Contract Times. Such an adjustment shall be Contractor's sole and exclusive remedy for the delays described in this Paragraph 12.03.C.
- D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.
- E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

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

13.01 Notice of Defects

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

13.02 Access to Work

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

13.03 Tests and Inspections

- A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.
- B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:
 - 1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and
 3. as otherwise specifically provided in the Contract Documents.
- C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.
 - D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.
 - E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.
 - F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

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

parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

13.05 *Owner May Stop the Work*

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

13.06 *Correction or Removal of Defective Work*

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

13.07 *Correction Period*

- A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:
 - 1. repair such defective land or areas; or
 - 2. correct such defective Work; or
 - 3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and
 - 4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

- B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or repair or such removal and replacement (including but not limited to all costs of repair or replacement of work of others) will be paid by Contractor.
- C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.
- D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.
- E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

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

13.09 *Owner May Correct Defective Work*

- A. If Contractor fails within a reasonable time after written notice from Engineer to correct defective Work, or to remove and replace rejected Work as required by Engineer in accordance with Paragraph 13.06.A, or if Contractor fails to perform the Work in accordance with the Contract Documents, or if Contractor fails to comply with any other provision of the Contract Documents, Owner may, after seven days written notice to Contractor, correct, or remedy any such deficiency.

- B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere. Contractor shall allow Owner, Owner's representatives, agents and employees, Owner's other contractors, and Engineer and Engineer's consultants access to the Site to enable Owner to exercise the rights and remedies under this Paragraph.
- C. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) incurred or sustained by Owner in exercising the rights and remedies under this Paragraph 13.09 will be charged against Contractor, and a Change Order will be issued incorporating the necessary revisions in the Contract Documents with respect to the Work; and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount of the adjustment, Owner may make a Claim therefor as provided in Paragraph 10.05. Such claims, costs, losses and damages will include but not be limited to all costs of repair, or replacement of work of others destroyed or damaged by correction, removal, or replacement of Contractor's defective Work.
- D. Contractor shall not be allowed an extension of the Contract Times because of any delay in the performance of the Work attributable to the exercise by Owner of Owner's rights and remedies under this Paragraph 13.09.

ARTICLE 14 – PAYMENTS TO CONTRACTOR AND COMPLETION

14.01 Schedule of Values

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

14.02 Progress Payments

A. Applications for Payments:

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

arrangements to protect Owner's interest therein, all of which must be satisfactory to Owner.

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

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.
2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:
 - a. the Work has progressed to the point indicated;
 - b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and
 - c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.
3. By recommending any such payment Engineer will not thereby be deemed to have represented that:
 - a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or
 - b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:
 - a. to supervise, direct, or control the Work, or
 - b. for the means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or
 - c. for Contractor's failure to comply with Laws and Regulations applicable to Contractor's performance of the Work, or
 - d. to make any examination to ascertain how or for what purposes Contractor has used the moneys paid on account of the Contract Price, or
 - e. to determine that title to any of the Work, materials, or equipment has passed to Owner free and clear of any Liens.
5. Engineer may refuse to recommend the whole or any part of any payment if, in Engineer's opinion, it would be incorrect to make the representations to Owner stated in Paragraph 14.02.B.2. Engineer may also refuse to recommend any such payment or, because of subsequently discovered evidence or the results of subsequent inspections or tests, revise or revoke any such payment recommendation previously made, to such extent as may be necessary in Engineer's opinion to protect Owner from loss because:
 - a. the Work is defective, or completed Work has been damaged, requiring correction or replacement;
 - b. the Contract Price has been reduced by Change Orders;
 - c. Owner has been required to correct defective Work or complete Work in accordance with Paragraph 13.09; or
 - d. Engineer has actual knowledge of the occurrence of any of the events enumerated in Paragraph 15.02.A.

C. Payment Becomes Due:

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

D. Reduction in Payment:

1. Owner may refuse to make payment of the full amount recommended by Engineer because:
 - a. claims have been made against Owner on account of Contractor's performance or furnishing of the Work;

- b. Liens have been filed in connection with the Work, except where Contractor has delivered a specific bond satisfactory to Owner to secure the satisfaction and discharge of such Liens;
 - c. there are other items entitling Owner to a set-off against the amount recommended; or
 - d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.
2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.
 3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

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

14.04 *Substantial Completion*

- A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.
- B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.
- C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive

certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

- D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities pending final payment between Owner and Contractor with respect to security, operation, safety, and protection of the Work, maintenance, heat, utilities, insurance, and warranties and guarantees. Unless Owner and Contractor agree otherwise in writing and so inform Engineer in writing prior to Engineer's issuing the definitive certificate of Substantial Completion, Engineer's aforesaid recommendation will be binding on Owner and Contractor until final payment.
- E. Owner shall have the right to exclude Contractor from the Site after the date of Substantial Completion subject to allowing Contractor reasonable access to remove its property and complete or correct items on the tentative list.

14.05 *Partial Utilization*

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

14.06 *Final Inspection*

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

14.07 *Final Payment*

A. *Application for Payment:*

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

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

1. If, on the basis of Engineer's observation of the Work during construction and final inspection, and Engineer's review of the final Application for Payment and accompanying documentation as required by the Contract Documents, Engineer is satisfied that the Work has been completed and Contractor's other obligations under the Contract Documents have been fulfilled, Engineer will, within ten days after receipt of the final Application for

Payment, indicate in writing Engineer's recommendation of payment and present the Application for Payment to Owner for payment. At the same time Engineer will also give written notice to Owner and Contractor that the Work is acceptable subject to the provisions of Paragraph 14.09. Otherwise, Engineer will return the Application for Payment to Contractor, indicating in writing the reasons for refusing to recommend final payment, in which case Contractor shall make the necessary corrections and resubmit the Application for Payment.

C. *Payment Becomes Due:*

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

14.08 *Final Completion Delayed*

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

14.09 *Waiver of Claims*

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

ARTICLE 15 – SUSPENSION OF WORK AND TERMINATION

15.01 *Owner May Suspend Work*

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

15.02 *Owner May Terminate for Cause*

- A. The occurrence of any one or more of the following events will justify termination for cause:
1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);
 2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;
 3. Contractor's repeated disregard of the authority of Engineer; or
 4. Contractor's violation in any substantial way of any provisions of the Contract Documents.
- B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:
1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);
 2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and
 3. complete the Work as Owner may deem expedient.
- C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or

remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

- D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.
- E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.
- F. If and to the extent that Contractor has provided a performance bond under the provisions of Paragraph 5.01.A, the termination procedures of that bond shall supersede the provisions of Paragraphs 15.02.B and 15.02.C.

15.03 *Owner May Terminate For Convenience*

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

15.04 *Contractor May Stop Work or Terminate*

- A. If, through no act or fault of Contractor, (i) the Work is suspended for more than 90 consecutive days by Owner or under an order of court or other public authority, or (ii) Engineer fails to act on any Application for Payment within 30 days after it is submitted, or (iii) Owner fails for 30 days to pay Contractor any sum finally determined to be due, then Contractor may,

upon seven days written notice to Owner and Engineer, and provided Owner or Engineer do not remedy such suspension or failure within that time, terminate the Contract and recover from Owner payment on the same terms as provided in Paragraph 15.03.

- B. In lieu of terminating the Contract and without prejudice to any other right or remedy, if Engineer has failed to act on an Application for Payment within 30 days after it is submitted, or Owner has failed for 30 days to pay Contractor any sum finally determined to be due, Contractor may, seven days after written notice to Owner and Engineer, stop the Work until payment is made of all such amounts due Contractor, including interest thereon. The provisions of this Paragraph 15.04 are not intended to preclude Contractor from making a Claim under Paragraph 10.05 for an adjustment in Contract Price or Contract Times or otherwise for expenses or damage directly attributable to Contractor's stopping the Work as permitted by this Paragraph.

ARTICLE 16 – DISPUTE RESOLUTION

16.01 Methods and Procedures

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

ARTICLE 17 – MISCELLANEOUS

17.01 Giving Notice

- A. Whenever any provision of the Contract Documents requires the giving of written notice, it will be deemed to have been validly given if:

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or
2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

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

17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

SUPPLEMENTARY CONDITIONS

These Supplementary Conditions amend or supplement the Standard General Conditions of the Construction Contract, EJCDC C-700 (2007 Edition). 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 indicated in the General Conditions. Additional terms used in these Supplementary Conditions have the meanings indicated herein, which are applicable to both the singular and plural thereof.

ARTICLE 1 - DEFINITIONS AND TERMINOLOGY

SC-1.01 *Defined Terms*

SC-1.01 Modify existing definitions as follows:

3. Replace the phrase "acceptable to Engineer" in Paragraph 1.01.A.3 of the General Conditions with the phrase "furnished by the Engineer"
11. Replace the phrase "concerning the Work" in Paragraph 1.01.A.11 with the phrase "portions of Work assigned to the specific Contractor".
13. Replace the phrase "completion of the Work" in Paragraph 1.01.A.13 with the phrase "completion of the portions of the Work assigned to the specific Contractor".
15. Replace Paragraph 1.01.A.15 in its entirety with the following:

Contractor – All individuals or entities with whom the Owner has entered into an Agreement for portions of Work described in the Contract Documents. Work not assigned to a specific Contractor shall be the responsibility of all Contractors.

SC-1.01 Add the following definitions immediately following Subparagraph 1.01.A.51:

52. General Contractor –The individual or entity with whom Owner has entered into an Agreement to perform the portions of the Work assigned in the Contract Documents to the General Contractor.
53. Electrical Contractor –The individual or entity with whom Owner has entered into an Agreement to perform the portions of the Work assigned in the Contract Documents to the Electrical Contractor.

ARTICLE 2 - PRELIMINARY MATTERS

SC-2.03 *Commencement of Contract Times; Notice to Proceed*

SC-2.03 In the last sentence of Paragraph 2.03.A, replace "later than the sixtieth day after the day of Bid Opening" with "later than the seventy-fifth day after the day of Bid Opening".

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SC-2.05 *Before Starting Construction*

SC-2.05 Add the following language at the end of the first sentence of Paragraph 2.05.A.1:

the preliminary Progress Schedule shall be the 90-Day Progress Schedule identified in Section 01310, Progress Schedule. A baseline Progress Schedule and subsequent monthly updates are required at the times indicated in Section 01310, Progress Schedule.

SC-2.05 Add the following language at the end of the second sentence of Paragraph 2.05.A.3:

The Schedule of Values shall be subdivided into categories matching each line item on the Bid Form. Additional requirements for the Schedule of Values are supplemented in Section 01019, Contract Considerations.

ARTICLE 3 - CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

SC-3.01 *Intent*

SC-3.01 Add the following new paragraph immediately after Paragraph 3.01.C:

- D. Contractor Documents are written in the imperative mood. When direction is given, it shall be understood that the direction is given to Contractor. For example, the phrase "Provide two pumps" shall be understood to mean "Contractor shall provide two pumps."

SC-3.03 *Reporting and Resolving Discrepancies*

SC-3.03 Add the following new paragraph immediately after Paragraph 3.03.B.1.b:

2. In determining Contract Price with respect to a conflict, error, or discrepancy within the Contract Documents, the Contract Documents shall be given precedence in the following order with Change Orders being the highest precedence:
1. Change Orders
 2. Work Change Directives
 3. Field Orders
 4. Agreement
 5. Addenda
 6. Laws and Regulations
 7. Supplementary Conditions
 8. General Conditions
 9. Drawings
 10. Specifications
 11. Owner's Standard Details
 12. Bid Form

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ARTICLE 4 - AVAILABILITY OF LANDS; SUBSURFACE AND PHYSICAL CONDITIONS; REFERENCE POINTS

SC-4.02 *Subsurface and Physical Conditions*

SC-4.02 Add the following new paragraphs immediately after Paragraph 4.02.B:

- C. The following drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) are known to Owner:
 - 1. Drawings dated July 1987, prepared by Greiner Engineering Sciences entitled: "Moriah Corners Sewer", consisting of 27 sheets numbered 1-27, inclusive. All of the information in such drawings constitutes "technical data" on which Contractor may rely.
- D. The drawings identified above are not part of the Contract Documents, but the "technical data" contained therein upon which Contractor may rely, as expressly identified and established above, are incorporated in the Contract Documents by reference. Contractor is not entitled to rely upon any other information and data known to or identified by Owner or Engineer.
- E. Copies of drawings identified in SC-4.02.C and SC-4.02.D that are not included with the Bidding Documents may be examined at EDR in Syracuse, NY during regular business hours.

SC-4.02 Delete Paragraphs 4.02.A and 4.02.B in their entirety and insert the following:

- A. No reports of explorations or tests of subsurface conditions at or contiguous to the Site, or drawings of subsurface conditions relating to existing or subsurface structures are known to the Owner:

SC-4.06 *Hazardous Environmental Condition at Site*

SC-4.06 Delete Paragraphs 4.06.A and 4.06.B in their entirety and insert the following:

- A. No reports or drawings related to Hazardous Environmental Conditions at the Site are known to Owner.

ARTICLE 5 - BONDS AND INSURANCE

SC-5.04 *Contractor's Liability Insurance*

SC-5.04 Add the following new Paragraphs immediately after paragraph 5.04.B:

- C. The limits of liability for the insurance required by Paragraph 5.04 of the General Conditions shall provide coverage for not less than the following amounts or greater where required by Laws and Regulations:

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1. Workers' Compensation, and related coverages under paragraphs 5.04.A.1 and A.2 of the General Conditions:
 - a. State: Statutory
 - b. Applicable Federal (e.g., Longshoreman's): Statutory

2. Contractor's General Liability under paragraphs 5.04.A.3 through A.6 of the General Conditions which shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody, and control of Contractor:
 - a. General Aggregate: \$500,000
 - b. Products - Completed Operations Aggregate: \$2,000,000
 - c. Personal and Advertising Injury: \$1,000,000
 - d. Each Occurrence (Bodily Injury and Property Damage): \$1,000,000
 - e. Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.
 - f. Excess or Umbrella Liability
 - 1) General Aggregate: \$5,000,000
 - 2) Each Occurrence: \$5,000,000

3. Automobile Liability under paragraph 5.04.A.6 of the General Conditions:
 - a. Bodily Injury:
Each Person \$1,000,000
Each Accident \$2,000,000
 - b. Property Damage:
Each Accident \$1,000,000

4. The Contractual Liability coverage required by paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:
 - a. Bodily Injury:
Each Accident \$1,000,000
Annual Aggregate \$2,000,000
 - b. Property Damage:
Each Accident \$1,000,000
Annual Aggregate \$2,000,000

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5. Owner, Engineer, and the following Engineer's Consultants shall be listed as additional insureds: None.
- D. The provisions or endorsements necessary to comply with paragraph 5.04.B.5 of the General Conditions shall include the obligation to notify the Owner and Engineer when an aggregate limit of liability required or certified has been reduced by the payment of claim(s).

ARTICLE 6 - CONTRACTOR'S RESPONSIBILITIES

SC-6.02 *Labor; Working Hours*

SC-6.02. Add the following new Paragraphs immediately after Paragraph 6.02.B:

- C. Normal working hours are defined as 7:00 a.m. to 3:00 p.m., Monday through Friday, excluding Holidays. The following are considered Holidays during which work at the Site is not allowed:
 - New Year's Day
 - Memorial Day
 - Independence Day
 - Labor Day
 - Thanksgiving
 - Day after Thanksgiving
 - Christmas
- D. Should Contractor's working hours extend outside normal working hours, any and all costs for weekend, Holiday, and/or on Site overtime services of Engineer's personnel, including but not limited to direct salaries, fringe benefits, overhead and profit, administration and supervision, incurred by Owner, will be the sole obligation of Contractor. In addition, Contractor shall pay for all travel costs for the above parties to reach the site on weekends, holidays, and/or after hours work.

SC-6.05 *Substitutes and "Or Equals"*

SC-6.05 Add the following subparagraph immediately after Subparagraph 6.05.A.1.b:

- c. Contractor provides a line-by-line comparison of the proposed product to the specified product. Line-by-line comparison shall not only include all specified features, but shall also include all other design and/or manufacturing differences between the proposed product and the specified product. Line-by-line comparison shall show no significant design or manufacturing differences that, in the Engineer's opinion, could result in lesser quality, performance, or reliability of the proposed product compared to the specified product.

SC-6.05.A.2. Add the following subparagraph immediately after Subparagraph 6.05.A.2.d of the General Conditions:

- e. If the substitute item requires modifications to the structures, piping, layouts, etc., detailed on the Drawings or described in the Contract Documents, the application shall also include details of proposed modifications necessary to accommodate the substitute item. Such details shall include

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scaled layouts, dimensions, and other pertinent information to enable Engineer to evaluate the entire application. If the substitute item and proposed modifications are approved, Contractor, at no additional cost to Owner, shall do all work necessary to make such modifications and absorb all costs of any related changes imposed on other contractors. Final details of such modifications shall be prepared and submitted for approval by Contractor in accordance with Section 01300, Submittals.

SC-6.05.A. Add the following paragraph immediately after Paragraph 6.05.A.2 of the General Conditions:

3. Time Constraints: All applications for use of substitutes or 'or equal' items shall be submitted to Engineer within 90 days of the Effective Date of the Agreement. No applications will be considered thereafter unless Contractor produces satisfactory evidence that the specified item is no longer manufactured or is unavailable for the Project.

SC-6.05.C. Add the following subparagraph after Paragraph 6.05.C of the General Conditions:

1. In order to aid Engineer in determining the equality of a proposed 'or equal' or substitute item (when compared to the item actually specified), Contractor shall arrange for the performance of any tests requested by Engineer. The nature, extent, tester and supervisions of such tests including engineering costs, shall be borne by Contractor. Certified test results shall be mailed directly to Engineer for all tests requested.

SC-6.06 *Concerning Subcontractors, Suppliers, and Others*

SC-6.06 Add a new paragraph immediately after Paragraph 6.06.G:

- H. Owner may furnish to any Subcontractor or Supplier, to the extent practical, information about amounts paid to Contractor on account of Work performed for Contractor by a particular Subcontractor or Supplier.

SC-6.08 *Permits*

SC-6.08.A. Add the following subparagraph to Paragraph 6.08.A of the General Conditions:

1. Contractor is required to comply with all requirements of permits imposed upon Owner in the same manner required by Owner.
2. Contractor shall complete, pay for, submit and obtain any permits required for construction including but not limited to building permits, local codes, etc.

SC-6.10 *Taxes*

SC-6.10 Add a new Paragraph immediately after Paragraph 6.10.A:

- B. Owner is exempt from payment of sales and compensating use taxes of the State of New York and of cities and counties thereof on all materials to be incorporated into the Work.

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

SC-6.12 *Record Documents*

SC-6.12 Add the following paragraph immediately after Paragraph 6.12.A:

- B. If Owner utilizes any part of the Project in accordance with paragraph GC-14.05, Contractor shall provide Engineer for Owner's use, a complete set of record drawings current to the date of Owner's utilization.

SC-6.16 *Emergencies*

Add the following paragraph after Paragraph 6.16.A of the General Conditions:

- B. Contractor shall designate one person to respond to emergencies and act on the Contractor's behalf during off-work hours at the Site. The person's name, address, and telephone number shall be provided to Owner during the preconstruction conference and the designated person shall be on call during off-work hours. Response time shall not exceed one hour after notification is given by Owner and/or Engineer that an emergency exists at the Site.

SC-6.17 *Shop Drawings and Samples*

SC-6.17.C.2 Replace "or specific written certification" with "certifying".

SC-6.17.D.1 In the first sentence of Paragraph 6.17.D.1, replace "in accordance with the Schedule of Submittals acceptable to Engineer" with "in accordance with Section 01300, Submittals".

SC-6.17 Add the following new paragraphs immediately after Paragraph 6.17.E:

- F. Furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than three submittals. Engineer will record Engineer's time for reviewing subsequent submittals of Shop Drawings, Samples, or other items requiring approval. Owner will deduct costs for such services from progress payments made to Contractor.
- G. In the event that Contractor requests a change of a previously approved item, Owner will deduct costs for Engineer's charges for its review time unless the need for such change is beyond the control of Contractor.

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ARTICLE 7 - OTHER WORK

SC-7.04 *Claims Between Contractors*

SC-7.04 Add the following new paragraph immediately after Paragraph 7.03:

SC-7.04 *Claims Between Contractors*

- A. Should Contractor cause damage to the work or property of any other contractor at the Site, or should any claim arising out of Contractor's performance of the Work at the Site be made by any other contractor against Contractor, Owner, or Engineer, then Contractor (without involving Owner or Engineer, shall either (1) remedy the damage, (2) agree to compensate the other contractor for remedy of the damage, or (3) remedy the damage and attempt to settle with such other contractor by agreement, or otherwise resolve the dispute by arbitration or at law.
- B. Contractor shall, to the fullest extent permitted by Laws and Regulations, indemnify and hold harmless Owner, Engineer, and the officers, directors, partners, employees, agents and other consultants and subcontractors of each and any of them from and against all claims, costs, losses and damages (including, but not limited to, fees and charges of engineers, architects, attorneys, and other professionals and court and arbitration costs) arising directly, indirectly or consequentially out of any action, legal or equitable, brought by any other contractor against Owner or Engineer consultants, to the extent said claim is based on or arises out of Contractor's performance of the Work. Should another contractor cause damage to the Work or property of Contractor or should the performance of work by any other contractor at the Site give rise to any other Claim, Contractor shall not institute any action, legal or equitable, against Owner or Engineer, 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 arbiter which seeks to impose liability on or to recover damages from Owner or Engineer, on account of any such damage or Claim.
- C. If Contractor is delayed at any time in performing or furnishing the Work by any act or neglect of another contractor, and Owner and Contractor are unable to agree as to the extent of any adjustment in Contract Times attributable thereto, 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 Engineer, for any delay, disruption, interference, or hindrance caused by any other contractor. This paragraph does not prevent recovery from Owner or Engineer, for activities that are their respective responsibilities.

ARTICLE 8 - OWNER'S RESPONSIBILITIES

(No amendments to General Conditions)

ARTICLE 9 - ENGINEER'S STATUS DURING CONSTRUCTION

SC-9.03 *Project Representative*

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

- B. The Resident Project Representative (RPR) will be Engineer'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 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. *Shop Drawings and Samples:*
 - a. Record date of receipt of Samples and approved Shop Drawings.
 - b. Receive Samples which are furnished at the Site by Contractor, and notify Engineer of availability of Samples for examination.
 6. *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.

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7. *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.

8. *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.

9. *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.

10. *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.

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11. *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.
 12. *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.
 13. *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. The RPR shall not:
1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
 2. Exceed limitations of Engineer's authority as set forth in the Contract Documents.
 3. Undertake any of the responsibilities of Contractor, Subcontractors, 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.

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SUPPLEMENTARY CONDITIONS

7. Accept Shop Drawing or Sample submittals from anyone other than Contractor.
8. Authorize Owner to occupy the Project in whole or in part.

ARTICLE 10 - CHANGES IN THE WORK; CLAIMS

(No Amendments to General Conditions.)

ARTICLE 11 - COST OF THE WORK; CASH ALLOWANCES; UNIT PRICE WORK

(No amendments to General Conditions)

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

SC-12.01 *Change of Contract Price*

SC-12.01.C *Contractor's Fee.* Delete the semicolon at the end of Subparagraph 12.01.C.2.c, and add the following language:

, provided, however, that on any subcontracted work the total maximum fee to be paid by Owner under this subparagraph shall be no greater than 27 percent of the costs incurred by the Subcontractor that actually performs the work;

SC-12.03 *Delays*

SC-12.03 Add the following paragraph after Paragraph 12.03.E:

- F. When establishing the Progress Schedule, an allowance shall be made for delays due to inclement weather. Contractor, at the time of each Application for Payment, shall submit to Engineer and Owner a list of all working days lost due to either inclement weather or Site conditions caused by inclement weather for the period covered by the Application for Payment above and beyond the four days allowance required each month. Accompanying this list shall be a summary of the specific conditions which caused the loss. This request will be reviewed by the Engineer in light of observations made by Owner, Engineer, and resident inspector, if any. Approval of the Application for Payment by Owner and Funding Agency, if any, will also include approval of the weather delay request, if acceptable. After Substantial Completion, a Change Order will be executed if a time extension for weather related delays is approved. Any time extension granted for inclement weather will be based solely on the time approved in Applications for Payment.

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

(No Amendments to General Conditions.)

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SUPPLEMENTARY CONDITIONS

ARTICLE 14 - PAYMENTS TO CONTRACTOR AND COMPLETION

SC-14.01 *Schedule of Values*

SC-14.01.A. Replace the phrase "form of Application for Payment acceptable to Engineer" in the first sentence with the phrase "form of Application for Payment furnished by Engineer."

SC-14.02.A. Add the following to the end of Subparagraph 14.02.A.1 of the General Conditions:

By signing the Application and Certificate for Payment, Contractor certifies that all items, units, quantities, and prices of Work and material in the estimate are correct, that all claimed Work has been performed and materials supplied in full accordance with the Contract, and that Contractor has no claims for damages, losses or expense against Owner for compensation in addition to that provided for in the application except such claims for change of Contract Price as Contractor has filed with Engineer and Owner in writing (in accordance with Article 10) prior to the date of his certifying the application.

SC-14.02.B. Add the following subparagraph after subparagraph 14.02.B.5.d of the General Conditions:

- e. or because of Contractor's failure to submit certifications, affidavits, schedules, or other written information when and as required in the Contract Documents, or Contractor's failure to make submittals in accordance with the Schedule of Submittals.

SC-14.02.C. *Payment Becomes Due*

SC-14.02.C.1. In Subparagraph 14.02.C.1, replace "Ten days," with "Thirty days."

SC-14.07 *Final Payment*

SC-14.07.A. Add the following subparagraph immediately after Paragraph 14.07.A.3:

- 4. The application shall be made on forms provided by Engineer. By signing the application and certificate for payment, Contractor certifies that the total cost of the Work and the amount due Contractor for payment is full compensation for all Work done under the terms of the Contract in its original form; that the payment is full compensation for all Work ordered to be done under Change Orders; and that the payment is full compensation for all other Work done by Contractor and for all damages, losses, and expense incurred by Contractor for doing and furnishing everything relating to or arising out of the Work, and that Contractor waives all right to claim or receive any further compensation in addition to that provided for in the final payment except as provided in paragraph 14.09.

ARTICLE 15 - SUSPENSION OF WORK AND TERMINATION

(No Amendments to General Conditions.)

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SUPPLEMENTARY CONDITIONS

ARTICLE 16 - DISPUTE RESOLUTION

(No Amendments to General Conditions.)

ARTICLE 17 - MISCELLANEOUS

Add the following new paragraphs immediately after Paragraph 17.06:

SC-17.07 *Labor and Legal Requirements*

- A. Contractor shall abide by all regulations and laws that relate to labor that may affect the Work of this Contract, including Federal, State, County, Town, City, and Village regulations.
- B. The latest Prevailing Wage Rate Schedules setting forth minimum wages and supplements for this area of the state, together with labor standard provisions and non-discrimination in employment provisions are appended to the Agreement.
- C. The Contractor shall make provision for the disability benefits, unemployment insurance and social security required by law.
- D. The Contractor shall keep himself fully informed of all laws of the State (in which the Project is located) and of the United States of America, and of all municipal laws and ordinances in any manner affecting the Work of this Contract, and of all orders or decrees of any body or tribunal having any jurisdiction or authority in any manner affecting such Work, and shall be responsible for strict compliance therewith. If any clause of this Contract does not conform to any such law, such clause shall be void insofar as it conflicts with such law, and such law shall be operative in lieu thereof.
- E. Each and every provision of law and clause required by law to be inserted in this Contract should be, is and is deemed to be inserted herein, and if through a mistake or otherwise any such provision is not inserted, or it is not correctly inserted, then upon the application of either party the Contract shall forthwith be amended physically to make such insertion.
- F. If any provision herein shall be as to destroy the mutuality of this Contract or to render it invalid or illegal, then if such provision shall not appear to have been so material that without it the Contract would not have been made by the parties, it shall not be deemed to form part thereof but the balance of the Contract shall remain in full force and effect.

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SECTION 01010

SUMMARY OF WORK

PART 1 GENERAL

- A. Provisions of Information for Bidders (IFB) Section 6 supersedes any inconsistencies with this section.

1.01. SECTION INCLUDES

- A. Work covered by Contract Documents.
- B. Contractor's use of site.
- C. Limits of work area.
- D. Construction permits and easements.
- E. Owner occupancy.
- F. Sequence of work.
- G. Connections to existing facilities.
- H. Alteration project procedures.
- I. Cutting and patching.
- J. Continuity of Service Plan.
- K. Requests to work outside normal working hours.

1.02. PROJECT – WORK COVERED BY CONTRACT DOCUMENTS

- A. Work covered by the Contract Documents is described in the Agreement.
- B. Work not specifically identified in the Bid Item Descriptions, but nevertheless required in the Contract Documents, shall be performed as shown and/or specified.

The work will include rehabilitation of the Tarbell Hill Pump Station. The work will include:

1. Replacement of existing pumps, piping, valves, and ancillary equipment.
2. Installation of a new generator and associated equipment as well as electrical and controls improvements.
3. Wet well and valve vault coating, structural and architectural improvements.

1.03. CONTRACTS

- A. Perform work of each prime contract under separate lump sum contracts with the Owner.

1.04. ADMINISTRATIVE AND PROCEDURAL SECTIONS APPLICABLE TO ALL CONTRACTS

- A. Section 01019 – Contract Considerations
- B. Section 01039 – Coordination
- C. Section 01300 – Submittals
- D. Section 01700 – Record Documents

1.05. TEMPORARY FACILITIES AND SERVICES SECTIONS APPLICABLE TO ALL CONTRACTS

- A. Section 01500 – Temporary Facilities

1.06. CONTRACT NO. 1 - GENERAL CONSTRUCTION

- A. Provide administrative and procedural work under the sections listed above.
- B. Provide temporary facilities and services under the sections listed above.
- C. Provide those construction facilities and temporary controls identified in Section 01500 which are required to be provided by the General Contractor.
- D. Prepare, coordinate, and revise Master Construction Progress Schedule as required under Section 01300.
- E. Conduct testing of project components as required under Section 01660.
- F. Perform work identified in Bid Item Description pages for this Contract.
- G. Work of this Contract not specifically identified in the Bid Item Descriptions, but nevertheless required in the Contract Documents, shall be performed as shown and/or specified.

1.07. CONTRACTOR USE OF SITE

- A. Limit use of site to allow for Owner occupancy and/or partial utilization.

1.08. LIMITS OF WORK AREA

- A. Confine construction operations within the Contract Limits shown on the Drawings.
- B. Storage of equipment and materials, or erection and use of sheds outside of the Contract Limits, if such areas are the property of Owner, shall be used only with Owner's approval. Such storage or temporary structures, even within the Contract Limits, shall be confined to Owner's property and shall not be placed on properties designated as easements or rights-of-way.

- C. Where storage of equipment, materials, job trailers, etc. is proposed outside the approved limits of disturbance, obtain permits including erosion and sedimentation control plan approval for those areas at no additional cost to Owner.

1.09. EASEMENTS

- A. Contractors shall obtain and pay for necessary construction permits from those authorities or agencies having jurisdiction over land areas, utilities or structures which are located within the Contract Limits and which will be occupied, encountered, used, or temporarily interrupted by Contractor's operations.
- B. When construction permits are accompanied by regulations or requirements issued by a particular authority or agency, it shall be Contractor's responsibility to familiarize himself and comply with such regulations or requirements as they apply to his operations on this project. All costs associated with additional field supervision or inspection by authorities or agencies having jurisdiction over land areas, utilities, or structures shall be Contractor's responsibility.
- C. Keep an approved set of permitted construction plans on site at all times.
- D. Easements and Rights-of-Way
 1. Limit use of and access to easements and rights-of-way to personnel and equipment necessary to perform work allowed by easement or rights-of-way documents.
 2. Maintain existing protective barriers, such as fences, gates, shrubbery barriers, or other containment devices installed to protect people or private property, such as pets or livestock. Contractor shall be responsible to mitigate damages resulting from Contractor's failure to maintain existing protective barriers.
 3. Maintain adequate access to private property by public service entities, such as U.S. mail, delivery services, utilities, police, fire, rescue, or other emergency services. Contractor shall be responsible to mitigate damages resulting from Contractor's failure to maintain adequate access.
- E. Occupying Private Land
 1. If Contractor intends to occupy private land other than land owned by Owner, land owned by Contractor, or land covered by easements and rights-of-way obtained by the Owner for the performance of the work by the Contractor, then Contractor shall obtain written consent from the owner of the land the Contractor intends to occupy.
 2. Written consent shall be obtained before Contractor enters or occupies the private land with equipment, tools, materials, or Contractor's personnel.
 3. Copies of written consent shall be provided to Owner, if requested by Owner.

1.10. OWNER OCCUPANCY

- A. The Owner will occupy the site during the entire period of construction for the conduct of normal operations.
- B. Cooperate with Owner to minimize conflict and to facilitate Owner's operations.
- C. Schedule the work to accommodate Owner occupancy.

1.11. SEQUENCE OF WORK

A. General

- 1. Provide an intended sequence of construction in accordance with Section 01310, Progress Schedule.
- 2. Contractor shall be solely responsible for the means, manpower, methods, techniques, sequences and procedures of construction unless specifically identified in the Contract Documents.
- 3. Contractor shall be responsible for sequencing and coordinating the work in accordance with the Contract Documents.
- 4. Contractor shall provide temporary facilities to maintain continuous operation of all existing facilities and utilities unless scheduled facility shutdowns are identified in the Contract Documents
- 5. Work shall be performed in a manner that minimizes impact to normal operation of existing facilities and utilities.
- 6. Contractor's operations shall not cause Owner to violate permit requirements.
- 7. If Contractor's operations cause Owner to receive a notice of violation for erosion and sedimentation practices, all costs including fines, legal notices, mailings, administrative tasks, and engineering associated with resolving the notice shall be borne by Contractor.

B. Sequence Constraints

- 1. Contractor shall make provisions to maintain facility operation during construction.
- 2. Contractor shall have all equipment and material on site prior to commencement of demolition activities.

1.12. OPERATION OF EXISTING FACILITIES

- A. Normal operations of the existing facilities will be performed by Owner. Only Owner's staff is allowed to operate existing facilities including equipment, valves, etc.
 - 1. Provide Owner and Engineer a minimum of five working days written notice of

necessary operation of existing valves, or equipment to facilitate construction activities.

2. Contractor's activities shall not disrupt Owner's access to operate and maintain existing equipment and facilities. Contractor shall furnish any temporary access required, including ladders, platforms, grating, and walkways, which shall comply with OSHA laws and regulations, for necessary plant operations.
3. Contractor's operations shall not disrupt truck access for the delivery or hauling of materials and suppliers to and from the site.

1.13. CONNECTIONS TO EXISTING FACILITIES

- A. A. General Contractor shall provide all openings, chases, etc., to fit its own Work and that of other Contractors. All such openings or chases shown on the Contract Drawings, or reasonably implied thereby, or as confirmed or modified by approved Shop Drawings, or shown on manufacturer's erection drawings, shall be provided by General Contractor.
- B. Where pipes or conduits are to pass through slabs or walls, or where equipment frames or supports are to be installed as an integral part of an opening, the sleeves opening forms or frames shall be furnished by the installer of the pipes, conduits or equipment, but shall be installed by General Contractor. Where hanger inserts, anchor bolts and similar items are to be installed as an integral part of a slab or wall, they shall be furnished by the installer of the pipe or other equipment requiring the same, but shall be installed by General Contractor.
- C. When requested by General Contractor, the installer of the pipes, conduit or equipment, including those Contractors who require openings or chases in slabs and walls for passage of ducts, mounting of equipment, etc., shall furnish all necessary information, instructions and materials to effect accurate installation of the required openings, chases, sleeves, frames, inserts, etc. When such items are secured in position, and just prior to construction of the surrounding slab or wall, the Contractor for whom the items are installed shall ascertain the proper number, locations and settings thereof, and General Contractor shall schedule its operations so as to provide a reasonable opportunity and time interval for such inspection.
- D. After installation of the pipe, conduit or duct is completed, the installer shall be responsible for sealing the annular space around the installed pipe, conduit or duct in accordance with laws and regulations.
- E. Cost resulting from correction of defective, ill-timed or incorrectly located work, or for subsequent work which becomes necessary because of omitted openings, chases, sleeves, frames, inserts, etc, shall be borne by the Contractor responsible therefore. To this end, no Contractor shall arbitrarily cut, drill, alter, damage or otherwise endanger the work of another Contractor. The nature and extent of any corrective or additional work shall be subject to the approval of the Engineer following consultation with the Contractors involved.
- F. General Contractor shall be responsible for all equipment and housekeeping pads and shall coordinate locations, sizes, and orientation with the installer. Coordination shall include verification of actual required size. Contractor shall not rely solely on the sizes shown on the Drawings.
- G. Temporary connections to existing facilities are covered in Section 01500, Temporary Facilities.

1.14. FACILITY OUTAGES

A. General

1. Provide a minimum of 15 working days written notice to Owner and Engineer prior to actual date of scheduled shutdown and scheduled work.
2. All associated work that can be completed on the waterline without taking it out of service shall be completed prior to the shutdown to minimize down time.
3. Have all required materials, labor, tools, and equipment on site at the required locations and available for use prior to beginning a shutdown.
4. Provide all temporary facilities required for shutdowns, in accordance with Section 01500, Temporary Facilities.
5. Shutdowns cannot be scheduled to begin on a Friday or day before a scheduled holiday.
6. When temporary shutdowns are planned utilizing tankage with finite storage volumes and/or for limited timeframes, backup bypass pumping systems shall be on site and immediately available for use during shutdowns in case facilities cannot be brought back on-line within the required time limits.
7. Begin work on temporarily isolated facilities immediately after isolation and expedite.
8. During scheduled shutdowns, complete all associated work within time frames and constraints identified in Contract Documents and the approved Continuity of Service Plan, including testing and startup.
9. With the assistance of the Owner operating valving, the Contractor shall be responsible for taking existing facilities off-line and draining the waterline as necessary to complete the work. Owner will designate locations on site for liquid and solids removed from the existing facilities to be pumped and/or hauled by Contractor. Contractor is responsible for final disinfection and cleaning of existing facilities to the degree required to perform associated work.

B. Scheduled Shutdowns – To be outlined in the scheduled composed by the Contractor.

1.15. CONTINUITY OF SERVICE PLAN

- A. Submit in accordance with the procedures described in Section 01300, Submittals.
- B. Submit plans for the continuity of utility service no later than 30 days prior to each planned shutdown.
- C. Plans shall include:
 1. Approximate dates and times of scheduled shutdown of service.
 2. Estimated period of shutdown.

3. Proposed sequence of waterline shutdown and recharge.
 4. Contractor personnel responsible for overseeing operations.
- D. Plans must be approved by Owner prior to proceeding with shutdown. Revisions to Continuity of Service Plans after initial approval shall be resubmitted to Owner at least 14 days prior to scheduled shutdown and must be approved by Owner prior to proceeding with shutdown.

1.16. REQUESTS TO WORK OUTSIDE OF NORMAL WORKING HOURS

- A. Submit requests to work outside normal working hours at least one week in advance. Requests to work outside normal working hours must be approved in advance by Owner.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01019

CONTRACT CONSIDERATIONS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Schedule of Values.
- B. Application for Payment.
- C. Change procedures.
- D. Alternates.

1.02. DEFINITIONS

- A. Mobilization - Mobilization includes, but is not limited to, performance of preparatory construction operations, including the movement of personnel and equipment to the project site; application, fee payment, and acquisition of all required permits (i.e. erosion and sediment control plans, temporary and permanent building and trade permits, utility connections, etc.); and the establishment of Engineer's and Contractor's offices, buildings, and other facilities required at the site in order to begin work on a substantial phase of the Contract. The cost of insurance and bonds.

1.03. SCHEDULE OF VALUES

- A. Submit three hard copies of Schedule of Values and one electronic copy in Microsoft Excel of Schedule of Values in accordance with the time frames identified in General and Supplementary Conditions.
- B. Line items shall be subdivided into the Bid Items shown on the Bid Form.
- C. The sum of all line items in the Schedule of Values shall equal the Total Bid Price included on the Bid Form.
- D. Each line item shall include a directly proportional amount of the Contractor's overhead and profit.
- E. Schedule of Values shall serve as a breakdown of work used to establish progress payments. Progress payments for lump sum items will be made based on the percentages of completion of the work items included in the Schedule of Values for each lump sum item. Progress payments for Allowances will be made as described elsewhere in the Contract Documents.
- F. For lump sum bid items, the following format shall be followed when developing the Schedule of Values:
 - 1. If Mobilization is not identified in the Bid Form as a separate Bid Item, Contractor may include in the Schedule of Values a line item for mobilization as part of a lump sum bid item.

- a. Lump sum line item shall include all work described in the definition of mobilization included herein.
 - b. Costs for bonds and insurance shall be included in the lump sum mobilization line item.
 - c. When Contractor has made utility connections, installed Contractor's field offices, Owner's and/or Engineer's field offices, and all other facilities required to begin work on a substantial portion of the Project, a payment of 50 percent of the lump sum mobilization Bid item will be made provided Contractor has already satisfied the requirements of General Condition Article GC-2.07. The remaining 50 percent will be prorated over the next five monthly progress payments.
 - d. Mobilization cost shall not be greater than 5 percent of the Total Bid Price.
2. Included separate line items for demobilization and contract closeout.
 3. Site work shall be subdivided into itemized quantities and unit costs for all individual construction components. Items shall be separated according to Specification section titles listed in the Table of Contents.
 - a. Site work shall not include earthwork (such as excavation) or structural work (such as foundations) specific to a particular structure or process.
 - b. Include erosion and sediment control under site work.
 - c. Include bypass pumping under site work and include daily, weekly, or monthly unit costs for providing and operating the bypass pumping system(s).
 - d. Include dewatering under site work and include daily costs for each structure.
 - e. Include off-site hauling of fill material under site work.
 - f. Include site restoration.
 - g. Include yard piping and ductbanks.
 - 1) Yard piping and ductbanks shall be subdivided into itemized quantities and unit costs for individual components.
 - 2) Identify major yard piping by pipe diameter and material as individual line items (i.e., 12-inch ductile iron pipe) and by specific pipe segments where possible (i.e., 12-inch ductile iron pipe from pumping station to storage tank). Minor yard piping components not exceeding 5 percent of overall yard piping costs may be identified as lump sum items.
 - 3) Identify major ductbanks by specific segments where possible (i.e., ductbank from control building to filters).

- 4) Piping and ductbank costs shall be stated as cost per unit length, based on the number of linear feet for each piping system estimated by Contractor.
 - 5) Piping and ductbank installation costs may include labor, excavation, bedding, encasement, and/or backfill if desired.
 - h. Include valves and hydrants based on valve type and size.
4. Each major construction component such as a structure or building (i.e., pumping station, filter, control building, etc.) shall have its own subsection and shall be subdivided into line items for individual construction components itemized by unit costs and quantities. Include yard piping, earthwork, or foundations specific to the major construction component with that construction component (i.e. excavation for a pumping station). Items shall be separated according to Specification section titles listed in the Table of Contents. Contractor may provide further divisions within each Specification section if desired or needed for clarity.
- a. For all mechanical equipment, each item shall be separated into the following two distinct payment items:
 - 1) Furnish equipment
 - 2) Install equipment
 - b. Separate line items shall be included for testing and startup including:
 - 1) Preliminary Field Testing.
 - 2) Functional Testing.
 - 3) System Demonstration Testing.
 - 4) Startup.
 - 5) Troubleshooting.
 - 6) Training.
5. Electrical, instrumentation, and controls should be listed under the major construction component (structure or building) in which it is installed. Major electrical components not located in a specific structure or building, such as substations or emergency generators, may have their own line items under the category of "Major Power Distribution."
6. Revise Schedule of Values to include executed Change Orders with each Application for Payment. List each Proposed Change Order (PCO) that is incorporated into executed Change Orders.

1.04. APPLICATIONS FOR PAYMENT

- A. Submit one electronic copy with original signature affixed for each application on forms attached to this

section.

- B. Contractor must have all record documents as identified in General Conditions Article 6.12 current and up to date prior to submitting Applications for Payment.
- C. Contractor shall submit all required backup information including, but not limited to, M/WBE monthly report documentation with each payment application in accordance with funding agency requirements.

1.05. CHANGE PROCEDURES

- A. Supplementing the General Conditions and Supplementary Conditions, Engineer may issue a Proposal Request or Notice of Change which includes a detailed description of a proposed change with supplementary or revised drawings and specifications, a change in Contract Time for executing the change and the period of time during which the requested price will be considered valid. Contractor shall prepare and submit a proposal to perform the indicated work indicating a proposed adjustment in Contract Price and Contract Times within 10 days.
- B. Contractor may propose changes by submitting a request for change to Engineer, describing the proposed change and its full effect on the Work. Include a statement describing the reason for the change, and the effect on the Contract Price and Contract Time with full documentation and a statement describing the effect on Work by separate or other contractors.
- C. Execution of Change Orders - Engineer will issue Change Orders for signatures of parties in the following order: Engineer, Contractor, Owner.

1.06. STANDARD FORMS

- A. Use standard forms attached to this section.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

Contractor's Application for Payment No. _____

	Application Period:	Application Date:
To (Owner):	From (Contractor):	Via (Engineer):
Project:	Contract:	
Owner's Contract No.:	Contractor's Project No.:	Engineer's Project No.:

Application For Payment

Change Order Summary

Approved Change Orders	Number	Additions	Deductions
TOTALS			
NET CHANGE BY			
CHANGE ORDERS			

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

<p>Contractor's Certification</p> <p>The undersigned Contractor certifies, to the best of its knowledge, the following:</p> <p>(1) All previous progress payments received from Owner on account of Work done under the Contract have been applied on account to discharge Contractor's legitimate obligations incurred in connection with the Work covered by prior Applications for Payment;</p> <p>(2) Title to all Work, materials and equipment incorporated in said Work, or otherwise listed in or covered by this Application for Payment, will pass to Owner at time of payment free and clear of all Liens, security interests, and encumbrances (except such as are covered by a bond acceptable to Owner indemnifying Owner against any such Liens, security interest, or encumbrances); and</p> <p>(3) All the Work covered by this Application for Payment is in accordance with the Contract Documents and is not defective.</p> <p>a</p>	<p>Payment of: \$ _____ (Line 8 or other - attach explanation of the other amount)</p> <p>is recommended by: _____ (Engineer) (Date)</p> <p>Payment of: \$ _____ (Line 8 or other - attach explanation of the other amount)</p> <p>is approved by: _____ (Owner) _____ (Date)</p>
---	---

Contractor Signature

By: _____ Date: _____

Approved by: _____
Funding or Financing Entity (if applicable) (Date)

Progress Estimate - Lump Sum Work

Contractor's Application

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

Progress Estimate - Unit Price Work

Contractor's Application

For (Contract):						Application Number:					
Application Period:						Application Date:					
A					B	C	D	E	F		
Item		Contract Information				Estimated Quantity Installed	Value of Work Installed to Date	Materials Presently Stored (not in C)	Total Completed and Stored to Date (D + E)	% (F / B)	Balance to Finish (B - F)
Bid Item No.	Description	Item Quantity	Units	Unit Price	Total Value of Item (\$)						
Totals											

Stored Material Summary

Contractor's Application

For (Contract):								Application Number:			
Application Period:								Application Date:			
A		B		C		D		E	F		G
Bid Item No.	Supplier Invoice No.	Submittal No. (with Specification Section No.)	Storage Location	Description of Materials or Equipment Stored	Stored Previously		Amount Stored this Month (\$)	Subtotal Amount Completed and Stored to Date (D + E)	Incorporated in Work		Materials Remaining in Storage (\$) (D + E - F)
					Date Placed into Storage (Month/Year)	Amount (\$)			Date (Month/Year)	Amount (\$)	
Totals											

Certificate of Substantial Completion

Project:	
Owner:	Owner's Contract No.:
Contract:	Engineer's Project No.:

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

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

Date of Substantial Completion

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

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

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

- Amended Responsibilities Not Amended

Owner's Amended Responsibilities:

Contractor's Amended Responsibilities:

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

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

Executed by Engineer

Date

Accepted by Contractor

Date

Accepted by Owner

Date

Work Change Directive

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

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

Item No.	Description

Attachments (list documents supporting change):

Purpose for Work Change Directive:

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

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

Estimated change in Contract Price and Contract Times:

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

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

Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:		Date of Contract:
Contractor:		Engineer's Project No.:

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

Description:

Attachments (list documents supporting change):

CHANGE IN CONTRACT PRICE:

Original Contract Price:
\$ _____

[Increase] [Decrease] from previously approved
Change Orders No. _____ to No. _____:
\$ _____

Contract Price prior to this Change Order:
\$ _____

[Increase] [Decrease] of this Change Order:
\$ _____

Contract Price incorporating this Change Order:
\$ _____

CHANGE IN CONTRACT TIMES:

Original Contract Times: Working days Calendar days
Substantial completion (days or date): _____
Ready for final payment (days or date): _____

[Increase] [Decrease] from previously approved Change Orders
No. _____ to No. _____:
Substantial completion (days): _____
Ready for final payment (days): _____

Contract Times prior to this Change Order:
Substantial completion (days or date): _____
Ready for final payment (days or date): _____

[Increase] [Decrease] of this Change Order:
Substantial completion (days or date): _____
Ready for final payment (days or date): _____

Contract Times with all approved Change Orders: Substantial
completion (days or date): _____
Ready for final payment (days or date): _____

RECOMMENDED:
By: _____
Engineer (Authorized
Date: _____

ACCEPTED:
By: _____
Owner (Authorized
Date: _____

ACCEPTED:
By: _____
Contractor (Authorized
Date: _____

Approved by Funding Agency (if applicable):

_____ Date: _____

Change Order Instructions

A. GENERAL INFORMATION

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

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

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

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

B. COMPLETING THE CHANGE ORDER FORM

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

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

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

Field Order
No. _____

Date of Issuance: _____ Effective Date: _____

Project:	Owner:	Owner's Contract No.:
Contract:	Date of Contract:	
Contractor:	Engineer's Project No.:	

Attention:

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

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

Description: _____

Attachments: _____

	Engineer:
--	-----------

Receipt Acknowledged by Contractor:	Date:
--	-------

Copy to Owner

SECTION 01026

LUMP SUM ITEMS
(BID ITEM DESCRIPTIONS)

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Price make-up.
- B. Elements of Bid Item Description page.
- C. List of lump sum items.
- D. Bid Item Descriptions - Attached pages.

1.02. PRICE MAKE-UP

- A. Lump sum prices bid by Contractor are deemed to be full compensation for all required labor, products, tools, equipment, plant, transportation, testing, inspection, services, incidentals, administrative procedures, applicable taxes, permit fees, overhead, profit, and other miscellaneous expenses.

1.03. ELEMENTS OF BID ITEM DESCRIPTION PAGE

- A. Identification of lump sum item, as set forth in the Bid Form.
- B. Brief statement of work involved in the item.
- C. Listing of components of work which make-up the item including reference to the section(s) covering each component.
- D. Cross-references to associated work not included in the item.

1.04. LIST OF LUMP SUM ITEMS - CONTRACT NO. 1 - GENERAL

Bid Item Title		Bid Item Description Number
1.	Mobilization / Demobilization	A-1
2.	General Construction	A-2
3.	Record Documents	A-3

1.05. LIST OF LUMP SUM ITEMS – ADDITIVE ALTERNATES - GENERAL

Bid Item Title		Bid Item Description Number
1.	SCADA System	B-1
2.	SCADA Integration	B-2

3.	Valve Vault Resurfacing	B-3
----	-------------------------	-----

1.06. BID ITEM DESCRIPTIONS

- A. Bid Item Description pages are attached at the end of this specification section.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

BID ITEM DESCRIPTION

A-1

LUMP SUM ITEM

BID ITEM A-1

MOBILAZATION / DEMOBILIZATION

- A. DESCRIPTION Under this item, the General Contractor shall mobilize, demobilize, and maintain his forces, equipment, and general plan for the prosecution of the work; provide schedules, submit shop drawing information, protect existing facilities, attend meetings, provide record drawings, bonding and insurance, and provide construction facilities and temporary controls.

- B. WORK INCLUDED UNDER THIS ITEM Mobilization and Demobilization
Insurance and Bonds (General and Supplementary Conditions)
Division 1 Specifications

- C. ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM All other Bid Items.

- D. METHOD OF PAYMENT Payment will be made based on the percentage of work completed on a monthly basis and in accordance with the Contractor's Schedule of Values of Work as approved by the Engineer. The Schedule of Values shall include, as a minimum, the items in paragraph B above.

BID ITEM DESCRIPTION

A-2

LUMP SUM ITEM

BID ITEM A-2

GENERAL CONSTRUCTION

- A. DESCRIPTION Under this item, furnish all materials, labor, tools, and construct the general construction work as called for in the Contract Documents and as outlined below.
- B. WORK INCLUDED UNDER THIS ITEM Division 1 Specifications
Division 2 Specifications
Division 3 Specifications
Division 5 Specifications
Division 9 Specifications
Division 15 Specifications
Division 16 Specifications
Division 17 Specifications
- C. ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM All other Bid Items.
- D. METHOD OF PAYMENT Payment will be made on a lump sum basis in accordance with the Contractor's Schedule of Values which shall include, as a minimum, all items listed herein under "B" broken down into sufficient detail for Engineer to adequately review progress payment amounts.

BID ITEM DESCRIPTION

A-3

LUMP SUM ITEM

BID ITEM A-3

RECORD DOCUMENTS

- A. DESCRIPTION Under this item, the General Contractor shall provide record documents consisting of record drawings in accordance with the Contract Documents.

- B. WORK INCLUDED UNDER THIS ITEM Division 1 Specifications

- C. ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM All other Bid Items.

- D. METHOD OF PAYMENT Payment will be made based on the percentage of work completed on a monthly basis and in accordance with the Contractor's Schedule of Values of Work as approved by the Engineer. The Schedule of Values shall include, as a minimum, the items in paragraph B above.

BID ITEM DESCRIPTION

B-1

LUMP SUM ITEM

BID ITEM B-1

SCADA SYSTEM

- A. DESCRIPTION Under this item, furnish all materials, labor, tools, and integrate the SCADA system to the pump station as called for in the Contract Documents and as outlined below.

- B. WORK INCLUDED UNDER THIS ITEM Division 16 Specifications
Division 17 Specifications

- C. ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM All other Bid Items.

- D. METHOD OF PAYMENT Payment will be made based on the percentage of work completed on a monthly basis and in accordance with the Contractor's Schedule of Values of Work as approved by the Engineer. The Schedule of Values shall include, as a minimum, the items in paragraph B above.

BID ITEM DESCRIPTION

B-2

LUMP SUM ITEM

BID ITEM B-2

SCADA INTEGRATION

- A. DESCRIPTION Under this item, furnish all materials, labor, tools, and integrate the SCADA system to the pump station as called for in the Contract Documents and as outlined below.
- B. WORK INCLUDED UNDER THIS ITEM Division 16 Specifications
Division 17 Specifications
- C. ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM All other Bid Items.
- D. METHOD OF PAYMENT Payment will be made based on the percentage of work completed on a monthly basis and in accordance with the Contractor's Schedule of Values of Work as approved by the Engineer. The Schedule of Values shall include, as a minimum, the items in paragraph B above.

BID ITEM DESCRIPTION

B-3

LUMP SUM ITEM

BID ITEM B-3

VALVE VAULT RESURFACING

- A. DESCRIPTION Under this item, furnish all materials, labor, tools, and integrate the SCADA system to the pump station as called for in the Contract Documents and as outlined below.
- B. WORK INCLUDED UNDER THIS ITEM Division 3 Specifications
Division 5 Specifications
- C. ASSOCIATED WORK NOT INCLUDED UNDER THIS ITEM All other Bid Items.
- D. METHOD OF PAYMENT Payment will be made based on the percentage of work completed on a monthly basis and in accordance with the Contractor's Schedule of Values of Work as approved by the Engineer. The Schedule of Values shall include, as a minimum, the items in paragraph B above.

SECTION 01039

COORDINATION AND MEETINGS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Coordination.
- B. Openings, chases, sleeves, inserts, etc.
- C. Field engineering.
- D. Preconstruction conference.
- E. Site mobilization conference.
- F. Progress meetings.
- G. Preinstallation conferences.
- H. Start-up conference.
- I. Electronic communication requirements.

1.02. RELATED SECTIONS

- A. General Conditions
- B. Supplementary Conditions - Refer to appropriate "SC" paragraphs which supplement or modify the above numbered paragraphs of the General Conditions.
- C. Section 01010 – SUMMARY OF WORK
- D. Section 01300 – SUBMITTALS
- E. Section 01660 - TESTING AND STARTUP

1.03. COORDINATION

- A. Coordinate scheduled work sequences and related operations beforehand with appropriate local, county, or state officials and agencies including affected property owners, when project is to be located in or adjacent to the public right-of-way.
- B. Coordinate scheduling, submittals, and work of the various sections of specifications to assure efficient and orderly sequence of installation of interdependent construction elements, with provisions for accommodating items installed later.
- C. Verify that utility requirement characteristics of operating equipment are compatible with building utilities. Coordinate work of various sections having interdependent responsibilities for installing,

connecting to, and placing in service, such equipment.

- D. Coordinate space requirements and installation of mechanical and electrical work which are indicated diagrammatically on Drawings. Follow routing shown for pipes, ducts, and conduit, as closely as practicable; place runs parallel with line of building. Utilize spaces efficiently to maximize accessibility for other installations, for maintenance, and for repairs.
- E. In finished areas, except as otherwise indicated, conceal pipes, ducts, and wiring within the construction. Coordinate locations of fixtures and outlets with finish elements.
- F. Coordinate completion and cleanup of work of separate sections in preparation for Substantial Completion and for portions of work designated for Owner's occupancy.
- G. After Owner occupancy of premises, coordinate access to site for correction of defective Work and Work not in accordance with Contract Documents, to minimize disruption of Owner's activities.

1.04. OPENINGS, CHASES, SLEEVES, INSERTS, ETC.

- A. Contractor shall provide all openings, chases, etc., in his work to fit the work. All such openings or chases shown on the Contract Drawings, or as required to provide complete work, or as confirmed or modified by shop drawings approved by the Engineer, or shown on manufacturer's erection or Contractor's pipe layout drawings, shall be provided.
- B. Where new pipes or conduits are to pass through existing slabs or walls, or where equipment frames or supports are to be installed as an integral part of an opening, the sleeves, opening forms, or frames shall be furnished by the installer of the pipes, conduits or equipment, but shall be placed by the Contractor. Where hanger inserts, anchor bolts and similar items are to be installed as an integral part of a slab or wall, they shall be furnished by the installer of the pipe or other equipment requiring the same, but shall be placed by the Contractor.
- C. The installer of the pipes, conduit or equipment, including openings or chases in slabs and walls for passage of ducts, mounting of equipment, etc., shall furnish all necessary information, instructions and materials to effect accurate installation of the required openings, chases, sleeves, frames, inserts, etc. When such items are secured in position, and just prior to construction of the surrounding slab or wall, the Contractor shall ascertain the proper number, locations and settings thereof, and the Contractor shall schedule operations to provide an opportunity and time interval for such inspection.
- D. After installation of the pipe, conduit, or duct is completed, the Contractor responsible for the pipe, conduit, or duct shall be responsible for sealing the annular space around the installed pipe, conduit or duct in accordance with the requirements of the applicable local, state or national building code.
- E. Any cost resulting from correction of defective, ill-timed or mislocated work, or for subsequent work which becomes necessary because of omitted openings, chases, sleeves, frames, inserts, etc. shall be borne by the Contractor responsible, therefore. Contractor shall not arbitrarily cut, drill, alter, damage or otherwise endanger the work. The nature and extent of any corrective or additional work shall be subject to the approval of the Engineer.

1.05. FIELD ENGINEERING

- A. Control datum for survey work is that provided by Engineer as shown on the Drawings.

- B. Engineer reserves right to inspect or check results of Contractor field engineering services specified herein for conformance with the Contract Documents.
- C. Contractor shall provide field engineering services as follows:
 - 1. Employ a land surveyor licensed in the State of New York and acceptable to Engineer.
 - 2. Protect all control and reference points. Accurately replace any such point which is damaged or moved.
 - 3. Provide correct lines, grades, locations and elevations for construction of all project components.
 - 4. Provide correct information for preparation of project record documents.
 - 5. Submit a copy of a registered Site drawing and certificate signed by the land surveyor who provided field engineering services that the locations and elevations of the work are in conformance with the Contract Documents.

1.06. PRECONSTRUCTION CONFERENCE

- A. Engineer will schedule a conference after the Effective Date of Agreement.
- B. Attendance Required - Owner, Engineer, funding agency(s) and each Contractor.
- C. Agenda
 - 1. Distribution of extra sets of Contract Documents.
 - 2. Submission of list of subcontractors, list of products, Schedule of Values, and progress schedule.
 - 3. Designation of personnel representing the parties in contract, Owner, and the Engineer.
 - 4. Procedures and processing of field decisions, submittals, substitutions, applications for payments, proposal request, change orders and contract closeout procedures.
 - 5. Scheduling.
 - 6. Requirements of regulatory agencies.
 - 7. Use of premises by Owner and Contractor.
 - 8. Temporary facilities to be provided by Contractor.
 - 9. Procedures for testing.
 - 10. Procedures for maintaining record documents.
 - 11. Maintenance of vehicular traffic

12. Periodic cleanup of site.
 13. Notification of utilities' owners.
 14. Electronic communications.
- D. Engineer will record minutes and distribute copies to participants, and to those affected by decisions made.

1.07. SITE MOBILIZATION CONFERENCE

- A. Engineer will schedule a conference at the project site prior to Contractor occupancy.
- B. Attendance Required - Owner, Engineer, Contractor and job superintendent, Contractor, Contractor's superintendent, and major subcontractors.
- C. Agenda
1. Use of premises by Owner and Contractors.
 2. Owner's requirements
 3. Construction facilities and controls provided by Owner.
 4. Temporary utilities provided by Owner.
 5. Survey and building layout.
 6. Security and housekeeping procedures.
 7. Schedules.
 8. Procedures for testing.
 9. Procedures for maintaining record documents.
 10. Requirements for start-up of equipment.
 11. Inspection and acceptance of equipment put into service during construction period.
 12. Requirements of regulatory agencies.
- D. Engineer will record minutes and distribute copies to participants, and to those affected by decisions made.

1.08. PROGRESS MEETINGS

- A. Engineer will schedule and administer meetings throughout progress of the work as needed.
- B. Engineer will make arrangements for meetings, prepare agenda with copies for participants, preside at meetings, record minutes, and distribute copies within five days to participants, and those affected

by decisions made.

- C. Attendance Required - Owner, Engineer, job superintendent of Contractor, major subcontractors and suppliers, as appropriate to agenda topics for each meeting.
- D. Agenda
 - 1. Review minutes of previous meetings.
 - 2. Review of work progress.
 - 3. Field observations, problems, and decisions.
 - 4. Identification of problems which impede planned progress.
 - 5. Review of submittals schedule and status of submittals.
 - 6. Review of off-site fabrication and delivery schedules.
 - 7. Maintenance of progress schedule.
 - 8. Corrective measures to regain projected schedules.
 - 9. Planned progress during succeeding work period.
 - 10. Coordination of projected progress.
 - 11. Maintenance of quality and work standards.
 - 12. Effect of proposed changes on progress schedule and coordination.
 - 13. Other business relating to work.

1.09. PREINSTALLATION CONFERENCES

- A. When required in individual specification sections, General Contractor shall convene a preinstallation conference at work site prior to commencing work of the section.
- B. Require attendance of parties directly affecting, or affected by, work of the specific section.
- C. Notify Engineer five days in advance of meeting date.
- D. Prepare agenda, preside at conference, record minutes, and distribute copies within 10 days after conference to participants, with two copies to Engineer.
- E. Review conditions of installation, preparation and installation procedures, and coordination with related work.

1.10. STARTUP CONFERENCE

- A. Engineer will schedule a coordinating conference at least 14 days prior to start-up.

- B. Attendance Required - Owner, Engineer, plant operator, Contractor and job superintendent.
- C. Prerequisites
 - 1. All prerequisites addressed in Section 01660, Testing and Startup, shall be satisfied prior to conference.
 - 2. All shop drawings and required manuals of instruction and maintenance shall be made available by the Contractor.
- D. Agenda
 - 1. Determine status of equipment.
 - 2. Ascertain presence of materials required to be at site for start-up procedure.
 - 3. Review responsibilities of Owner and Contractor.
 - 4. Establish startup procedure; develop schedule(s) when appropriate.
 - 5. General coordination of all aspects of startup and initial operation.
 - 6. New York State Department of Environmental Conservation notification.
- E. Engineer will record minutes of meeting and distribute copies within 15 days to participants.

1.11. ELECTRONIC COMMUNICATION REQUIREMENTS

- A. Submit each shop drawing in electronic format in accordance with Section 01300, Submittals
- B. Request for Information (RFI) – Shall be submitted in electronic format. Information should include, but not be limited to: Document sent from/to information.
 - 1. RFI number.
 - 2. Date created.
 - 3. RFI title/description.
 - 4. Question.
 - 5. Proposed solution.
 - 6. Referenced Drawing.
 - 7. Referenced specification section.
 - 8. Attachments - Provide all additional information relative to the RFI such as sketches, drawings, product data, etc. in pdf format.

- C. Submit construction photographs required under Section 01380, Construction Documentation, electronically as attachments in .pdf format.
- D. Submit all letters and memorandums not related to items previously described in this Article in .pdf form via email.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01300

SUBMITTALS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Submittal procedures.
- B. Review of submittals.
- C. Schedule of submittals.
- D. Proposed products list.
- E. Shop drawings.
- F. Samples.
- G. Manufacturers' instructions.
- H. Manufacturers' certificates.

1.02. RELATED SECTIONS

- A. General Conditions
 - 1. Schedules.
 - 2. Progress schedule.
 - 3. Shop drawings and samples.
 - 4. Submittal procedures.
 - 5. Final payment (delivery of required documents).
- B. Supplementary Conditions - Refer to the appropriate "SC" paragraphs which supplement or modify the General Conditions.
- C. Section 01640 - EQUIPMENT-GENERAL
- D. Section 01700 - CLOSEOUT AND RECORD DOCUMENTS
- E. Section 11990 - OEM CONTROL PANELS
- F. Section 15170 - MOTORS

1.03. SUBMITTAL PROCEDURES

- A. Transmit each required submittal using Engineer-accepted form.
- B. Number the submittals as follows:
1. First - Specification section number.
 2. Submittal number within the specification section.
 3. Review cycle number.
 4. Title of submittal.
- C. Identify project, Contractor, subcontractor or supplier; pertinent Drawing sheet and detail number(s), and specification section number, as appropriate.
- D. Apply Contractor's stamp, signed or initialed certifying that review, verification of products required, field dimensions, adjacent construction work, and coordination of information, is in accordance with the requirements of the work and Contract Documents. Stamp shall show the following information:
1. Shop Submittal Number _____
 2. Deviations: None _____; As Listed _____
 3. Reference Specification Number _____
 4. Reference Drawing Number _____
 5. Space Requirement: As Designed _____ Different, As Listed _____
 6. Representation is made to the Owner and Engineer that the Contractor has determined and verified all field measurements and quantities, field construction criteria, materials, catalog numbers and similar data, that he has reviewed and coordinated the information in each shop drawing with the requirements of the work and the Contract Documents, and hereby approves this submittal.

Contractor _____

Signature _____

Date _____
- E. All submittals shall be submitted through electronic submission system. All submittals shall be in PDF format. All files shall be combined into a single bookmarked file.
- F. Identify deviations from Contract Documents and Product or system limitations which may be detrimental to successful performance of the completed work in accordance with General Conditions.
- G. Identify space requirements which differ from those designed or shown on the Contract Documents.

- H. Revise and resubmit in accordance with General Conditions. Identify all changes made since previous submittal in a cover letter or memorandum
- I. Distribute copies of reviewed submittals to concerned parties. Instruct parties to promptly report any inability to comply with provisions.
- J. Submittals not requested will not be recognized or processed.
- K. Submittals for which a performance affidavit is required by the individual specification section or Section 01640, Equipment-General, will not be reviewed until an acceptable performance affidavit is included.
- L. Items shall not be fabricated or delivered without fully approved shop drawings.
- M. Ensure no associated work begins until associated shop drawings are fully approved.
- N. Fabrication prior to receiving an "Approved" or "Approved as Corrected – No Resubmittal Required" is at Contractor's risk.

1.04. REVIEW OF SUBMITTALS

- A. Review of submittals will be in accordance with General Conditions.
- B. Review Times
 - 1. No less than 14 days shall be allowed for Engineer's review of submittals and resubmittals unless otherwise specified in the Contract Documents.
 - 2. No less than 14 days shall be allowed for Engineer's review of Division 17 submittals and all other items including PLC-based control systems.
- C. Review Codes
 - 1. Approved.
 - 2. Approved as Corrected – No Resubmittal Required.
 - 3. Approved as Corrected – Resubmittal Required.
 - 4. Approved as Corrected – Provide Requested Information Only.
 - 5. Revise and Resubmit.
 - 6. Not Approved.
 - 7. For Informational Purposes Only.
- D. Payment will not be made for any items requiring submittals until no further submittals are required for the item

1.05. SCHEDULE OF SUBMITTALS

- A. Include schedule of submittals with baseline schedule.
- B. Revise and resubmit until acceptable to Engineer.

1.06. PROPOSED PRODUCTS LIST

- A. Within 10 days after date indicated in the Notice to Proceed, submit complete list of major products proposed for use, with name of manufacturer, trade name, and model number of each product, and appropriate specification section number.
- B. For products specified only by reference standards, give manufacturer, trade name, model or catalog designation, and reference standards.
- C. Submit all "or-equal" and substitution items in accordance with the requirements of the General Conditions and Supplementary Conditions.

1.07. SHOP DRAWINGS

- A. Provide information in accordance with General Conditions as supplemented herein and as required by individual specification sections.
- B. Shop drawing submittals shall include all descriptive data, performance characteristics, material specifications, spare parts list, drawings, piping diagrams, wiring schematics, and shall be complete and accurate to indicate item-by-item compliance with the Contract Documents.
- C. Shop drawings shall be drawn at scales matching those on the Drawings depicting the same items.
- D. All catalog cuts, manufacturer's specifications, drawings, and verbal descriptions shall be clearly marked to allow identification of the specific products used.
- E. If the submittal deviates from the requirements of the specifications in any way, it shall be clearly marked in the submittal with the justifying reason stated for evaluation by Engineer.
- F. Electrical and control submittals shall include a verbal description of the functions, metering equipment, alarm points, alarm sequences, and any other specific features provided. Control panel submittals shall be in accordance with Section 11990, OEM Control Panels, and Division 17, Instrumentation Specifications.
- G. Electric motor submittals shall be in accordance with Section 15170, Motors.
- H. All electrical equipment submittals shall be in accordance with Division 16, Electrical Specifications.

1.08. SAMPLES

- A. Provide in accordance with General Conditions as supplemented herein and as required by individual specification sections.
- B. Submit samples to illustrate functional and aesthetic characteristics of the product, with integral parts and attachment devices. Coordinate sample submittals for interfacing work.

- C. Submit samples of finishes from the full range of manufacturers' standard colors in custom colors selected, textures, and patterns for Engineer's selection.
- D. Include identification on each sample, with full project information.
- E. Submit the number or samples specified in individual specification sections; one of which will be retained by Engineer.
- F. Reviewed samples which may be used in the work are indicated in individual specification sections.

1.09. MANUFACTURER'S INSTRUCTIONS

- A. When specified in individual specification sections, submit manufacturers' printed instructions for delivery, storage, assembly, installation, startup, adjusting, and finishing, in quantities specified for product data.
- B. When specified in Section 01640, Equipment-General, submit manufacturer's operation and maintenance instructions for equipment supplied for this project. Manuals shall be delivered after shop drawing approval and prior to equipment being started up, and shall be prepared in accordance with Section 01640, Equipment-General.
- C. Identify conflicts between manufacturers' instructions and Contract Documents.

1.10. MANUFACTURER'S CERTIFICATES

- A. When specified in individual specification sections, submit manufacturer's certificate to Engineer for review, in quantities specified for product data.
- B. Indicate that material or product conforms to or exceeds specified requirements. Submit supporting reference data, affidavits, and certifications as appropriate.
- C. Certificates may be recent or previous test results on material or product, but must be acceptable to Engineer.
- D. When specified in Section 01640 or individual specification sections, submit manufacturer's performance affidavit for equipment to be furnished for this project. Affidavits shall be of format and content prescribed in Section 01640, Equipment-General, and shall be included with the shop drawing or product data submittal for the item of equipment to be furnished.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01310

PROGRESS SCHEDULE

PART 1 GENERAL

1.01. SUMMARY

- A. This specification section covers the development and utilization of the progress schedule. In the event of conflicts or discrepancies with any other provisions of the Contract Documents relating to such, this section shall govern.

1.02. DEFINITIONS

- A. Terms used herein shall be in accordance with the definitions set forth in the Associated General Contractor's of America (GCA) publication, "Construction Planning & Scheduling".

1.03. BASIC REQUIREMENTS

- A. Schedule and monitor all work using Critical Path Method (CPM) techniques.
- B. Progress schedule shall be maintained throughout entire contract and shall be used by Contractor to schedule, plan, organize, and execute the work.
- C. Progress schedule shall:
 - 1. Comply with Contract Times identified in the Agreement.
 - 2. Reflect all mandated sequencing identified in Contract Documents.
 - 3. Include adequate time for Engineer's review of submittals. Under no circumstances will the progress schedule be allowed to include Engineer review times shorter than those prescribed in Section 01300, Submittals, and individual specification sections. The need for resubmittals based on Engineer's review will not entitle Contractor to Contract Time extensions and the progress schedule must include adequate time for resubmittals.
 - 4. Include time required by Contract Documents based on work days lost due to inclement weather.
 - 5. Progress schedule shall include adequate time for testing and startup.
- D. Each activity, except Notice to Proceed, shall have at least one predecessor. Each activity, except final completion, shall have at least one successor.
- E. Construction activities shall have a maximum duration of 20 work days. All durations shall be developed based on definitive manpower and resource planning.
- F. Float is not for the exclusive benefit of the Owner or Contractor and must be used in the best interest of the Project in order to maintain Contract Times. Contractor will not be allowed to sequester float through such strategies as extended activity durations, extensive crew/resource sequencing, etc.

1.04. SUBMITTALS

A. Submit the following in accordance with the procedures identified in Section 01300, Submittals:

1. Baseline Schedule

a. Submit one electronic version within 10 days after Notice to Proceed.

b. Bar chart shall show the following for each activity:

- 1) Activity ID
- 2) Activity description
- 3) Original duration
- 4) Early start
- 5) Early finish
- 6) Late start
- 7) Late finish

2. Monthly Updates

a. After acceptance of the baseline progress schedule, submit monthly updates with each Application for Payment. The cutoff date for each monthly update shall be mutually agreed upon by Engineer and Contractor prior to submittal of first monthly update.

b. Submit one electronic version.

c. The monthly updates shall include, but not be limited to, tabulated listing of all activities showing the following:

- 1) Activity ID
- 2) Activity description
- 3) Original duration
- 4) Percent complete
- 5) Remaining duration
- 6) Early start or actual start
- 7) Early finish or actual finish
- 8) Late start or actual start

- 9) Late finish or actual finish
 - 10) Total float
- B. Engineer's review of Progress Schedule submissions is solely to determine if progress schedule has been prepared in accordance with Contract Documents. Such acceptance will not impose on Engineer and/or Owner responsibility for the progress schedule, sequencing of work, progress of work, nor will it interfere with and/or relieve Contractor full responsibility for the progress schedule, means, methods, and sequence of construction when not specifically dictated by the Contract Documents.
- C. Should Contractor fail to provide submittals, and/or revised submittals, within the time frames prescribed, Contractor will be in default and Owner is not obligated to provide progress payments to Contractor until such time as acceptability of submittals can be verified.

1.05. BASELINE PROGRESS SCHEDULE

- A. Baseline progress schedule shall include no activity progress.
- B. Provide sufficient detail to allow use for planning, scheduling, and control all work included in contract. The degree of detail shall be to the satisfaction of the Engineer, and shall account for the following project-specific items:
- 1. Structural breakdown of project.
 - 2. Required phasing.
 - 3. Milestones.
 - 4. Trades involved.
 - 5. Maintaining operation of existing facilities.
 - 6. Subcontractor work plans.
 - 7. Crew flows and sizes.
 - 8. Access to site and work areas.
 - 9. Identification of coordination between Contractor, subcontractors, and suppliers.
 - 10. Testing and startup.
 - 11. Partial utilization by Owner.
- C. In addition to a breakdown of physical construction activities specified herein, include activities for the following:
- 1. Submittals.
 - 2. Engineer's review of submittals.

3. Fabrication and delivery of materials and equipment.
 4. Finish milestone activity for all Functional Tests associated with a given system(see Section 01660, Testing and Startup, for definition).
 5. Separate activities for loading/debugging application software for each system. Amount of time Contractor shall allow for these activities shall be no less than that defined in the Division 17 specifications.
- D. Update to include any revisions to the System Delivery Plan identified in Section 01660, Testing and Startup.
- E. The accepted baseline progress schedule will form the basis of the first monthly update.

1.10. REVISIONS

- A. The Owner, Engineer, and Contractor shall have the right to propose revisions to the progress schedule if it is deemed to be in the best interest of the project.
- B. All Owner, Engineer, and Contractor proposed revisions must be submitted to each party no later than seven days prior to the date by which Contractor must submit monthly updates in order for proposed revisions to be considered for that update.
- C. Objections to Proposed Revisions
1. If Owner, Engineer, and/or Contractor object to proposed revisions made by any other party, the objecting party shall provide written notice to each other party within seven days of receipt of proposed revisions, stating objections.
 2. Proposed revisions that are not mutually agreeable shall be discussed at the following progress meeting.
- D. Engineer shall have final say on acceptance or rejection of all proposed progress schedule revisions based solely on requirements of the Contract Documents.
- E. All Engineer-accepted revisions will be incorporated into the next progress schedule update.

1.11. RECOVERY SCHEDULES

- A. If Contractor fails to achieve planned progress, as indicated in the progress schedule, and lack of progress delays the critical path or an intermediate Milestone by more than 10 work days, submit a proposed recovery schedule to Engineer identifying how Contractor will recover lost time.
- B. Failure to submit a recovery schedule and failure to cooperate with the Owner and/or Engineer in the recovery schedule process shall allow Owner the right to order Contractor to increase manpower to recover lost time, without adjustment to the Contract Price.
- C. Owner has the right to withhold progress payments until such time as Contractor's progress is brought into compliance with progress schedule.

1.12. DELAYS AND EXTENSIONS OF CONTRACT TIMES

- A. When Contractor believes that Contract Times will be delayed by circumstances outside of its control, Contractor shall include with its notice of Claim, a forward looking Time Impact Analysis (TIA) identifying the anticipated impact to Contract Times. Forward looking TIA shall include the following;
1. A fragnet prepared using the progress schedule submitted with the most recent Application for Payment.
 2. A report identifying all new activities included with the fragnet and all proposed logic changes associated with the fragnet.
 3. Summary of all requested extensions to Contract Times.
 4. Cause of the delay, actions Contractor proposes to take to minimize delays, and actions Contractor proposes for Owner and/or Engineer to minimize delays.
- B. Engineer will review each forward looking TIA after submission. If acceptable to Engineer, Engineer will provide written notice to Owner within 14 days of submission, copying Contractor on correspondence, recommending that the fragnet should be incorporated into the progress schedule and a change order should be issued providing requested extension of Contract Times. Owner will provide written notice to Contractor within 14 days of receipt of Engineer's recommendation, either concurring or denying Engineer's recommendation.
- C. If a forward looking TIA submittal is not acceptable to Engineer, Engineer will provide written notice to Contractor identifying deficiencies with TIA. Contractor will have seven days from receipt of Engineer's written notice to submit a revised TIA addressing deficiencies.
- D. Contract Time extensions will only be considered for events that impact Contract Times as demonstrated by acceptable forward looking TIAs.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01380

CONSTRUCTION DOCUMENTATION

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Construction photographs.

1.02. DESCRIPTION

- A. Take construction record photographs prior to mobilization and daily during the course of the work.
- B. Contractor shall provide construction documentation as specified in this section unless otherwise noted.

1.03. CONSTRUCTION PHOTOGRAPHS

- A. Contractor shall provide digital construction photographs taken weekly during the major stages on construction listed below and shall be furnished to Engineer and Owner with each Application for Payment.
 - 1. Site before mobilization. A minimum of 25 digital photographs of the pre-construction conditions shall be provided.
 - 2. Progress photos of each work area.
 - 3. Completion of underground facilities prior to backfilling.
 - 4. Completion of site clearing.
 - 5. Completion of excavations.
 - 6. Completion of reinforcing and formwork prior to concrete pours.
 - 7. Completion of enclosure for each structure.
 - 8. Interior of tanks prior to filling with liquid.
 - 9. Installation of all interior and exposed exterior piping, equipment, and electrical components.
 - 10. Testing of all piping, equipment, and systems.
 - 11. Completion of work at each work area.
 - 12. Completion of site restoration and landscaping.

- B. Views and Quantities Required
 - 1. At least 10 photos per week of work area.
 - 2. Multiple views of each item.
- C. Camera used for digital photography shall be a 10.0 megapixel or greater.
- D. Electronic Copies
 - 1. Maintain database of pictures for the entire length of the project.
 - 2. Provide a CD with electronic versions of all prints taken in during the course of the Project (in .jpg format) with final Application for Payment.
 - 3. All electronic copies of photos shall be in .jpg format. All electronic copies of photos shall be arranged on CDs by date and subject.
 - 4. All electronic copies of the photos shall include the following identification:
 - a. Name and Owner's Contract number.
 - b. Subject and orientation of view (for example, "Aeration Tank Foundation, looking north").
 - c. Date and time of exposure.

1.04. REUSE OF CONSTRUCTION DOCUMENTATION

- A. All construction documentation furnished to Owner shall become the property of the Owner and cannot be copyright or otherwise protected in a manner that prevents free reuse by either the Owner and/or Engineer.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. DELIVERY OF PRINTS AND ELECTRONIC COPIES

- A. Preconstruction photos shall accompany the first Application for Payment. This Application for Payment will not be approved without receipt of such materials.
- B. Monthly construction photos (in electronic format) shall accompany each monthly Application for Payment. Monthly Applications for Payment will not be approved without receipt of such materials.
- C. Final construction photos shall accompany the final Application for Payment. This Application for Payment will not be approved without receipt of such materials.

- D. Provide prints at the request of the Owner or Engineer.

END OF SECTION

SECTION 01400
QUALITY CONTROL

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Quality assurance and control of installation.
- B. References and standards.
- C. Tolerances.
- D. Field samples.
- E. Inspection and testing services.
- F. Testing by Contractor.
- G. Shop testing.
- H. Manufacturers' field services and reports.

1.02. QUALITY ASSURANCE/CONTROL OF INSTALLATION

- A. Monitor quality control over suppliers, manufacturers, products, services, site conditions, and workmanship, to produce work of specified quality.
- B. Comply fully with manufacturers' instructions.
- C. Verify that field measurements are as indicated on shop drawings and as instructed by the manufacturer.
- D. If manufacturers' instructions conflict with Contract Documents, request clarification from Engineer before proceeding.
- E. Comply with specified standards as a minimum quality for the work except when code requirements or equipment manufacturer requires more stringent standards.
- F. Perform work by persons qualified to produce workmanship of specified quality.
- G. Secure products in place with positive anchorage devices designed and sized to withstand stresses, vibration, physical distortion and disfigurement.
- H. Employ skilled and experienced installer to perform cutting and patching.
- I. Submit written request in advance of cutting or altering elements which may affect:
 - 1. Structural integrity of element.

2. Integrity of weather-exposed or moisture-resistant elements.
 3. Efficiency, maintenance, or safety of element.
 4. Visual qualities of sight-exposed elements.
 5. Work of Owner or separate contractor.
- J. Execute cutting, fitting, and patching, including excavation and fill, to complete work and to:
1. Fit the several parts together, to integrate with other work.
 2. Uncover work to install or correct ill-timed work.
 3. Remove and replace defective and non-conforming work.
 4. Remove samples of installed work for testing.
 5. Provide openings in elements of work for penetrations of mechanical and electrical work.
- K. Execute work by methods which will avoid damage to other work, and provide proper surfaces to receive patching and finishing.
- L. Cut rigid materials using masonry saw or core drill.
- M. Restore work with new products in accordance with requirements of Contract Documents.
- N. Fit work tight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces.
- O. Maintain integrity of wall, ceiling, or floor construction; completely seal voids.
- P. Refinish surfaces to match adjacent finishes. For continuous surfaces, refinish to nearest intersection; for an assembly, refinish entire unit.
- Q. Identify any hazardous substance or condition exposed during the work to the Engineer in writing for decision or remedy.

1.03. REFERENCES AND STANDARDS

- A. For products and workmanship specified by association, trade, or other consensus standards, comply with requirements of the standard, except when more rigid requirements are specified and/or are required by applicable codes.
- B. Obtain copies of standards where required by individual specification sections.
- C. If specified reference standards conflict with Contract Documents, request clarification from Engineer before proceeding.

1.04. TOLERANCES

- A. Monitor fabrication and installation tolerance control to produce acceptable work. Do not permit tolerances to accumulate.
- B. Comply with manufacturers' tolerances. If manufacturers' tolerances conflict with Contract Documents, request clarification from Engineer before proceeding.
- C. Adjust products to appropriate dimensions; position before securing products in place.

1.05. FIELD SAMPLES

- A. Furnish field samples at the site as required by individual specification sections.
- B. Acceptable samples represent a quality level for the work.
- C. Where field sample is specified in individual specification sections to be removed, clear area after field sample has been accepted by Engineer.

1.06. TESTS AND INSPECTIONS

- A. Contractor shall employ and pay for the services of an independent testing laboratory to perform inspections, tests, and approvals.
- B. Independent testing laboratory will:
 - 1. Perform inspections, tests, and other services specified in the individual specification sections and as required by Engineer and Owner.
 - 2. Perform inspecting, testing, and source quality control which may occur on or off project site, as required by Engineer or Owner.
 - 3. Prepare and submit reports to the Construction Administrator indicating observations and results of tests and indicating compliance or non-compliance with Contract Documents. Construction Administrator will forward copy of report(s) to Contractor.
- C. Contractor shall:
 - 1. Cooperate with independent firm; furnish samples of materials; furnish design mix, equipment, tools, storage and assistance as requested.
 - 2. Notify Construction Administrator firm 24 hours prior to expected time for operations requiring services.
 - 3. Provide weekly look-ahead schedules for testing needs.
 - 4. Make arrangements with independent firm and pay for additional samples and tests required for Contractor's own use. Independent laboratory must be licensed to operate in the State of New York.
- D. Retesting required because of non-conformance to specified requirements shall be performed, on

instructions by the Construction Administrator, by the same independent firm which performed the initial tests and inspections.

- E. Costs for retesting and re-inspection will be deducted from progress payments to Contractor.

1.07. SHOP TESTING

- A. All electrically-driven equipment shall be tested for functionality and performance at the factory.
- B. To the extent practical, equipment shall be assembled, tested and certified at the factory and the working clearances checked to ensure that all parts are properly fitted. At the discretion of the Engineer, this requirement will be waived for equipment that is impractical to test in the factory.
- C. Equipment shall be tested in the shop of the manufacturer in a manner which shall conclusively prove that its characteristics, including any specified pressure, duty, capacity, efficiency, performance, function, or other special requirements, comply fully with the requirements of the Contract Documents and that it will operate in the manner specified. All computations shall be recorded and dated, certified copies of the test results shall be submitted to the Engineer.
- D. Electric motors 10 HP and larger shall be assembled, tested and certified at the factory and the working clearances checked to insure that all parts are properly fitted. The tests shall be in accordance with ANSI/IEEE 112 – Standard Test Procedure for Polyphase Induction Motors and Generators and ANSI/IEEE 115 – Test Procedures for Synchronous Machines standards, including heat run and efficiency tests. All computations shall be recorded and dated, certified copies of the test results shall be submitted to the Engineer.
- E. Shop tests shall confirm that equipment was manufactured within required physical tolerances and that the equipment operates within acceptable limits of the specified performance. Equipment shall be retested following correction of any deficiencies until it is found to be acceptable.
- F. Test measurements shall be taken with properly calibrated instruments. Tests shall be conducted in accordance with recognized standards and procedures.
- G. Additional shop testing requirements may be found in the individual specification sections under which the equipment will be provided.

1.08. MANUFACTURERS' FIELD SERVICES

- A. When specified in individual specification sections, material or product suppliers or manufacturers shall provide qualified staff personnel to observe site conditions, conditions of surfaces and installation, quality of workmanship, start-up of equipment, test, adjust and balance of equipment and demonstration and training as applicable, and to initiate instructions when necessary.
- B. Submit qualifications of observer to Engineer 30 days in advance of required observations. Observer subject to approval of Engineer.
- C. Report observations and site decisions or instructions given to applicators or installers that are supplemental or contrary to manufacturers' written instructions.
- D. Certify that equipment has been properly installed and is ready for start-up and testing.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01410

REFERENCES

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Partial list of references.

1.02 REFERENCES

- A. When a reference standard is specified, comply with requirements and recommendations stated in that standard, except when they are modified by the Contract Documents, or when applicable laws, ordinances, rules, regulations or codes establish stricter standards. The latest provisions of applicable standards shall apply to the work, unless otherwise specified. Reference standards include, but are not necessarily limited to, the following:

1. AA – Aluminum Association
2. AABC – Associated Air Balance Council
3. AAMA – American Architectural Manufacturer's Association
4. AASHTO – American Association of State Highway and Transportation Officials.
5. ABMA – American Bearing Manufacturers Association
6. ABMA – American Boiler Manufacturers Association
7. ACGIH – American Conference of Governmental Industrial Hygienists
8. ACI – American Concrete Institute
9. ACIFS – American Cast Iron Flange Standards
10. ADA – Americans with Disabilities Act
11. ADAAG – Americans with Disabilities Act Accessibility Guidelines
12. ADC – Air Diffusion Council
13. AEIC – Association of Edison Illuminating Companies
14. AF&PA – American Forest and Paper Association
15. AGA – American Galvanizers Association
16. AGA – American Gas Association
17. AGMA – American Gear Manufacturing Associations
18. AHA – American Hardboard Association
19. AHAM – Association of Home Appliance Manufacturers
20. AIA – American Institute of Architects
21. AISC – American Institute of Steel Construction
22. AISI – American Iron and Steel Institute
23. ALSC – American Lumber Standard Committee
24. AMCA – Air Movement and Control Association, Inc.
25. AMP – Architectural Metal Manufacturers
26. ANSI – American National Standards Institute
27. APA/EWA – American Plywood Association
28. API – American Petroleum Institute
29. API – American Pipe Institute
30. ARI – Air-Conditioning and Refrigeration Institute
31. ASCE – American Society of Civil Engineers
32. ASHRAE – American Society of Heating, Refrigeration, and Air Conditioning Engineers
33. ASME – American Society of Mechanical Engineers

34. ASPE – American Society of Plumbing Engineers
35. ASTM – American Society for Testing and Materials
36. AWPA – American Wood Preservers Association
37. AWS – American Welding Society
38. AWWA – American Water Works Associations
39. BIA – Brick Industry Association
40. BOCA – The Building Officials and Code Administrators National Building Code
41. BS – British Standards Institution
42. CAS – Chemical Abstract Services
43. CDA – Copper Development Association
44. CGA – Compressed Gas Association
45. CGMI – Ceramic Glazed Masonry Institute
46. Cisca – Ceiling and Interior Systems Construction Association
47. CISP – Cast Iron Soil Pipe Institute
48. CLFMI – Chain Link Fence Manufacturer's Institute
49. CMAA – Crane Manufacturers Association of America
50. CRSI – Concrete Reinforcing Steel Institute
51. CSA – Canadian Standards Association
52. CSDA – Concrete Sawing & Drilling Association, Inc
53. CTI – Cooling Tower Institute
54. DHI – Door and Hardware Institute
55. DIN – German Institute for Standards
56. DIPRA – Ductile Iron Pipe Research Association
57. DOE – Department of Energy
58. EIA – Electronic Industries Association
59. EEI – Edison Electric Institute
60. EJMA – Expansion Joint Manufacturers' Association
61. FAA – Federal Aviation Administration
62. FCC – Federal Communication Commission
63. Fed Spec – Federal Specifications
64. FIPS – Federal Information Processing Standards Publication
65. FM – Factory Mutual
66. FRPI – Fiberglass Reinforced Plastics Institute
67. GA – Gypsum Association
68. GANA – Glass Association of North America
69. GLUMRB – Great Lakes and Upper Mississippi River Board (10 States)
70. GS – Green Seal
71. HI – Hydraulic Institute
72. HMI – Hoist Manufacturers Institute
73. HMMA – Hollow Metal Manufacturers Association
74. IASDS – International Association of Concrete Drillers and Sawyers
75. IBC – International Building Code
76. IBR – Institute of Boiler and Radiator Manufacturers
77. ICEA – Insulated Cable Engineers Association
78. IEC – International Electrotechnical Commission
79. IECC – International Energy Conservation Code
80. IEEE – Institute of Electrical and Electronic Engineers
81. IFC – International Fire Code
82. IMSA – International Municipal Signal Association
83. IPCEA – Insulated Power Cable Engineers Association
84. ISA – International Society of Automation

85. ISO – International Standards Organization
86. JIC – Joint Industrial Council
87. LBL – Lawrence Berkeley National Laboratory
88. MIL – Military Specifications
89. ML/SFA – Metal Lath/Steel Framing Association
90. MSS – Manufacturers Standardization Society
91. NAAMM – National Association of Architectural Metal Manufacturers
92. NACE – National Association of Corrosion Engineers
93. NAPF – National Association of Pipe Fabricators
94. NB – National Board of Boiler Pressure Vessels
95. NCMA – National Concrete Masonry Association
96. NCWM – National Conference on Weights and Measures
97. NEBB – National Environmental Balancing Bureau
98. NEC – National Electrical Code
99. NELMA – Northeastern Lumber Manufacturers Association
100. NEMA – National Electrical Manufacturers Association
101. NESC – National Electrical Safety Code
102. NETA – International Electrical Testing Association
103. NFPA – National Fire Protection Association
104. NFRC – National Fenestration Rating Council
105. NGA – National Glass Association
106. NIST – National Institute of Standards and Technology
107. NLGA – National Lumber Grade Authority
108. NPCA – National Precast Concrete Association
109. NRCA – National Roofing Contractors Association
110. NSF – National Sanitary Foundation
111. NTMA – National Terrazzo and Mosaic Association
112. NYCRR – Codes, Rules and Regulations of the State of New York
113. NYSBC – New York State Building Code
114. NYSDAM – New York State Department of Agriculture and Markets
115. NYSDEC – New York State Department of Environmental Conservation
116. NYSDOL – New York State Department of Labor
117. NYSDOT – New York State Department of Transportation
118. OSHA – Occupational Safety and Health Administration
119. OTC – Ozone Transport Commission
120. PCA – Portland Cement Association
121. PCI – Prestressed Concrete Institute
122. PDI – Plumbing and Drainage Institute
123. PEI – Petroleum Equipment Institute
124. PESH – Public Employee Safety & Health (PESH) Program
125. PFI – Pipe Fabrication Institute
126. PGMCM – Primary Glass Manufacturers Council
127. PPI – Plastic Pipe Institute
128. RCSC – Research Council on Structural Connections
129. RFCI – Resilient Floor Covering Institute
130. RMA – Rubber Manufacturers' Association
131. SAE – Society of Automotive Engineers
132. SASA – New York State School Asbestos Safety Act
133. SCAQMD – South Coast Air Quality Management District's
134. SDI – Steel Deck Institute
135. SDI – Steel Door Institute

136. SMACNA – Sheet Metal and Air Conditioning Contractors National Association
137. SPI – Society of the Plastics Industry
138. SSPC – Society of Protective Coatings
139. STI – Steel Tank Institute
140. SWPPP – Storm Water Pollution Prevention Plan
141. TCNA– Tile Council of North America, Inc.
142. UBC – Uniform Building Code
143. UFPO – Underground Facilities Protection Organization
144. UL – Underwriters Laboratory
145. UNI-BELL – Uni-Bell Plastic Pipe Association
146. USACE – U.S. Army Corps of Engineers
147. USBR – United States Department of the Interior, Bureau of Reclamation
148. USDA – United States Department of Agriculture
149. USEPA – United States Environmental Protection Agency
150. USGBC – U.S. Green Building Council
151. USHUD – United States Department of Housing and Urban Development New York State
152. WCLIB – West Coast Lumber Inspection Bureau
153. WEF – Water Environment Federation

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01500

TEMPORARY FACILITIES

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Continuity of Service.
- B. Temporary utilities
- C. Temporary controls.
- D. Construction facilities.

1.02. CONTINUITY OF SERVICE

- A. Provide temporary equipment including pumps, piping, valves, bulkheads, electrical equipment and all system components necessary to maintain the existing facilities in service during construction.
- B. Provide temporary power, instrumentation, controls, and alarms necessary to assure continued facilities operation during the alterations of existing facilities components or installation of new equipment.
- C. Construction may require the closing of various gates and valves to isolate tanks, channels, and equipment. The Owner does not guarantee that the gates and valves will be completely water tight. It is the Contractor's responsibility to take whatever measures are necessary to proceed with construction in the event that valves or gates leak.
- D. Provide temporary access required, including ladders, platforms, grating, walkways, and awnings which comply with OSHA laws, for necessary facilities operations.
- E. Provide all line stops and temporary bypass piping and valves required to connect new piping to existing piping, unless otherwise specified.
- F. No extra payment shall be made for any labor, materials, tools, equipment or temporary facilities required during construction. All costs therefore shall be considered to have been included in the Bid.

1.10. TEMPORARY SANITARY FACILITIES

- A. Contractor shall provide and maintain required sanitary facilities and enclosures for use by all persons employed at the site.
- B. Contractor shall remove facilities from site at end of construction.

1.11. BARRIERS

- A. Contractor shall provide barriers to prevent unauthorized entry to construction areas to allow for Owner's use of site, and to protect existing facilities and adjacent properties from damage from construction operations and demolition. Maintain Owner access to all areas of plant in continuous

operation.

- B. Provide barricades and covered walkways required by governing authorities for public rights-of-way and for public access to existing building.
- C. Provide protection for plant life designated to remain. Replace damaged plant life.
- D. Protect vehicles, stored materials, site, and structures from damage.
- E. Supplement barriers with suitable signs, railings and night lights, as necessary to conform with governing authorities and regulations.

1.12. WATER CONTROL

- A. Contractor shall grade site to drain. Maintain excavations free of water. Provide, operate, and maintain pumping equipment.
- B. Protect site from puddling or running water. Provide water barriers as required to protect Site from soil erosion.

1.13. PROTECTION OF INSTALLED WORK

- A. Contractor shall protect its installed work from damage and deterioration due to construction activities, traffic, birds, pests, vermin, wildlife, pets, pedestrians, visitors, vandals, dust, vapors, floods, precipitation, driving rain, wind, snow storms, melting temperatures, or freezing temperatures; provide special protection where specified in individual specification sections.
- B. Provide temporary and removable protection for installed products. Control activity in immediate work area to minimize damage.
- C. Provide protective coverings at walls, projections, jambs, sills, and soffits of openings.
- D. Protect finished floors, stairs, and other surfaces from traffic, dirt, wear, damage, or movement of heavy objects, by protecting with durable sheet materials.
- E. Prohibit traffic or storage upon waterproofed or roofed surfaces. If traffic or activity is necessary, obtain recommendations for protection from waterproofing or roofing material manufacturer.
- F. Prohibit traffic over landscaped areas. Provide adequate barriers, directional signs, and/or guards, if necessary to provide adequate protection of landscaped areas.
- G. Owner reserves right to order that additional protective measures be taken beyond those proposed by Contractors, to safeguard the existing facilities and Work at no additional cost to Owner.

1.14. SECURITY

- A. Contractor shall provide security and facilities to protect its work, and that of other contractors including existing facilities, and Owner's operations from unauthorized entry, vandalism, or theft.
- B. Contractor shall maintain a daily sign-in sheet for his workers and subcontractors.

1.15. ACCESS ROADS

- A. Contractor shall utilize existing on-site roads for project access and construction traffic. Coordinate with Owner and Engineer.
 - 1. Provide detours as necessary for unimpeded traffic flow.
 - 2. Roads shall be free for use by all personnel involved in project and be adequate for transportation of persons, materials, equipment, and products to construction area.
 - 3. Maintain roads in serviceable condition, free of obstructions, potholes, ponded water, debris, and accumulated snow and ice, until completion of project.

1.16. PARKING

- A. Contractor shall construct temporary gravel surface parking areas to accommodate all construction personnel involved with the project.
- B. When site space is not adequate, Contractor shall provide additional off-site parking..

1.17. MAINTENANCE OF TRAFFIC

- A. Contractor shall maintain and regulate traffic within Contract Limits in accordance with applicable state, county, and local regulations.
- B. Conduct operations so as to maintain access for vehicular and pedestrian traffic to and from properties adjoining or adjacent to those streets and roads affected by construction activities, and to subject the public to a minimum of delay and inconvenience.
- C. Erect suitable signs and barricades including warning lights at night, to alert traveling public. Provide watchmen and flagmen as necessary to maintain and regulate traffic.
- D. Provide flagmen, to direct and regulate traffic on heavily traveled thoroughfares on which traffic will be subject to delays or detours caused by construction operations.
- E. Plan operations so that access to any dwelling, building or hospital is assured in case of fire or other emergency. Review with and obtain approval from local fire and police departments and school districts (for buses) regarding anticipated detours and obstructions to traffic flow which could hinder passage of fire apparatus, ambulance or otherwise.
- F. Not more than one block nor more than one cross-street intersection may be torn up, obstructed or closed to travel at one time without permission of the Owner. If the project involves pipe laying operations, and if more than one pipe laying crew is operating at separate locations in the work area, this requirement shall apply to each crew's operation, but shall be consistent with traffic maintenance procedures required by the Owner.
- G. When the normal route of vehicular access to any property must be temporarily obstructed, notify the affected property owner at least 24 hours in advance of intended operations at the location. The route shall subsequently be re-opened not later than one day following the start of construction at that location, unless special arrangements have been made with property owner. Vehicular access to hospitals, schools, fire and police departments must be provided at all times.

- H. Contractor shall comply with requirements of Department of Public Works and Department of Transportation agencies having jurisdiction:
1. Where the work is in or encroaches upon a public right-of-way, such as a road, Contractor shall perform the work in strict compliance with the rules, regulations, requirements, and staff decisions of all applicable Department of Transportation agencies having jurisdiction.
 2. Strict adherence to the latest edition of the Work Area Protection Manual and Land Use Permit Regulations (or equivalent documents in the Project area) is required.
 3. Frequent inspections of work conditions by staff of agencies having jurisdiction should be anticipated by Contractor.
 4. Compliance with the requirements of the agencies having jurisdiction shall be the sole responsibility of the Contractor with the determination of compliance at the sole discretion of the staff of agencies having jurisdiction.
 5. Failure to comply with the requirements of agencies having jurisdiction will result in full-time or part-time inspection by the staff of the agencies having jurisdiction.
 6. Charges for these inspections will be based on the policies of the agencies having jurisdiction as determined solely by the agencies having jurisdiction.
 7. Whenever charges are incurred, these charges will be invoiced to the Owner. The Owner will invoice the Contractor for these charges plus a 20 percent administrative fee. The Contractor shall pay these invoices no less frequently than monthly.
 8. Contractor shall not be granted Substantial Completion until all of these invoices are paid by the Contractor to the Owner.
 9. No additional claim for increased cost or extension of time shall be allowed in the event these requirements are imposed by agencies having jurisdiction.

1.18. PROGRESS CLEANING

- A. Contractor shall maintain areas free of waste materials, debris, and rubbish. Maintain site and structures in a clean and orderly condition, as follows:
1. Remove debris and rubbish from pipe chases, plenums, attics, crawlspaces, and other closed or remote spaces, prior to enclosing the space.
 2. Broom and vacuum clean interior areas prior to start of surface finishing, and continue cleaning to eliminate dust.
3. Collect and remove waste materials, debris, and rubbish from site weekly and dispose off-site.
- B. Contractor shall store unused tools and equipment at its yard or base of operations.

1.19. POLLUTION CONTROLS

A. Dust Control

1. Contractor shall execute work by methods to minimize raising dust from construction operations.
2. Provide positive means to prevent airborne dust from dispersing into atmosphere.
3. Wash down disturbed areas daily.
4. Implement best management practices in accordance with requirements of agencies having jurisdiction over dust control.

B. Erosion and sediment control shall be provided in accordance with the Contract Documents, the requirements of governing regulatory agencies.

1. Contractor shall plan and execute construction by methods to control surface drainage from cuts and fills, from borrow and waste disposal areas.
2. Minimize amount of bare soil exposed at one time.
3. Provide temporary measures such as berms, dikes, and drains, to regulate water flow and prevent soil erosion.
4. Periodically inspect earthwork in disturbed areas to detect evidence of erosion and sedimentation; promptly apply corrective measures.
5. Implement best management practices in accordance with requirements of agencies having jurisdiction over erosion and sediment control.

C. Noise Control

1. All construction equipment and tools exhibiting potential noise nuisance shall be provided with noise muffling devices.
2. Confine use of such equipment and tools between the hours of 7 a.m. and 5 p.m.
3. Implement best management practices in accordance with requirements of agencies having jurisdiction over noise control.

D. Pollutants Control - Provide methods, means and facilities to prevent contamination of soil, water and atmosphere from discharge of noxious, toxic substances, and pollutants produced by construction operations.

1.20. REMOVAL OF UTILITIES, FACILITIES, AND CONTROLS

- A. Contractor remove temporary utilities, equipment, facilities, controls, materials, prior to Substantial Completion.
- B. Remove temporary barriers, enclosures, etc. in concert with completion of those segments of work

which no longer require such measures.

- C. Remove temporary underground installations to a minimum depth of 2 feet.
- D. Clean and repair damage caused by installation or use of temporary work.
- E. Restore existing facilities used during construction to original condition. Restore permanent facilities used during construction to specified condition.

1.21. CONTRACTOR'S FIELD OFFICE

- A. Provide weathertight field office with lighting, electrical outlets, heating, cooling and ventilating equipment, and equipped with furniture, drawing rack, drawing display table, and filing cabinets for use.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01540

TEMPORARY BYPASS PUMPING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Contractor shall furnish, install, test, and operate temporary bypass pumping systems and bypass piping systems where necessary to complete the work.
 - 1. Bypass Pumping System - The bypass pumping system shall consist of all equipment, piping, valves, meters, plugs, power supplies, and other appurtenances required to divert sewer flows. The bypass pumping system shall be comprised of primary and secondary pumping setups in addition to all bypass piping necessary to complete the work. The work shall be scheduled in such a manner that allows the completion of the work in a time frame that minimizes the duration of bypass pumping.
 - 2. Bypass Piping - The bypass piping shall consist of the piping, valves, supports, and other appurtenances including, but not limited to, air relief valves and dewatering connections. The bypass piping includes both the suction and discharge piping for each primary and backup bypass setup. Separate suction pipes shall be provided for each bypass pump.
- B. The Engineer's and Owner's receipt of the Flow Bypass Plan does not relieve Contractor of responsibility for means, methods, and sequences of construction; requirement to pump and transport peak flows; and safety.

1.02. RELATED SECTIONS

- A. Division 1 specifications.
- B. Division 2 specifications.

1.03. PERFORMANCE AND DESIGN REQUIREMENTS

- A. Design the installation and operation of temporary pumping systems in accordance with laws and regulations, including local noise and light ordinances.
- B. Bypass Pumping System Requirements.
 - 1. Temporary pumping systems shall be designed to pump peak capacity with one pump out of service in accordance with the following bypass pumping set-ups at the pump stations. The suggested pump suction and discharge locations are provided in the mechanical drawings.

Primary Setup No.	Location	Minimum No. of Pumps ⁽¹⁾	Minimum Pump Capacity (gpm)	Minimum Total Dynamic Head (ft)
1	Tarbell Hill Pump Station	2	200	50

⁽¹⁾ Represents the total number of pumps necessary to operate at the design conditions. The total includes the duty and standby pumps.

- C. The system shall include, at a minimum, the following equipment:
 - 1. Suction lift primary pump(s). The primary pump(s) shall be capable of pumping the peak flow, be connected to the bypass piping, be isolated with valves, and be complete with power supplies.
 - 2. One suction lift standby pump with equal capacity of the duty pumps. Standby pump shall be stored at the site or at a site mutually agreed to by Contractor and Owner. If standby pump is placed in operation, an additional standby pump shall be provided within four hours.
 - 3. Required variable frequency drives (VFDs), floats, pump control panels, and float switches for pump operations and alarm indication.

- D. Provide a standby pump on site and ready for operation of the same capacity as the largest temporary bypass pump. In addition, one of the following two conditions must be met:
 - 1. The temporary pumping system must be capable of operating continuously (24 hours per day, 7 days per week) by Contractor. In the event of a pump failure, the Owner shall be notified within 15 minutes and the temporary backup pump shall be placed into service within 1 hour of the pump failure.
 - 2. Install, test, and maintain remote telemetry to monitor operation of the temporary pump(s) and the wet well level(s). Notify Owner within 15 minutes of a pump and/or system failure. Report to site within 30 minutes of a pump and/or system failure, and place the temporary backup pump in service within 1 hour of a pump and/or system failure. The telemetry system shall notify up to six individuals in a specific order; the contact phone numbers shall be coordinated with and provided to the Owner.
 - 3. For temporary pumping system with automatic backup pump operation, report to site within 30 minutes of a pump failure to ensure the automatic backup system is operating properly.

- E. Temporary pumping systems shall be equipped with noise reduction features that limit the noise output to 65 dbA within 50 feet of the equipment or to 60 dbA at the nearest residence property line, whichever is less.

- F. Location of bypass pumping systems shall be coordinated with the Owner and Engineer.

- G. The bypass pumps shall be diesel-driven. Provide fuel supply for 48 hours of operation on site and stored in accordance with laws and regulations for diesel-powered systems. Assume responsibility for all spills and regulatory fines due to failure of the temporary pumping system.

- H. See Section 01010, Summary of Work, for facility outage requirements and constraints.
- I. Provide concrete Jersey barriers in all locations where temporary pumps, piping, and other accessories are located in roadways, driveways, and other vehicle-accessed areas.
- J. Provide security fencing for all temporary pumps where not located within a secured area.
- K. Provide all software development and device configuration required for the system, including but not limited to, the PLC and graphics, alarming, and autodialer.
- L. The Contractor shall incorporate provisions to remove water from the primary bypass pumping system to protect against freezing and damage. During cold weather operations, diesel generators shall utilize block heaters and critical priming piping shall be protected with heat tracing. Contractor shall provide cold weather mix diesel fuel during cold weather operations.

1.04. QUALITY CONTROL

- A. Contractor to design, review the installation, and approve the bypass pumping and piping system. Calculations and review comments will be kept on file for the duration of the contract.
- B. Contractor shall employ the services of a vendor who can demonstrate to the Engineer that they specialize in the design and operation of temporary bypass systems.
- C. Vendor shall be Godwin Pumps (Xylem) or Engineer-approved equal.

1.05. SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300, Submittals, as supplemented herein.
- B. Flow Bypass Plan – Contractor shall submit a specific detailed description of each proposed temporary pumping system at least 60 days prior to intended use. The submittal shall include a written description of the plan including, but not limited to, the following:
 - 1. Quantity, capacity, and location of all pumping equipment.
 - 2. Pump performance curves and head capacity curves demonstrating the capability to meet all required flows.
 - 3. Sewer plugging plan (as applicable), including type, location, and emergency release procedures.
 - 4. The size, type, and routing of all suction and discharge piping and associated valves and pipe supports, including the means of connecting the system.
 - 5. Shop drawings for materials of piping, valves, plugs, piping supports, and all accessories,
 - 6. Shop drawings for pumps, motors, and controls.
 - 7. Compliance with permits required by the New York State Department of Environmental Conservation or the Owner.

8. Plan for sound attenuation for the bypass pumping system.
9. Cold weather operational plan to protect equipment and pipes from freezing, including provisions to remove water that is trapped in sections at low spots in the discharge line.
10. Standard and emergency shutdown plan indicating emergency (24-hour) contacts, drain points, draindown time, disinfection, and disassembly.
11. Schedule for installation and maintenance of bypass pumping lines.
12. Plan to limit odors from being generated, including seals at discharge manholes and primary and secondary setup manholes.
13. Alarm system(s) that will allow prompt determination of loss of bypass piping integrity during operation.
14. Schedule for routine inspection of bypass pumping lines.

1.06. PROJECT RECORDS

- A. The Contractor shall maintain records which indicate the following:
 1. Dates of installation and operation of primary and secondary setups.
 2. Maintenance schedules for each pump.
 3. Dates and times of any flow loss from the bypass pumping system.
 4. Dates and times of any backups of flow and Contractor action with corrective actions taken.

1.07. REGULATORY REQUIREMENTS

- A. Conform to regulatory agencies having jurisdiction over the work.
- B. Contractor is responsible for fines levied on Owner by state, federal, and/or other agencies due to spills caused by failure of temporary pumping and piping systems.

1.08. FIELD MEASUREMENTS

- A. Prior to start of construction, verify by field measurements that existing conditions are as shown on Drawings. Notify Engineer of differences.

1.09. COORDINATION

- A. Coordinate field work under provisions of Section 01039, Coordination and Meetings, including maintenance of traffic and emergency 911 service.
- B. Coordinate work with local utility companies (private and municipal) for location of existing utilities and protection thereof.
- C. Coordinate flow bypassing with Owner. The Contractor will be responsible for the removal or moving

of snow surrounding the bypass system and piping.

1.10. TEMPORARY PUMPING COORDINATION MEETING

- A. The Contractor shall be responsible for the installation, operation, and removal of all flow bypass facilities and surface restoration in accordance with the approved project schedule.
- B. After Owner and Engineer review and approval of temporary pumping system submittal(s), and at least 14 days prior to intended use, schedule a coordination meeting with the Owner, Engineer, Contractor, and subcontractor or temporary pump supplier, if applicable.
- C. No temporary pumping shall take place until after satisfactory completion of the coordination meeting.
- D. Work shall be scheduled to minimize the duration of bypass pumping.

PART 2 PRODUCTS

2.01. PUMPS

- A. The pumps and drives shall be rated for continuous duty and shall be capable of pumping the required flow ranges without surging, cavitation, or vibration. Where required pumping rates are not specified, coordinate with Engineer to determine required pumping range prior to submitting associated shop drawings. Pumps shall not overload drivers at any point on the pump operating curve.
- B. Pumps shall be suitable for use with raw unscreened sewage and trash being pumped. Pumps shall be self-contained units designed for temporary use.
- C. Pumps shall be suction lift style with automatic self-priming that do not require the use of foot- valves or vacuum pumps in the priming system.
- D. The pumps shall be diesel powered or powered by a diesel-powered generator.
- E. Provide the necessary start/stop and level controls for each pump.
- F. Provide the necessary motors and VFDs for pump operation.

2.02. BYPASS PIPING

- A. Pipe 12 inches and larger shall be ductile iron or fused joint high density polyethylene (HDPE) pipe to provide a leak-proof piping system. Flanged joints shall be used for exposed or submerged ductile iron pipe. Pipe joints shall be accepted by Engineer prior to use for temporary ductile iron pipe.
- B. Rigid Piping - Hot dipped, galvanized steel piping. Each pipe joint shall have a ball and socket-type connection, rubber O-ring, and lever closure for positive sealing.
- C. Flexible Piping - Synthetic rubber core, reinforced with synthetic fabric with wire helix, covered with synthetic rubber wrapping. Joint fittings to match rigid piping fittings.
- D. HDPE Pipe - Pipe shall be HDPE ASTM C3350, Bluestripe. Pipe shall be minimum DR-9, 200 psi working pressure.

1. Fittings shall be HDPE anchor fittings, butt fusion welded to pipe. Fittings shall include stainless steel stiffener, insert, and all other accessories required. Pipe and anchor fitting shall be the same size.
- E. All pipe and fittings shall have a pressure rating a minimum of 50 percent higher than the highest working pressure expected in the system based on the existing piping pressures or on the Contractor's bypass pumping design.

2.03. TEMPORARY PLUGS

- A. Plugs shall be inflatable and designed for the specific purpose of providing temporary plugging of active pipes. Sewer plugs shall be pneumatic and capable of accommodating the maximum allowable surcharge heads that may be experienced during the construction of this project.
- B. All plugs shall be firmly attached to a stationary object at ground level by a steel cable in order to prevent loss of plugs in pipelines.

PART 3 EXECUTION

3.01. GENERAL

- A. Install, operate and maintain temporary pumping systems and appurtenances, including but not limited to, associated piping, valves, instrumentation, controls, and accessories, in accordance with the manufacturer's instructions. Provide all oil, fuel, grease, lubricants, tools, and spare parts required for operation and maintenance of the temporary pumping systems for the duration of use. Remove all temporary pumping systems and appurtenances equipment following the completion of temporary pumping.
- B. Contractor is responsible for proper operation of complete temporary pumping systems.
- C. Adequate hoisting equipment for each pump and accessory shall be maintained on the project sites.
- D. Demonstrate all temporary pumping systems to Owner and/or Engineer for conformance with the Contract Documents prior to use. Measure the noise output during the demonstration phase and provide the results to Engineer.
- E. Temporary pumping systems shall be placed in service a minimum of 72 hours before any work requiring use of the temporary pumping system may begin. Demonstrate continuous trouble-free operation for entire 72-hour period.
- F. Temporary pumping systems shall remain operable until all components of new work requiring temporary pumping systems have successfully completed all required testing. Once activated, do not decommission without prior approval of the Owner and Engineer.
- G. Once written permission is issued by the Engineer, remove all components of the temporary pumping and piping systems. After removal of temporary pumping systems, perform all restoration work to the satisfaction of the Owner.
- H. Take precautions to prevent spills when cutting pipelines or decommissioning existing piping.

3.02. FIELD QUALITY CONTROL AND MAINTENANCE

- A. Testing on Installation - The Contractor shall perform leakage and pressure tests of the bypass piping, using clean water, prior to actual operation if directed by the Engineer. The test pressures shall be 1.5 times the expected operating pressures. The Engineer will be given 24 hours' notice prior to testing.
- B. Routine Inspection and Maintenance
 - 1. The Contractor shall inspect all operating bypass pumping systems each weekday or more frequently as necessary to ensure the proper operation of the system. Suction and discharge piping shall be cleaned to maintain the required performance of the bypass pumping system.
 - 2. The Contractor shall ensure that the bypass pumping system is properly maintained.
- C. Extra Materials
 - 1. Spare parts for pumps and piping shall be kept on site as required.
 - 2. Adequate hoisting equipment for each pump and accessories shall be maintained on the site.

3.03. PREPARATION

- A. Precautions
 - 1. The Contractor is responsible for locating any existing utilities in the area selected for installation of the bypass pipelines. The Contractor shall minimize the disturbance to existing utilities and shall obtain approval from the Owner and Engineer for any relocation of the bypass pipeline. All costs associated with the relocation of utilities and obtaining of approvals shall be paid by the Contractor.
 - 2. During all bypass pumping operations, the Contractor shall protect the bypass pumping and piping facilities from damage inflicted by equipment. The Contractor shall be responsible for all intentional or accidental physical damage to the bypass pumping and piping system caused by human or mechanical failure or interference.
 - 3. During installation of the bypass pumping lines, the Contractor shall make every effort to minimize the disruption of work at the project site. The Contractor shall protect all structures or other obstacles in the path of the pipeline from damage through the use of shields and buffering devices.

END OF SECTION

SECTION 01564
EROSION CONTROL

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Installation of sedimentation and erosion control barriers.
- B. Anchoring all topsoil stockpiles with straw mulch and ringing with haybales.
- C. Protection of catch basins with haybale or silt fence rings.
- D. Inspection of all erosion measures after each rainfall and at least daily during prolonged rainfall.
- E. Repairing immediately any failed sedimentation and erosion control barrier.
- F. Removing and disposing sediment deposits in a manner that does not result in additional erosion or pollution.
- G. Removal of haybales or silt fences after completion of construction and permanent stabilization of erosion.
- H. Removal of sedimentation barriers after completion of construction.

1.02. RELATED SECTIONS

- A. Section 01026 - LUMP SUM ITEMS: Requirements applicable to lump sum prices for work of this section.
- B. Section 02030 - DEMOLITION

1.03. PERFORMANCE REQUIREMENTS

- A. Observe government policy established by United States Environmental Protection Agency (USEPA) Memorandum 78-1.
- B. Observe requirements set forth by the Federal Highway Administration Task Force 25.
- C. Conform all erosion and sedimentation control measures of "New York Guidelines for Urban Erosion and Sediment Control" published by USDA Soil Conservation Service.

1.04. PLAN

- A. Taking into account specific constraints or other criteria outlined herein, the Contractor shall prepare a detailed plan which sets forth his program of operations to effectively control erosion and sediment-runoff at all times during construction and during the one-year guarantee period following completion of the work.
 - 1. Two copies of the plan shall be filed with the Engineer.

2. At least one copy shall be kept at the project site at all times, and shall be made available for examination by authorized representatives of the regulatory agencies having jurisdiction over the project.
3. The plan shall be arranged so as to include:
 - a. Chronological completion dates for each temporary (and permanent) measure for controlling erosion and sediment.
 - b. Location, type and purpose for each temporary measure to be undertaken.
 - c. Dates when those temporary measures will be removed.
4. The plan shall be submitted within 10 days after the Notice to Proceed.
5. Submit in accordance with Section 01300, Submittals.

PART 2 MATERIAL AND PRODUCTS

2.01. MATERIALS

- A. Hay/Straw Bales - Shall be securely tied and measure 14 inches by 18 inches by 30 inches long or greater.
- B. Silt Fence
 1. Super Silt Fence – As manufactured by Geofabrics or equal.
 2. Silt fence shall be constructed using fence posts and wire fence or prefabricated units in accordance with New York guidelines for urban erosion and sediment control.
- C. Stakes and Fasteners
 1. Shall be two #3 rebar or two 2-inch by 2-inch minimum hardwood stakes for each hay/straw bale.
 2. Shall be a minimum of 2-inch by 2-inch minimum by 48-inch hardwood post for silt fences.
- D. Erosion Control Fabric - North American Green Type S75 or equal shall be used.

2.02. PRODUCTS

- A. Sediment Barriers - Sediment barriers shall be hay or straw bales, stone, silt fences or other approved materials that will prevent migration of silts and sediment to receiving waters.
- B. Mulch and Seeding - Mulch and seeding shall be in accordance with requirements of Tables 1 and 2 of this section.
- C. Diversion Terraces - Diversion terraces shall be installed on the uphill side of the disturbed areas to

divert surface runoff away from unstabilized slopes.

- D. Interceptor Channels - Interceptor channels shall be installed across disturbed areas where the slope is running parallel to the direction of trenches.
- E. Trench Barriers - Trench barriers shall be used where the disturbed area is sloped in direction of the pipeline, when the slope exceeds 15 percent.
- F. Stabilized Construction Entrances – Stabilized construction entrances shall be installed at each work vehicle entry point.
- G. Geotextile Dewatering Bag – Geotextile dewatering bags are to be used to trap sediment from dewatering activities.

PART 3 EXECUTION

3.01. GENERAL REQUIREMENTS

- A. Drawings do not show all of the necessary control measures to prevent erosion and sedimentation.
 - 1. It is the Contractor's responsibility to design, implement and maintain erosion and sedimentation control measures which effectively prevent accelerated erosion and sedimentation.
- B. All erosion and sedimentation control measures shall be inspected by the Contractor daily and immediately after periods of rainfall.
 - 1. Repair and/or maintenance of sedimentation and erosion control measures will be made as soon as needed.
 - 2. The Contractor will be held responsible for the implementation and maintenance of all control measures on this site.
- C. Land disturbance shall be kept to a minimum.
 - 1. Restabilization will be scheduled immediately after any disturbance.
- D. Silt fences or haybales will be installed along the toe of all critical cut and fill slopes.
- E. Catch basins will be protected with silt fences or haybales throughout the construction sequence and until all disturbed areas are stabilized.
- F. Erosion and sedimentation control measures will be installed prior to all construction activities.
- G. Sediment removal from control structures shall be the responsibility of the Contractor.
 - 1. Sediment shall be disposed of in a manner which is consistent with overall intent of plan and which does not result in additional erosion.
- H. The erosion and sedimentation control measures described herein are intended as a general guide for

the Contractor.

1. It is the Contractor's responsibility to provide any and all work necessary to prevent erosion of soil from the construction site and to provide silt fences, haybales or other control measures as the need arises during construction at no additional cost to the Owner.
- I. Remove all sedimentation and erosion control barriers after completion of construction and permanent stabilization of erosion.

3.02. DIVERSION TERRACES

- A. Diversion terraces shall be used as a temporary measure installed on the uphill side of the disturbed areas to divert surface runoff away from unstabilized slopes, and the project area.
- B. Recommended Minimum Dimensions
 1. Height - 1.5 feet
 2. Top Width - 2 feet
 3. Side Slopes - 2:1 or flatter
 4. Material - Soil

3.03. INTERCEPTOR CHANNELS

- A. Interceptor channels shall be used across disturbed areas where the slope is running parallel to the direction of trenches.
- B. Interceptor channels reduce erosion by intercepting storm runoff and diverting it to outlets on the lower side of the disturbed area where it can be disposed of having minimum erosion impact.
- C. Recommended Dimensions and Materials
 1. Depth - 0.5 feet
 2. Width - 2 to 4 feet
 3. Side Slopes - 2:1 or flatter
 4. Spacing - Where required
 5. Material - Stable on-site material

3.04. TRENCH BARRIERS

- A. Trench barriers shall be used where the disturbed area is sloped in the direction of the pipeline, when the slope exceeds 15 percent.
- B. Trench barriers shall be earth-filled sacks or piled stone, stacked to the top of the trench after installation of the sewer and prior to backfill, if backfill is delayed.

- C. Trench barriers shall act as an erosion check by preventing the washout of the trench.
- D. Recommended Dimensions and Materials
 - 1. Height - To top of trench.
 - 2. Spacing - Approximately every 150 feet.
 - 3. Material - Earth-filled sacks or piled stones.

3.05. SEDIMENT BARRIERS

- A. Sediment barriers shall be used at storm drain inlets; across minor swales and ditches; and at other applications where the structure is of a temporary nature and structural strength is not required.
 - 1. Sediment barriers are temporary berms, diversions, or other barriers that are constructed to retain sediment on-site by retarding and filtering storm runoff.
- B. Recommended Materials and Dimensions
 - 1. Hay or Straw Bales
 - a. Bales should be bound with twine.
 - b. Bales should be anchored to the ground with fence posts, wood pickets, or #3 rebar. Two anchors per bale are required.
 - c. Bales shall be installed so that runoff cannot escape freely under the bales.
 - d. Height - 1.5 feet Width - 1.5 to 3.0 feet
 - e. Cross-Sectional Area Required Per Tributary Acre - 50 square feet
 - 2. Stone
 - a. Height - 1.5 to 2.0 feet (uniform top elevation) top
 - b. Width - 3 to 5 feet
 - c. Side Slopes - 3:1 or flatter
 - d. Cross-Sectional Area Required Per Tributary Acre - 20 square feet
 - e. Material - Coarse rock or stone
 - 3. Brush
 - a. Brush should be bound with twine.
 - b. Brush should be anchored such that it does not move and runoff cannot escape freely

under the barrier.

- c. Height - 1.5 to 2.0 feet
 - d. Cross-Sectional Area Required Per Tributary Acre - 15 square feet
4. Silt Fence
- a. Synthetic fabric 48 inches wide for fencing material.
 - b. Hardwood stakes shall be minimum 2-inch diameter spaced at 8 to 10 feet apart for posts.
 - c. Height - \pm 30 inches above ground.

3.06. MULCH

- A. Used alone or in conjunction with other structural or vegetative erosion control measure, mulch is applied on any disturbed area which is subject to erosion, for protection of disturbed soil or newly reseeded areas.

3.07. EROSION CONTROL FABRIC

- A. Erosion control fabric shall be used on slopes greater than 10 percent. Prior to installation of the erosion control fabric, the underlying layer is to be graded as shown on the Drawings.

3.08. VEGETATION

A. Temporary Vegetation

- 1. The planting of temporary vegetative cover shall be performed on disturbed areas where the earthmoving activities will be ceased for a period of more than 45 days.
 - a. The vegetation shall provide short-term rapid cover for the control of surface runoff and erosion, until permanent vegetation can be established or earthmoving activities can resume.
- 2. Table 2 gives recommended types of temporary vegetation, corresponding rates of applications, and planting seasons.
 - a. In situations where other cover is desired, the recommendations of the local and County Conservation Districts shall be followed.

B. Permanent Vegetation

- 1. Planting of various permanent vegetative covers shall be performed on disturbed areas where the earthmoving activities have ceased. The vegetation shall reestablish ground cover for the control of surface runoff and erosion.
- 2. The seed bed for permanent vegetative cover shall be prepared by using lime and fertilizer.

- a. If the time of the seeding occurs during a dry period, mulch shall be applied to conserve soil moisture.

TABLE 1

MULCH MATERIALS, RATES AND USES

Mulch Material	Quality Standards	Application Per 1,000 Sq. Ft.	Rates Per Acre	Depths of Application
Straw or hay	Air-dried; free from coarse	75-100 lbs.; 2-3 bales	1.5-2.5 tons; 90-120 bales	Lightly cover 75 to 90% of surface
Wood chips	Green or air-dried	500-900 lbs.	10-20 tons	2" - 7"

TABLE 2

TEMPORARY SEEDINGS FOR EROSION CONTROL OF CONSTRUCTION SITES

Species or Mixture for Temporary Cover	Percent by Weight	Seeding Rates in Lbs. per 1,000 Sq. Ft.	Recommended Seeding Dates
Annual Rye Grass	100%	1	April 1 to June 1 and August 15 To October 15
Field Broomegrass	100%	1	March 1 to June 15 and August 15 To September 15
Sudangrass	100%	1	May 15 to August 15

3.09. SPECIAL CONDITIONS

- A. Prohibited Construction Practices - Prohibited construction practices include but shall not be limited to the following:
 - 1. Dumping of spoil material into any stream corridor, any wetlands, any surface waters or at unspecified locations, even with permission of the property owner.
 - 2. Indiscriminate, arbitrary or capricious operation of equipment in any stream corridors, any wetlands or any surface waters.
 - 3. Pumping of silt-laden water from trenches or other excavations into any surface waters, any stream corridors or any wetlands.
 - 4. Damaging vegetation adjacent to or outside of the access road or the right-of-way.
 - 5. Disposal of trees, brush and other debris in any stream corridors, any wetlands, any surface water or at unspecified locations.
 - 6. Permanent or unspecified alteration of the flow line of the stream.

7. Open burning of construction project debris.
- B. Defective Devices - Any erosion and sediment control devices which become damaged, clogged or otherwise non-functional shall be immediately replaced by the Contractor, without additional compensation.
 - C. Adjustment
 1. If the planned measures do not result in effective control of erosion and sediment runoff to the satisfaction of the regulatory agencies having jurisdiction over the project, the Contractor shall immediately adjust his program and/or institute additional measures so as to eliminate excessive erosion and sediment-runoff.
 2. If the Contractor fails or refuses to comply promptly, the Owner may issue an order stopping all or part of the work until satisfactory corrective action has been taken. No part of the time lost due to any such stop orders shall be made the subject of a claim for extension of time or for excess costs or damages by the Contractor.

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Products.
- B. Shipping and handling.
- C. Storage and protection.
- D. Substitutions.

1.02. RELATED SECTIONS

- A. General Conditions
- B. Supplementary Conditions - Refer to the appropriate "SC" paragraphs which supplement or modify the above numbered paragraphs of the General Conditions.
- C. Section 01400 - QUALITY CONTROL: Product quality monitoring.

1.03. PRODUCTS

- A. Products - Means new material, machinery, components, equipment, fixtures, and systems forming the work. Does not include machinery and equipment used for preparation, fabrication, conveying and erection of the work. Products may also include existing materials or components required for reuse.
- B. Do not use materials and equipment removed from existing premises, except as specifically permitted by the Contract Documents.
- C. Provide interchangeable components of the same manufacturer, for components being replaced.

1.04. SHIPPING AND HANDLING

- A. Arrange deliveries in accordance with the progress schedule. Allow time for inspection prior to installation.
- B. Coordinate deliveries to avoid conflict with work, conditions at site, work of other Contractors, and availability of personnel and handling equipment.
- C. Transport products by methods to avoid product damage; deliver in undamaged condition in manufacturer's unopened containers or packaging, dry, with identifying labels intact and legible.
- D. Deliver in manufacturer's unopened containers or packaging, dry, with identifying labels intact and legible.
- E. Provide equipment and personnel to handle products by methods to prevent soiling or damage. Protect

sensitive equipment and finishes against impact, abrasion and other damage.

- F. Protect sensitive equipment and finishes against impact, abrasion, and other damage.
- G. Promptly inspect shipments to assure compliance with requirements, correct quantities, and identify damage.

1.05. STORAGE AND PROTECTION

- A. Store and protect products in accordance with manufacturer's instructions, with seals and labels intact and legible. Store sensitive products in weathertight, climate-controlled enclosures in an environment favorable to product.
- B. For exterior storage of fabricated products, place on sloped supports, above ground.
- C. Provide off-site storage and protection when site does not permit on site storage or protection.
- D. Cover products subject to deterioration with impervious sheet covering. Provide ventilation to prevent condensation and degradation of products.
- E. Store loose granular materials on solid flat surfaces in a well-drained area. Prevent mixing with foreign matter.
- F. Provide equipment and personnel to store products by methods to prevent soiling, disfigurement, or damage.
- G. Arrange storage of products to permit access for inspection. Periodically inspect to assure Products are undamaged and are maintained in acceptable condition.

1.06. SUBSTITUTIONS

- A. Engineer will consider requests for Substitutes or "Or Equal" items after the Effective Date of the Owner-Contractor Agreement, and then only within the time constraints stipulated in the Supplementary Conditions.
- B. Substitutions may be considered when a product becomes unavailable through no fault of the Contractor. Furnish evidence that product is unavailable.
- C. Document each request with complete data substantiating compliance of proposed Substitution with Contract Documents.
- D. A request constitutes a representation that the Contractor:
 - 1. Has investigated proposed product and determined that it meets or exceeds the quality level of the specified product.
 - 2. Will provide the same warranty for the substitution as for the specified product.
 - 3. Will coordinate installation and make changes to other work which may be required for the work to be complete with no additional cost to Owner.

4. Waives claims for additional costs or time extension which may subsequently become apparent.
 5. Will reimburse Owner the costs incurred by Owner for review and any subsequent redesign services by Engineer, including Engineer's revisions to the Contract Documents, and Engineer's assistance in connection with review by authorities when re-approval is required, if Engineer determines that the item of material or equipment proposed by Contractor is a substitute item.
- E. Substitutions will not be considered when they are indicated or implied on shop drawing or product data submittals, without separate written request, or when acceptance will require revision to the Contract Documents.
- F. Substitution Submittal Procedure
1. Submit three copies of request for substitution for consideration. Limit each request to one proposed substitution.
 2. Submit shop drawings, product data, and certified test results attesting to the proposed product equivalence.
 3. The Engineer will notify Contractor, in writing, of decision to accept or reject request.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01640
EQUIPMENT-GENERAL

PART 1 GENERAL

1.01 SECTION INCLUDES

- A. Submittals.
- B. Performance affidavit.
- C. Equipment design.
- D. Spare parts.
- E. Equipment identification.
- F. Standardization of grease fittings.
- G. Anchors and supports.
- H. Shop tests.
- I. Installation of equipment.
- J. Testing.
- K. Services of manufacturer's representative.
- L. Operation and maintenance manual.
- M. Lubrication schedule.
- N. Failure of equipment to perform.
- O. Guarantee.
- P. Schedule of Equipment Testing and Manufacturer's Services.

1.02. RELATED SECTIONS

- A. Section 01300 – SUBMITTALS
- B. Section 01400 - QUALITY CONTROL
- C. Section 01600 - MATERIALS AND EQUIPMENT
- D. Section 01660 - TESTING AND STARTUP
- E. Section 03600 – GROUT

- F. Section 05500 - MISCELLANEOUS FABRICATIONS
- G. Section 11303 – SUBMERSIBLE PUMPS
- H. All Division 11 Specifications
- I. Section 15170 - MOTORS

1.03. SUBMITTALS

- A. Submit shop drawings in accordance with Section 01300, Submittals.
- B. Submit performance affidavits prior with applicable shop drawings.
- C. Installation Certificates.
- D. Certification of Equipment Compliance.
- E. Operations and maintenance manuals.
- F. Training Plans
 - 1. Submit no less than 30 days prior to proposed date for training in accordance with procedures identified in Section 01300, Submittals.
 - 2. Training plan must be approved by Engineer prior to scheduling actual date for training.
 - 3. Provide syllabus with sufficient detail to establish content of training, duration of each topic, and demonstrate adequate content to train Owner's staff on proper operation and maintenance of equipment.
- G. DVD recordings of training sessions.
- H. Written training reports.
- I. Guarantees.

1.04. PERFORMANCE AFFIDAVITS

- A. Provide performance affidavits for products listed in the Schedule of Equipment Testing and Manufacturer's Services, included at the end of this section and as required in the individual technical sections.
- B. Performance affidavits shall be developed by each manufacturer and shall certify to Contractor and Owner, jointly, that manufacturer has examined the Contract Documents and that the equipment, apparatus, process, or system will meet the performance requirements set forth in the Contract Documents in every way. Equipment design, manufacturing, and assembly specifications are an integral part of the performance requirements.
- C. Shop drawings will not be reviewed prior to receipt by the Engineer of an acceptable performance

affidavit.

D. The performance affidavit must be signed by an officer (vice president or higher) of the basic corporation, partnership or company manufacturing the equipment, and witnessed by a notary public.

E. The performance affidavits shall be in the following format: Addressed to (Contractor) and (Owner):

Reference: Contract No. (Project)

Text: "(Manufacturer's Name) has examined the Contract Documents and verified that the (product) meets in every way the performance requirements and design specifications set forth in Section(s) _____ of the Contract Documents."

Signature: Corporate officers shall be vice president or higher (unless statement authorizing signature is attached).

Notary: Signature(s) must be notarized.

1.05. EQUIPMENT DESIGN

A. Equipment and appurtenances shall be designed in conformity with ANSI, ASME, IEEE, NEMA, and other generally accepted applicable standards.

B. Equipment and appurtenances shall be of rugged construction and of sufficient strength to withstand all stresses which may occur during fabrication, testing, transportation, installation, all conditions of operation, or as required by specifications.

C. All bearings and moving parts shall be adequately protected by bushings or other approved means against wear, and provision shall be made for adequate lubrication by readily accessible devices.

D. Details shall be designed for appearance as well as utility. Protruding members, joints, corners, gear covers, etc., shall be finished in appearance. All exposed welds on machinery shall be ground smooth and the corners of structural shapes shall be rounded or chamfered.

E. Machinery parts shall conform within allowable tolerances to the dimensions shown on the working drawings. The corresponding parts of identical machines shall be made interchangeable.

F. All machinery and equipment shall be safeguarded in accordance with the safety codes of the ANSI and OSHA and the State Industrial Code. All rotating shafts, couplings or other moving pieces of equipment shall be provided with suitable protective guards of sheet metal or wire mesh neatly and rigidly supported. Guards shall be removable as necessary to provide access for repairs.

G. Details promoting maintenance, ease of replacing parts, and lubrication shall be a prime consideration in design.

H. Products shall be designed for corrosion resistance and shall not be constructed of materials which may prohibit ease of maintenance due to corrosion. All fasteners on areas requiring access for maintenance and lubrication shall be Type 316 stainless steel unless otherwise specified. Zinc- or cadmium-plated fasteners for these areas shall not be used.

I. Iron and steel products used in this project shall be produced in the United States in accordance with

AIS requirements. Refer to Section 01300, Submittals, and Exhibit E for further requirements.

1.06. SPARE PARTS

- A. Provide spare parts as required by individual specification sections.
- B. Provide spare parts that are identical and interchangeable with original parts.
- C. For each part (or group of small parts), provide a tag which shall carry the following information:
 - 1. Name and associated tag number(s) of equipment.
 - 2. Name of the part.
 - 3. Manufacturer's name and the date of manufacture.
 - 4. Identification number of the part.

1.07. EQUIPMENT IDENTIFICATION

- A. Each piece of equipment shall be provided with a substantial brass or stainless steel nameplate, securely fastened in a conspicuous place and clearly inscribed with the manufacturer's name, year of manufacture, serial number and principal rating data.

1.08. STANDARDIZATION OF GREASE FITTINGS

- A. Provide grease fittings of the hydraulic type, Alemite #1600 Series, Lincoln, or equal.
- B. Coordinate grease fittings on all mechanical equipment to be compatible with a single type of grease gun.

1.09. ANCHORS AND SUPPORTS

- A. Obtain and install all necessary guides, bearing plates, anchor and attachment bolts, working drawings for installation, templates and all other appurtenances necessary for the installation of the equipment specified. Subcontractors furnishing equipment shall also furnish anchors and templates to the General Contractor.
- B. Anchor bolts shall be of size and strength suitable for purpose intended and shall be in accordance with Section 05500, Miscellaneous Fabrications, and the individual specification sections.
- C. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated or needed. Equipment shall be leveled by first using sitting nuts on the anchor bolts and then filling the space between the equipment base and concrete pedestal with grout. Where equipment bases (i.e., pumps) are installed with grout holes, subsequent to field testing, those bases shall be totally filled with grout.
- D. Provide grout as required by Section 03600, Grout.
- E. Provide concrete equipment pads or housekeeping pads for all mechanical, heating and ventilating, plumbing and electrical equipment. Coordinate with other contractors before pad placement to confirm dimensions, location and anchor requirements.

1.10. SHOP TESTS

- A. Arrange shop tests of the equipment indicated in the Schedule of Equipment Testing and Manufacturer's Services and individual equipment specification sections.
- B. Arrange for the Engineer to witness performance tests in the manufacturer's shop, if required by the individual specification section.
- C. Pump shop tests shall be conducted and reported in accordance with the Standards established by the Hydraulic Institute. Pump tolerances shall be within limits acceptable by these standards.
- D. Demonstrate by the tests that the equipment characteristics, including any specified pressure, duty, capacity, rating, efficiency, performance, function or other special requirements, comply fully with the requirements of the Contract Documents and that it will operate in the manner specified.
- E. Submit certified copies of the manufacturer's test data and interpreted results as required by Section 01300, Submittals.

1.11. INSTALLATION OF EQUIPMENT

- A. Field modifications shall not be made without prior approval from Engineer.
- B. Install all equipment strictly in accordance with recommendations of the manufacturer.
- C. Provide all necessary guides, bearing plates, anchors, and attachment bolts, working drawings for installation, templates, and all other appurtenances necessary for the installation of the equipment specified.
- D. Anchor bolts shall be of size and strength suitable for purpose intended and shall be in accordance with Section 05500, Miscellaneous Fabrications, and the individual specification sections.
- E. Pipe sleeves or other means of adjusting anchor bolts shall be provided where indicated and where needed. Equipment shall be leveled by first using sitting nuts on the anchor bolts and then filling the space between the equipment base and concrete pedestal with grout. Where equipment bases (i.e., pumps) are installed with grout holes, those bases shall be totally filled with grout after successful completion of Functional Testing and prior to System Demonstration Testing.
- F. Coordinate equipment pad size before pad placement to confirm dimensions, location, conduit and anchor requirements.

1.12. TESTING

- A. Perform all testing in accordance with Section 01660, Testing and Startup.

1.13. SERVICE OF MANUFACTURER'S REPRESENTATIVE

- A. Arrange for the equipment manufacturer to furnish the services of a qualified representative where specified in the Schedule of Manufacturer's Services and the individual specification sections. The manufacturer's representative shall visit the site as many times as needed to fulfill its obligations required by the Contract Documents. The minimum number of days required for manufacturer

services is listed in the Schedule of Manufacturer's Services.

- B. Contractor shall be responsible for any additional time required for the manufacturer's representative to resolve equipment installation and/or operation problems due to a lack of coordination between the supplied equipment and the Contract Documents such as, but not limited to, dimensions, electrical problems or performance.
- C. Arrange for the equipment representative to visit the plant on occasions after initial start-up and during the first year of operation if required by the individual specification sections. The purpose of these visits shall be to review equipment operation, assist the operators in correcting operational problems and basic inspection of the equipment.
- D. Manufacturer's representative shall assist and supervise Contractor during installation, testing, and operation of equipment where specified in the Schedule of Manufacturer's Services and the individual specification sections.
- E. Manufacturer's representative shall provide all certificates specified in the Schedule of Manufacturer's Services and the individual specification sections.
 - 1. Installation Certificate - Submit one copy to both Owner and Engineer of manufacturer representative's Installation Certificate indicating that the manufacturer's representative has inspected the installation and that the equipment provided by their organization has been properly installed, aligned, lubricated, and is ready for operation.
 - 2. Certification of Equipment Compliance - Submit one copy to both Owner and Engineer of manufacturer representative's written Certification of Equipment Compliance indicating that the manufacturer's representative has witnessed the Functional Test for the equipment provided by their organization, final adjustments to the equipment have been made, the equipment has been tested to their satisfaction, and the equipment meets all performance and testing requirements included in the Contract Documents, excluding testing to be performed either during or after startup.
- F. Testing Reports
 - 1. Functional Test Reports - Submit one copy to both Owner and Engineer of manufacturer representative's written Functional Test reports including performance test results unless otherwise noted.
 - 2. Performance Testing During or After Startup - When the Contract Documents require performance testing to be conducted during or after startup, submit one copy of performance test results with an updated Certification of Equipment Compliance as previously specified.
- G. Training
 - 1. Manufacturer shall provide services of qualified, factory trained, operations and maintenance personnel to instruct Owner personnel in proper care, operation, and maintenance of equipment. At a minimum, training shall include:
 - a. Theory of operation.
 - b. Actual operation.

- c. Mechanical maintenance.
 - d. Electrical maintenance.
 - e. Instrumentation and alarms.
 - f. Optimization of operation.
 - g. Safe operating and working practices and operation of safety devices.
 - h. Troubleshooting.
 - i. Demonstration of equipment startup procedures, operation, and shutdown procedures using equipment installed under this contract.
2. Training shall be scheduled with the Owner. Training times shall be dependent on the availability of required Owner staff.
 3. Trainer shall provide all materials and training manuals required for training in quantities required by Owner.
 4. Contractor shall hire a professional video production firm to digitally record and produce video from all training sessions. All videos shall be clear in picture and sound quality and free from shake or vibration. Videos should be edited to include dates of training, subject matter, trainer's name and affiliation, and length of video on the title credits and shall be edited to remove any gaps from the program. Unacceptable training videos should be re-recorded and re-produced.
 5. Provide one digital DVD recording of each training session to the Owner. DVDs and cases shall be labeled with project name, equipment description, date of training, trainer's name and affiliation.
 6. Trainer shall develop a written report for each training session. At a minimum, reports shall summarize training sessions, indicate any problems that may have been encountered during operation of equipment, and include a sign-in sheet identifying all attendees. Contractor shall submit one copy of each training report to both Owner and Engineer.
- H. Manufacturer or manufacturer's representative shall document equipment installation, checkout, startup, testing, and training on the Manufacturer's Equipment and Checkout Form, attached to this specification.

1.14. OPERATION AND MAINTENANCE MANUALS

A. General

1. Submit operation and maintenance manuals as required by the Schedule of Manufacturer's Services and the individual specification sections in accordance with the procedures identified in Section 01300, Submittals.
2. Prior to completion of the work, and at least 30 days prior to the 50 percent payment, submit for Engineer's review three copies of all preliminary draft operation and maintenance manuals.

Preliminary draft operations and maintenance manuals may be submitted separately for individual items.

3. Prior to completion of the work, and at least 60 days prior to the 85 percent payment, submit for Engineer's review three copies of all final draft operation and maintenance manuals. Preliminary draft operations and maintenance manuals may be submitted separately for individual items.
 - a. All comments generated by Engineer during review of preliminary draft operation and maintenance manuals must be adequately addressed prior to submission of final draft operation and maintenance manuals. Final draft operation and maintenance manuals shall be complete in their entirety except for specific information related to testing and startup. Final draft operations and maintenance manuals must be approved by Engineer prior to the following:
 - 1) Training of associated items.
 - 2) System Demonstration Testing.
 4. Prior to final payment, provide five copies of the final operation and maintenance manual. The final operation and maintenance manual shall include all required operations and maintenance information consolidated into one manual with multiple volumes. The final operation and maintenance manual shall include testing and startup results where applicable.
- B. Manual Preparation - Manuals shall include operation and maintenance information on all systems and items of equipment. The data shall consist of catalogs, brochures, bulletins, charts, schedules, approved shop drawings corrected to as-built conditions and assembly drawings and wiring diagrams describing location, operation, maintenance, lubrication, operating weight, lubrication charts and schedules showing manufacturer's recommended lubricants for each rotating or reciprocating unit, and other information necessary for Owner to establish effective operating and maintenance programs. The following shall also be included:
1. Title page giving name and location of facility, drawing number where shown, and specification section where described.
 2. Equipment cover sheet listing the supplied equipment manufacturer's name, brand name, model numbers, serial numbers, equipment installer (provide contact name, address, phone and fax numbers, and e-mail address), equipment supplier (provide contact name, address, phone and fax numbers, and e-mail address), and equipment manufacturer (provide contact name, address, phone and fax numbers, e-mail address, and website address),
 3. Performance curves for all pumps and equipment.
 4. Approved shop drawings of each piece of equipment.
 5. Design criteria for the equipment, in table format. Information shall include standard size information such as length, width, or diameter, and capacity information such as flow and head that is not included in the nameplate table.
 6. Troubleshooting in table format as follows:

Problem	Possible Causes	Corrective Action

7. Nameplate data for the equipment in table format. Nameplate information shall include data for the overall assembly and any major components such as motors, gear reducers, etc.
 8. Manufacturer’s cut sheets and dimensional drawings of each piece of equipment, and details of all replacement parts.
 9. Manufacturer’s erection, operation, and maintenance instructions for all equipment and apparatus, and complete listing of nameplate data.
 10. Complete electrical and control schematics with labeled terminations for all individual pieces of equipment and systems including one line diagrams, schematic or elementary diagrams, and interconnection and terminal board identification diagrams.
 11. A description of the controls provided with the equipment.
 12. Complete piping and interconnecting drawings.
 13. Complete parts list with parts assembly drawings (preferably by exploded view), names and addresses of spare parts suppliers, recommended list of spare parts to be kept “in stock” and sample order forms. Lead time requirements for ordering parts shall be estimated.
 14. Instructions with easily understood schematics or diagrams for disassembling and assembling equipment for overhaul and repair.
 15. Shop testing results where applicable.
 16. Manufacturer’s Installation Certificate.
 17. Manufacturer’s Certificate of Equipment Compliance.
 18. Field testing/performance reports where applicable.
 19. Manufacturer’s equipment warranty.
 20. Information not applicable to a specific piece of equipment installed on this project shall be removed from or crossed out on the submissions.
 21. Illegible data due to any cause, including poor copy quality or reduction, will not be accepted. Manuals with illegible data will be rejected and returned for correction.
- C. Organization - O&M Manuals shall be organized as follows:
1. All instructions shall be bound into a series of identical 3- or 4-inch heavy-duty three- ring binders. Where necessary, more than one binder may be used to assemble the data. When two or more binders are used, each book or volume shall be titled to indicate its particular book or volume number and the total number of volumes per set (i.e., Volume 2 of 12). The

Contractor shall plan manual content and shall "break" the data between volumes at reasonable locations so no loss in continuity of data presentation occurs.

2. Information shall be organized by specification section, each covering an individual equipment item.
3. Sections shall be listed in a Table of Contents at the front of each volume.
4. Shop drawings 24 inches by 36 inches in size shall be folded to approximately 12 inches by 9 inches with drawing title box exposed along either edge. Shop drawings descriptive of a single item of equipment shall be grouped together and fully indexed on the outside of the folders in a neat and uniform manner.
5. All shop drawings included in the binders and/or folders shall be those previously submitted for review and approval and shall bear Engineer's stamp of approval and comments as originally noted thereon.

D. Electronic Operations and Maintenance Data

1. In addition to the specified printed operations and maintenance materials, furnish all specified operations and maintenance materials in electronic format with the final draft operations and maintenance manual submittals prior to Substantial Completion. Electronic equipment manual files shall be submitted in Adobe Acrobat Reader (.PDF) format.
2. Electronic files shall be submitted on one or more compact disks (650 MB CD). Two sets of compact disks shall be provided, one for Owner and one for Engineer. CDs and covers shall be labeled with the project name, supplier, equipment identification, and specification section. CDs shall be provided in individual hard plastic cases.

1.15. LUBRICATION

- A. For equipment that requires lubrication, manufacturer shall prepare a lubrication schedule for all equipment utilizing lubricants from as few companies as possible (preferably single source).
- B. Include lubrication schedule in the operation and maintenance instructions.

1.16. FAILURE OF EQUIPMENT TO PERFORM

- A. Promptly correct by replacement or otherwise any defects in the equipment, or failure to meet the guarantees or performance requirements.
- B. If Contractor fails to make these correction, or if the improved equipment again fails to meet the guarantees or specified requirements, the Owner, notwithstanding his having made partial payment for work and materials which have entered into the manufacture of said equipment, may reject said equipment and order the Contractor to remove it from the premises at the Contractor's expense.

1.17. GUARANTEE

- A. Provide equipment guarantees in accordance with Article 13 of the General Conditions. Guarantee requirements may be added to or modified in the individual specification sections.

B. Manufacturer Warranties During Correction Period

1. Where indicated in the individual specification sections, provide a one-year manufacturer warranty made out in the name of the Owner, coinciding with the correction period defined in General Conditions for the particular piece of equipment.
2. One copy of each manufacturer warranty shall be provided to both Owner and Engineer within 30 days of successful completion of startup.
3. All requirements of the correction period defined in General Conditions Article 13.07 shall apply to the manufacturer's warranty and the equipment supplier obligations shall be the same as Contractor obligations defined in General Conditions for the particular piece of equipment covered by the warranty.

- C. Special Guarantees - Provide both Owner and Engineer one copy of special guarantees required in individual specification sections. Special guarantees shall be made out in the Owner's name.

1.18. EQUIPMENT SCHEDULE

- A. The attached schedule outlines the various items of equipment specified in other sections and lists the responsibilities of the equipment manufacturer for each section of the specifications for Contract No. 1.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

(continued)

Equipment Name	Spec Section ⁽¹⁾	X=Required ⁽¹⁾				Services of Manufacturer's Representative ^(1,2)						O&M Manual ⁽¹⁾	Video Recording of Training Required ⁽¹⁾
		Performance Affidavit	Shop Tests	Field Tests	Certification of Equipment Compliance	Installation	Preliminary Field Test	Functional Test	System Demonstration	Startup	Training		
Submersible Pumps	11303	X	X	X	X		2 ⁽³⁾	2 ⁽³⁾		2 ⁽³⁾	1	X	X
Programmable Logic Controllers (PLC)	17100	X	X	X		1/2			5	2	1	X	X
Level Measurement (Suspended Pressure Transducer Type)	17375	X		X		1/2		1/2			1/2	X	X

⁽¹⁾Refer to individual specification sections for additional details, and the Bid Form and Section 01026 for Deductive Alternate equipment.

⁽²⁾All times are actual on-site times and represent minimum requirements.

⁽³⁾Two separate trips; one for each unit/system location.

MANUFACTURER'S EQUIPMENT CHECK-OUT & CERTIFICATION

PROJECT:		REPORT NO.:	
COMPANY:		DATE:	
NAME OF EQUIPMENT:		PROJECT NO.:	
EQUIPMENT TAG:		CONTRACT NO.:	
SPEC SECTION:		MODEL NO.:	
SHOW DRAWING ITEM NO.:		SERIAL NO.:	

_____, as the authorized Manufacturer's Representative for the above-referenced equipment, hereby certifies that we have completely inspected, aligned, operated and adjusted said equipment on this date.

Equipment Evaluation Checklist	Completed and Acceptable	Deficient Explanation Below	N/A
Verify there is no visible corrosion or mechanical damage to the equipment.			
Verify the nameplates are correct.			
Verify that all mountings are secure, all piping is attached, all belts and drives are installed and tensioned correctly, and all safety features are in place.			
Verify that prerequisites and preliminary tests for low voltage motor control centers, adjustable frequency drives, and all other electrified equipment, have been completed. Verify all control and power circuits to the equipment are energized.			
Verify that factory test reports have been received and approved.			
For systems tests, verify that all applicable prerequisites and preliminary tests for subsystems and auxiliary equipment have been completed.			
Bump motors to verify correct rotation.			
Verify operation of seal water system.			
Verify operation of valves and verify proper open or shut positions.			
Check all feed and drain lines.			
Verify the equipment has been checked against the approved shop drawing and complies with all details, including comments by the Engineer.			
Verify that all equipment has been properly lubricated in accordance with manufacturer's requirements.			

Deficiencies:

MANUFACTURER'S EQUIPMENT CHECK-OUT & CERTIFICATION

Corrections:

Special Instructions:

Training (Check One):

	_____ hours of training on equipment operation and maintenance was given on _____ to the following personnel:
	No training was provided; it will be scheduled for a later date.
	No training is required.

Manufacturer's Certification Statement:

The equipment is complete, conforms to the requirements of the Contract and is ready for permanent operation. There is nothing in the installation that will render the Manufacturer's warranty null and void.

Authorized Signature _____

Title _____ Date _____

The equipment is ready for permanent operation and nothing in the installation will render the Manufacturer's warranty null and void. The deficiencies noted are minor and will not adversely affect the equipment operation. The deficiencies will be corrected at a later date.

Authorized Signature _____

Title _____ Date _____

The equipment certification cannot be completed at this time.

Authorized Signature _____

Title _____ Date _____

MANUFACTURER'S EQUIPMENT CHECK-OUT & CERTIFICATION

Witnessed by Contractor:

Authorized Signature _____

Title _____ Date _____

Witnessed by Engineer:

Authorized Signature _____

Title _____ Date _____

Attachments (list manufacturer's field report):

**Attach Manufacturer's Check-Out Report.*

END OF SECTION

SECTION 01660

TESTING AND STARTUP

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Definitions.
- B. Submittals.
- C. Preliminary field testing.
- D. Functional testing.
- E. System demonstration testing.
- F. Startup.
- G. Meetings.

1.02. DEFINITIONS

- A. System - The combination of subsystems that will collectively undergo sequential system demonstration testing, startup, and delivery to the Owner. Each system includes all components necessary for that system to function as intended, including structural/architectural components, HVAC, plumbing, process equipment, piping, power, automated controls, life safety, etc.
- B. Subsystem - The multiple components of a system. Subsystems are generally defined as unit processes and support systems, including structural/architectural components, HVAC, plumbing, process equipment, piping, power, automated controls, life safety, etc.
- C. System Delivery Plan - Contractor's schedule for delivering systems to the Owner.
- D. Preliminary Field Test - Field test to demonstrate that equipment is properly installed and ready for operation.
- E. Functional Test - Field test to demonstrate successful operation and performance of equipment in all intended modes of operation, including operation from remote devices with the exception of the plant PCS.
- F. PCS Programming Phase - Period of time for PCS programmer to load, test, and debug PCS application software.
- G. System Demonstration Testing - Continuous successful operation of a system in its entirety utilizing a testing fluid prescribed by the Owner for seven consecutive days prior to startup of that system.
- H. Startup - Continuous successful online operation of a system in its entirety utilizing actual process fluid and at actual service conditions for seven consecutive days prior to delivery of that system to the Owner.

1.03. SUBMITTALS

A. Functional Testing Plans

1. Submit at least 30 days prior to proposed functional testing date in accordance with procedures identified in Section 01300, Submittals.
2. Submit individual plans for each piece of equipment requiring a functional test.
3. Coordinate with Owner to determine testing fluid sources and include in functional testing plans.
4. At a minimum, the System Delivery Plan shall include the following systems at the pump stations:
 - a. Tarbell Hill Pump Station, including:
 - 1) Raw sewage pumps
 - 2) Associated electrical and controls
5. Proposed start and finish dates for all system demonstration tests and startup.
6. Incorporate into progress schedule.
7. Resubmit proposed changes in accordance with procedures identified in Section 01300, Submittals.

B. System Demonstration Testing and Startup Plans

1. Submit a minimum of 30 days prior to proposed system demonstration test date in accordance with procedures identified in Section 01300, Submittals.
2. Identify all testing media sources and disposal locations including testing fluid, sludge, utility water, chemicals, process air, instrument air, etc. for both system demonstration testing, and startup.
3. Identify all instrumentation and recording devices required to complete testing.
4. Identify all required laboratory testing.
5. Identify days during which the manufacturer's representatives will be on site.

1.04. GENERAL

- A. Provide a minimum of 14 days' notice to the Owner and Engineer prior to all testing. The Owner and Engineer reserve the right to witness all testing.
- B. Materials, Supplies, and Utilities

1. Owner Furnished, Unless Otherwise Specified
 - a. Power via utility during testing.
 2. Contractor Furnished
 - a. All required tools, materials, and spare parts.
 - b. All required instrumentation and monitoring devices, including temporary devices required for testing (i.e., flow meters, pressure gauges, level sensors, etc.)
 - c. All required fuel, lubricants, energy, equipment, and instruments.
 - d. All required utilities not furnished by the Owner.
 - e. All required chemicals not furnished by the Owner.
 - f. Laboratory services where specified or otherwise required.
 - C. Connection to Existing Equipment and Facilities - Test all equipment and facilities to ensure that they are in operating condition before the final tie-ins are made which connect new equipment and facilities to existing equipment and facilities.
 - D. Contractor Operating Personnel
 1. System Demonstration Testing
 - a. Provide the following on call personnel that are capable of arriving at the site within two hours after request by Contractor furnished and monitored alarms:
 - 1) One person associated with testing.
 2. Startup
 - a. Provide the following on-call personnel capable of arriving at the site within two hours after request: One qualified person
- 1.05. PRELIMINARY FIELD TESTING
- A. Demonstrate the following:
 1. Equipment is permanently installed in the correct location and orientation.
 2. Equipment is properly adjusted, aligned, and lubricated.
 3. Equipment is prepared for operation in strict accordance with the Contract Documents and with manufacturer's recommendations.
 - B. Make all changes, adjustments and replacements required to comply with the requirements of the Contract Documents.

- C. Preliminary field testing shall be witnessed by the manufacturer's representative where required by Section 01640, Equipment-General, and the individual specification sections.
- D. Prerequisites
 - 1. Accepted System Delivery Plan.
 - 2. Permanent power has been connected and unit is ready for operation.

1.06. FUNCTIONAL TESTING

- A. At a minimum, functional tests shall include the following:
 - 1. Verification that equipment meets the specified performance requirements in every detail and performs its intended function without any unusual vibration, noise or other signs of possible malfunction. Unless specifically identified otherwise in individual specification sections, all performance testing shall be conducted during functional testing.
 - 2. Motor testing where required.
 - 3. Vibration testing where required.
 - 4. Demonstration of successful operation in all control modes including all remote devices except the Plant PCS.
- B. Prerequisites
 - 1. Accepted Functional Testing Plan.
 - 2. Preliminary field testing.
 - 3. Manufacturer's Installation Certificate.
 - 4. Final Draft Operations and Maintenance Manual.
- C. Testing fluid shall be non-potable water unless otherwise specified or required by Owner.

1.07. SYSTEM DEMONSTRATION TESTING

- A. Operate system in simulated fashion as described in the accepted System Demonstration Testing and Startup Plan demonstrating all modes of operation. This shall include, when practical, simulation of extreme conditions so as to check the response of instrumentation and control devices, bypass functions, pumping cycles, etc. Contractor shall be responsible for the complete operation of the system, including the positioning of valves, gates, switches, proper equipment devices, controls and associated components furnished and/or installed under this contract. Owner will provide operation of all existing treatment plant components unless otherwise specified.
- B. If any component of the system fails to operate in accordance with the Contract Documents during system demonstration testing, provide all necessary repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the system. Required adjustments to equipment shall be made by a qualified manufacturer's representative. After

the system is restored to proper operating conditions, restart the test. No credit will be given for operating time prior to system failures when calculating test durations.

- C. Equipment shall be powered from the permanent power source prior to system demonstration testing.
- D. Prerequisites
 - 1. Accepted System Demonstration Testing and Startup Plan.
 - 2. Functional testing of all system components.
 - 3. Associated system demonstration testing and startup meeting.
 - 4. Required training for all system components not specifically identified in individual specifications sections as post startup training.
 - 5. Leakage testing of associated piping and tanks.
 - 6. Permanent safety and protection devices installed and operational. Safety devices shall include, but not be limited to, fall protection, hand railing, grating and floor plates, leak detection, motor thermal and overload protection, emergency power generation, equipment lockouts, floatation devices, fire alarms and systems, ventilation systems, and lighting in operational areas in or directly related to the system being tested. All open excavations in or adjacent to the operational areas shall be covered.
 - 7. Verification that all required lubrication equipment and materials are readily available to Contractor at the site.
 - 8. System piping, valves, instruments, control panels, and electrical equipment properly labeled in accordance with the Contract Documents.
- E. Testing fluid shall be non-potable water unless otherwise specified or required by Owner.

1.08. STARTUP

- A. Operate system under Owner's direction demonstrating all modes of operations. This shall include, when practical, simulation of extreme conditions so as to check the response of instrumentation and control devices, bypass functions, pumping cycles, etc. Contractor shall be responsible for the complete operation of the system, including the positioning of valves, gates, switches, proper equipment devices, controls and associated components furnished and/or installed under this Contract. Owner will provide operation of all existing treatment plant components and provide all required sampling and laboratory testing required for operation of system during Startup unless otherwise specified.
- B. If any component of the system fails to operate in accordance with the Contract Documents during Startup, provide all necessary repairs, maintenance, replacement of parts, corrections, adjustments, and other actions necessary to restore proper operation of the system. Required adjustments to equipment shall be made by a qualified manufacturer's representative. After the system is restored to proper operating conditions, restart the test. No credit will be given for operating time prior to system failures when calculating test durations. Examples of system failures include, but are not limited to the following:

1. Tank overflows.
 2. Equipment failures and/or malfunctions.
 3. Instrumentation failures and/or malfunctions.
 4. Tank or piping failures and/or leakage.
 5. Loss of power to equipment and/or devices.
- C. Upon successful completion of startup, the system shall be delivered to the Owner for partial utilization.
- D. Prerequisites
1. System demonstration testing.
 2. Provide Owner with up-to-date record drawings showing all components as they are installed. The record drawings shall cover all major components of the system including power feed, control and alarm annunciation, and piping.
 3. Seven days written notice prior to proposed actual beginning of startup date. Startup cannot commence without Owner and Engineer acceptance of proposed actual beginning of Startup date.

1.10. SYSTEM DEMONSTRATION TESTING AND STARTUP MEETINGS

- A. At least 14 days prior to the proposed start date for each system demonstration test, conduct a meeting with Owner and Engineer to review testing plans, finalize testing procedures, verify status of associated equipment and prerequisites, and coordinate all aspects of system demonstration testing and startup. Representatives of the Owner, Engineer, and Contractor shall attend the conference.
- B. Prerequisites
1. Accepted System Demonstration Testing and Startup Plan.
 2. Completion of all associated functional testing.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 01700

CLOSEOUT AND RECORD DOCUMENTS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Closeout procedures.
- B. Record documents.

1.02. RELATED SECTIONS

- A. General Conditions
- B. Supplementary Conditions
- C. Section 01640 – EQUIPMENT-GENERAL

1.03. CLOSEOUT PROCEDURES

- A. Contract closeout procedures shall be in accordance with the General Conditions and as specified herein.
- B. Correct or replace all defective work in accordance with the requirements of the General Conditions.
- C. The following items shall be provided by the Contractor prior to Final Application of Payment:
 - 1. Spare parts, maintenance and extra materials in quantities specified in individual specification sections. Deliver to project site and place in location as directed; obtain receipt prior to final payment.
 - 2. Provide duplicate notarized copies of certifications for those items with extended transferable warranties beyond one year. Prepare separate submittal for each item.
 - 3. Warranties and Bonds - Provide duplicate notarized copies of certifications for those items with extended transferable warranties beyond one year. Prepare separate submittal for each item.
 - a. Execute and assemble documents from subcontractors, suppliers, and manufacturers.
 - b. Provide Table of Contents and assemble in three D-side ring binder with durable plastic cover.
 - c. Submit prior to final Application for Payment.
 - d. For items of work delayed beyond date of Substantial Completion, provide updated submittal within 10 days after acceptance, listing date of acceptance as start of warranty period.
 - 4. Operation and Maintenance Manuals as specified in Section 01640, Equipment - General.

1.04. RECORD DOCUMENTS

- A. The following supplements the requirements of the General Conditions:
1. Record, keep, and monitor up-to-date record documents of work constructed in the field. Legibly mark in red ink or red pencil to show all changes in, or directly associated with, the work of this contract. Keep entire set of record documents current on a day-to-day basis. Record documents shall be kept on hand in the Contractor's field office and shall be available for periodic examination by Engineer upon request.
 2. Examples of annotations that could occur are as follows:
 - a. Change in location or elevation of structures.
 - b. Change in dimensions of structures.
 - c. Elimination of structures.
 - d. Unforeseen modifications to existing structures.
 - e. Relocation of equipment.
 - f. Additions to or expansion of structures.
 - g. Changes in mechanical trades components; (electrical, heating, ventilating, plumbing).
 - h. Measured location of internal utilities or mechanical trade items, which are to be concealed from view, referenced to visible and accessible features of the structure.
 - i. Change in location or elevations of Underground Facilities installed under this Contract.
 - j. Change in materials, such as pipe materials.
 - k. Relocation of existing underground facilities.
 - l. Change in topographical contours of finished earth and paved surfaces.
 - m. Change in elevations of finished surfaces along route of installed underground facilities.
 3. Show measurement of pipeline location from edge of pavement, at a minimum of 100-foot intervals.
- B. At Substantial Completion, affix Contractor's red identification stamp to front cover of each set of record documents and label them as "Record Documents." One set of record documents shall be given to Engineer no later than 14 days after the date of Substantial Completion. Engineer will either approve record documents or return them to Contractor with comments. Contractor shall resubmit record documents until Engineer has no further comments. Affix Contractor's identification stamp, together with the label "Record Documents," as follows:
1. On each drawing, just above the Engineer's title block.

2. On each shop drawing, just above the preparer's title block.
 3. On the front cover or front page of all other documents.
- C. Final payment to Contractor will not be considered until acceptable record documents have been turned over to Owner.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

Not used.

END OF SECTION

SECTION 02030

DEMOLITION

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Demolition and removal of site-related construction.
- B. Demolition and removal of tanks, related structures, and residual tank contents.
- C. Demolition and removal of process equipment and piping.
- D. Demolition and removal of electrical construction.
- E. Contractor is responsible to coordinate demolition work and sequencing with all other Contractors, Engineer, and Owner.

1.02. RELATED SECTIONS

- A. Section 01010 - SUMMARY OF WORK
- B. Section 01039 - COORDINATION AND MEETINGS
- C. Section 01300 - SUBMITTALS
- D. Section 01500 - TEMPORARY FACILITIES
- E. Section 01700 - CLOSEOUT AND RECORD DOCUMENTS
- F. Section 02223 – BACKFILLING
- G. Section 09900 – PAINTING

1.03. SUBMITTALS

- A. Submit under provisions of Section 01300, Submittals.
- B. Contractor shall submit a detailed demolition work plan for all demolition activities including all necessary diagrams and/or drawings accounting for Owner's continuing occupancy and the sequence of construction. The demolition work plan shall include the following at a minimum:
 - 1. Identify items to be demolished and discuss the demolition, removal, and disposal procedures.
 - 2. Disposal locations of removed items.
 - 3. Relocation of salvageable items.
 - 4. Temporary storage of items to be reused.

5. Time lines and sequence of work.
 6. Location of temporary barricades, fences, and signs.
 7. Provisions for disposal of sludge, grit, and debris.
- C. The work plan shall be reviewed by the Engineer and approved by the Owner prior to the commencement of all demolition work.
- 1.04. PROJECT RECORD DRAWINGS AND PHOTOGRAPHS
- A. Submit under provisions of Section 01700, Closeout and Record Documents.
 - B. Accurately record, horizontally and vertically, actual locations of capped utilities, subsurface obstructions.
- 1.05. REGULATORY REQUIREMENTS
- A. Conform to applicable codes for demolition of structures, protection of adjacent structures, dust control, runoff control, and disposal of materials.
 - B. Obtain required permits from authorities.
 - C. Notify affected utility companies before starting demolition operations and comply with their requirements.
 - D. Do not close or obstruct roadways, sidewalks, hydrants, or parking areas without required permits.
 - E. Conform to applicable regulatory procedures if a hazardous environmental condition is encountered at site or if hazardous material disposal is required.
- 1.06. HAZARDOUS ENVIRONMENTAL CONDITIONS
- A. If an unknown unforeseeable hazardous environmental condition is encountered at the site, or if Contractor or anyone for whom Contractor is responsible creates a hazardous environmental condition, immediately:
 1. Secure or otherwise isolate such condition;
 2. Stop all work in connection with such condition and in any area affected thereby; and
 3. Notify Owner and Engineer (and promptly thereafter confirm such notice in writing).
 - B. Resume work in connection with such condition or in any affected area only after Owner has obtained any required permits related thereto and delivered to Contractor a written notice specifying under what special conditions work may be resumed safely.
- 1.07. SEQUENCING
- A. Sequence demolition work to conform with provisions of Section 01010, Summary of Work and Section 01030, Sequence of Work

- B. Existing equipment and structures shall not be demolished or removed from service until the new replacement equipment and material necessary to construct the new structures and complete the work is on site and ready for installation. Contractor shall minimize the time equipment and treatment processes are out of service.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

- A. Notify Owner and Engineer at least 48 hours in advance of intended start of demolition operations in each affected area.
- B. Provide, erect, and maintain temporary barriers, signs, and security devices.
- C. Erect and maintain temporary partitions and weatherproof closures to prevent spread of dust, odors, and noise in areas of continued Owner occupancy identified in Section 01010, Summary of Work.
- D. Protect existing structures, equipment, appurtenances, architectural features, and materials which are not to be demolished. Prevent movement or settlement of adjacent structures.
- E. Protect existing site-related items such as pavements, walkways, parking areas, curbs, aprons, and landscaping features which are not to be demolished.
- F. Protect existing electrical; heating, ventilating, and air conditioning; and plumbing systems, including related components, which are not to be demolished.
- G. Mark location of underground utilities.

3.02. DEMOLITION REQUIREMENTS

- A. Confine demolition operations within the contract limits.
- B. Conduct operations to minimize interference with adjacent and occupied building areas. Maintain protected egress and access at all times.
- C. Cease operations immediately if adjacent structures appear to be in danger. Notify Engineer. Do not resume operations until directed.
- D. All materials, except rubble and non-metallic scrap, shall become the property of the Owner if requested by Owner.
- E. Dispose of rubble and non-metallic scrap.

3.03. DEMOLITION

- A. Break up and remove slabs-on-grade, pavements, curbs, aprons, etc., and related items in designated areas.
- B. Break up and remove foundation walls, footings, etc., including any below-grade concrete slabs, to a point minimum 2 feet below grade to accommodate work per the Contract Documents.
- C. Break up and remove concrete structures and tanks, including walls, piers, base slabs, cover slabs, etc.
- D. Empty and remove buried tanks, meter pits, and associated piping.
- E. Backfill, compact, and rough grade areas excavated, including cavities created by removal of demolished items, in accordance with Section 02223, Backfilling.
- F. Disconnect, cap, and identify utilities within demolition areas.
- G. Remove designated buried sewer and storm drain piping systems, permanently capping with concrete plugs those segments to be abandoned, and provide temporary capping of those segments to be reused.
- H. Disconnect and remove designated process piping systems, including valves and fittings; provide temporary capping of those segments of the system to be reused. Plug openings in walls and floors where utilities are removed.
- I. Detach, dismantle, and remove metal components of process equipment from designated buildings, including miscellaneous metal work items associated with access to and operation of such equipment.
- J. Carefully disconnect support, protect, and remove designated equipment to be reused on the project or salvaged for Owner's future use.
- K. All removed materials and equipment designated for reuse on the project, or salvaged for Owner's future use, shall be protected from damage and from deterioration by weather.
- L. Remove and dispose of demolished materials as work progresses. Do not burn materials; do not bury materials.
- M. Patch and refinish existing visible surfaces which are to remain in accordance with Section 01039, Coordination and Meetings.
- N. Paint designated metal surfaces and reinforcing steel exposed by demolition operations, in accordance with Section 09900, Painting.
- O. Remove temporary barricades, partitions, signs, etc.
- P. Remove and dispose of residual materials such as grit, sludge, debris, trash, and other scrap.
- Q. Upon completion of demolition operations, leave areas in a clean condition.

END OF SECTION

SECTION 02110

SITE CLEARING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Removal of surface debris, rubbish, snow and water without unnecessary excavation of topsoil and subsoil.
- B. Removal of paving, curbs and walks.
- C. Removal of trees, shrubs, and other plant life.
- D. Removal of stumps and root system of trees and shrubs.
- E. Disposal of excess materials, trash, and debris.
- F. Topsoil excavation and stockpile reusable topsoil for later use.

1.02. RELATED SECTIONS

- A. Section 01500 - TEMPORARY FACILITIES
- B. Section 01564 - EROSION CONTROL
- C. Section 02112 - PAVEMENT CUTTING

1.03. REGULATORY AND DISPOSAL REQUIREMENTS

- A. Coordinate clearing work with utility companies.
- B. Conform to applicable local, state and federal codes for environmental requirements, disposal of debris, and stockpiling
- C. On-site disposal of surplus materials shall be the sole responsibility of the Contractor.
- D. Make all arrangements for disposal sites, unless the Owner designates special locations. All expenses for disposal shall be borne by the Contractor. Bidders shall carefully investigate all aspects of surplus material disposing operations.
- E. Prior to depositing surplus material at any off-site location, obtain a written agreement between Contractor and the owner of the property on which the disposal of the material is proposed. The agreement shall state that the owner of the property gives permission for the Contractor to enter and deposit material of a particular classification on the owner's property at no expense to the project Owner, and shall include any other conditions pertinent to the situation as agreed upon by each party. The owner of the property is responsible for all risks associated with the surplus material. The project Owner is not liable for damages associated with the surplus material.

- F. Follow standard horticultural practice for cutting and/or pruning of trees, brush, and shrubs.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

- A. Verify that existing plant life designated to remain, is tagged or identified.
- B. Mark limits of clearing by flagging, fencing or other approved methods.
- C. Vehicles used to haul soft or wet material over streets or pavements shall be watertight to prevent deposits on the streets or pavements. In all cases where any materials are dropped from the vehicles of the Contractor, he shall clean up the same, and keep the crosswalks, street and pavements clean and free from debris.
- D. Identify on-site waste or salvage areas for placing removed materials.

3.02. PROTECTION

- A. Locate, identify, and protect existing utilities that are to remain, including notification of Dig Safely New York.
- B. Install temporary fences (minimum 3 feet high) in accordance with the Stormwater Pollution Prevention Plan and Erosion and Sediment Control Details to protect trees, plant growth, and features designated to remain, as final landscaping.
- C. Protect bench marks, survey control points, and existing structures from damage or displacement.
- D. Where trees are to be protected or preserved, no excavation and grubbing, except as directly required for construction, shall be performed within the radius of spread of tree branches.
- E. No storage of topsoil materials or construction equipment will be permitted within the radius of spread of such tree branches.

3.03. CLEARING

- A. Clear areas required for access to site and execution of work.
- B. Remove paving, curbs, and walks where required.
- C. Remove trees and shrubs within marked areas. Remove stumps, main root ball, and root system to a root diameter of less than or equal to 1 inch.
- D. Clear undergrowth and deadwood, without disturbing subsoil.
- E. Remove debris, extracted rock, and plant life.

- F. Prune branches and/or roots of trees to be preserved or where they interfere with or obstruct construction operations.
 - 1. If exposed, bend and relocate main lateral roots and tap roots.
 - 2. Engage a state-certified arborist or qualified tree surgeon who shall cut roots and/or branches with sharp pruning instruments without breaking or chopping.
 - 3. Qualified personnel shall paint all cuts with standard tree paint or equivalent which is waterproof, antiseptic, elastic and free of kerosene, coal, tar, creosote, and other harmful substances.
 - 4. Where required, extend pruning procedures to restore the natural shape of the entire tree or shrub.
- G. Damaged Trees - Vegetation which has been damaged by site clearing activities and deemed non-functional by the Owner shall be replaced by the Contractor with vegetation of the same genus and species at Contractor's expense.

3.04. DISPOSAL OF MATERIAL

- A. All material shall be treated as surplus material and disposed of off-site in a legal manner per Article 1.03.

3.05. TOPSOIL EXCAVATION

- A. Excavate topsoil from areas to be further excavated, re-landscaped, or re-graded without mixing with foreign materials.
- B. All topsoil, loam, or other natural organic materials covering such areas shall be removed; and when suitable for reuse as topsoil shall be stockpiled. Stockpiles shall be established only at approved locations and shall be maintained to prevent erosion and contamination until reuse. To prevent intermixing, topsoil shall not be stockpiled immediately adjacent to other stockpiled materials. All excavated materials shall be stockpiled at locations which will not create public endangerment or inconvenience. Stockpiles shall be kept clear of Fire Department and police facilities and equipment, and clear of driveways, sidewalks, and crossings.
- C. Stockpile in area designated by Owner on-site to depth not exceeding 8 feet. Protect from erosion in accordance with the Stormwater Pollution Prevention Plan and Erosion and Sediment Control Details. Remove excess topsoil not being reused to a location designated by Owner.
- D. No topsoil shall be removed from the site without Owner's permission.

END OF SECTION

SECTION 02112

PAVEMENT CUTTING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Pavement cutting.
- B. Pavement scoring.
- C. Pavement (concrete) breaking.
- D. Pavement grinding.
- E. Pavement removal and disposal.

1.02. REFERENCES

- A. NYSDOT - Manual of Uniform Traffic Control Devices.

1.03. RELATED SECTIONS

- A. Section 01500 - TEMPORARY FACILITIES
- B. Division 2 specifications.

1.04. REGULATORY REQUIREMENTS

- A. Coordinate pavement cutting with utility companies.
- B. Conform to applicable local, state, and federal codes for legal disposal of pavement materials.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

- A. Notify local officials, Fire and Police Departments of streets, pedestrian trails, or paths to be blocked off, detours or restrictions to maintaining of traffic on a daily basis.
- B. Set up barricades, warning signs and traffic direction information prior to start of pavement cutting per MUTCD.

- C. Provide flagmen to direct traffic.

3.02. PAVEMENT CUTTING AND BREAKING

- A. Pavements covering those areas to be excavated shall be broken up, removed, and then disposed of in accordance with Article 1.04 above. All paved areas shall be first cut or scored continuously along a straight line, parallel to and on each side of the centerline of the trench or excavation, at a width sufficient for the trench excavation or structure excavation.
- B. Pavement cuts in concrete pavement or pavement with a concrete base shall be made by scoring or cutting the concrete with a concrete saw. The depth of the saw cut shall be to the full depth of the concrete pavement thickness. Before excavation, the concrete pavement shall then be broken up with hand operated, pneumatic paving breakers, or mechanical drop hammers designed for such purpose, providing they may be used without endangering existing utilities or causing undesirable vibrations. "Headache balls" will not be permitted for breaking up concrete pavement.
- C. Pavements cuts in blacktop pavement shall be made by scoring or cutting the pavement with a concrete saw, wheel cutter, pneumatic paving breaker or drop hammer type pavement cutter. The pavement cut must be continuous, and made for the full depth of the pavement.
- D. Pavement cuts for final pavement replacement shall be made as outlined above. Pavement cuts shall be made parallel to the centerline of the trench, shall be located at a minimum of 12 inches outside the backfilled trench on undisturbed subgrade in a straight line between those stations where changes in direction of the installed piping were made. Where a full street width overlay is to be installed the cutbacks may follow the backfilled trench alignment. Loose, torn, cut, marked up or damaged pavement outside the cutback areas shall be removed and replaced at the Contractor's expense and match the proposed permanent paving.
- E. Pavement cuts in driveways shall be made in a straight alignment perpendicular or parallel to the driveway and for its full width.
- F. Pavement cuts in parking areas shall be made in a straight alignment parallel to the centerline of trench.

END OF SECTION

SECTION 02141

REMOVAL OF WATER

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Providing equipment, materials and labor required to successfully complete the work included in this section.
- B. Maintaining and operating pumps and related equipment, including standby equipment, of sufficient capacity to adequately perform dewatering as required by this section.
- C. Lowering the groundwater table elevation.
- D. Intercepting seepage from excavation slopes.
- E. Controlling groundwater flow that may adversely affect excavation or construction activities.
- F. Collecting, removing and disposing of all excess groundwater.
- G. Collecting, removing, and disposing of all wastewater.
- H. Removing and/or disposing of spoil, excess materials, equipment, trash and debris used for or resulting from the work included in this section.

1.02. RELATED SECTIONS

- A. Division 1 specifications.
- B. Division 2 specifications.

1.03. REGULATORY REQUIREMENTS

- A. Conform to applicable local, state and federal requirements for legal disposal of water.
- B. Temporary water supplies shall meet requirements of local, state and federal regulatory agencies.
- C. Conform to applicable OSHA standards.

1.04. WELLPOINT DEWATERING SYSTEM

- A. If wellpoint dewatering methods are proposed by Contractor, he shall prepare a plan of dewatering system and discuss plan with the Owner in the presence of the Engineer. Review or comments by Owner concerning the proposed plan shall not relieve Contractor of his responsibilities for dewatering his excavations in conformance with this section of the specifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

- A. Contractor to conduct appropriate sub-surface investigations to become familiar with the groundwater conditions at the site. Allocate sufficient time and use appropriate procedures based on these conditions for dewatering excavations.
- B. Arrange for water sampling and analysis of each water supply source which may be affected by dewatering operations and submit a copy of the results to the Owner.
- C. Examine adjacent structures and utilities, both existing and under construction, for possible settlement, movement or other adverse effects resulting from dewatering methods or water removal. Protect such structures and utilities.
- D. Should the drawdown of groundwater levels by removal or dewatering systems critically reduce or disrupt public or private water supplies, the Contractor shall be prepared to:
 - 1. Provide adequate potable water to the owners or users of the affected water supplies until groundwater levels have recovered, so as to sufficiently restore those deficient water supplies.
 - 2. Provide to the Engineer documentation to confirm that temporary water supplies meet the requirements of local, state and federal regulatory agencies.

3.02. REMOVAL OF WATER

- A. Assume responsibility for site, surface and subsurface drainage. Maintain such drainage as specified herein during the life of the contract.
- B. Supply all supervision, labor, material, equipment, including standby equipment, necessary to maintain a dry excavation as may be necessary to construct the project.
- C. Maintain groundwater in or below the bearing strata at a safe level at all times by methods which prevent loss of fines, which preserves the undisturbed state of subgrade soils and which sufficiently lowers the groundwater level in permeable strata at or below excavation and fill levels such that blowing or unstable conditions do not develop in the bottom or sides of excavation or fill areas.
- D. Groundwater shall be maintained below the pipe invert to witness testing of pipe joints and new connections, upon recharging of water line.
- E. Protect all adjacent structures, existing and under construction, from settlement, flotation, damage or other adverse effects resulting from water removal or dewatering methods.
- F. Install all drains, ditching, sluiceways, pumping and bailing equipment, wicking, sumps, wells, well points, cutoff trenches, curtains, sheeting and all other equipment and structures necessary to create

and maintain a dry excavation and a groundwater level at a minimum of 2 feet below excavation subgrades.

1. As part of any dewatering system, observation wells or piezometers shall be provided and installed, as required, to effectively and efficiently monitor drawdown to required levels.
- G. Discharge water removed from the site to natural watercourses, storm drains, or channels.
1. Large quantities of water shall not be discharged as overland flow. Overland flow is not permitted onto private property.
 2. Water shall not be discharged to storm sewers without the prior approval of the Engineer or Owner.
 3. Water discharge to any sanitary sewage is prohibited.
 4. Water shall be discharged in accordance with the Stormwater Pollution Prevention Plan.
 5. Wastewater shall be disposed of in a manner satisfactory to the local Public Health Officer.
- H. Dewatering operations shall cease when all foundations, structures, pipe installations and other excavated areas have been properly backfilled and compacted, and are safe from damage, flotation, settlement and displacement.

3.03. MAINTENANCE

- A. Operate and maintain dewatering and removal operations on a 24-hour basis for the time required to complete that portion of the work which requires dewatering prior to its construction and which requires protection from flotation or displacement of such work until proper backfilling and compaction is completed.

3.04. REMOVAL

- A. After groundwater levels have returned to elevations appropriate for conditions and time of year, without causing damage to the work, remove all dewatering equipment and related equipment from the site and restore site to original conditions or rehabilitate site to meet requirements of Contract Documents.

END OF SECTION

SECTION 02205

PROTECTION OF EXISTING FACILITIES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Location of facilities.
- B. Notification of owners and authorities.
- C. Coordination and preparation.
- D. Protection of facilities.
- E. Protection of sewers and storm drains.
- F. Protection of water mains near sewers.
- G. Abandonment of utilities.
- H. Restoration of property markers.

1.02. RELATED SECTIONS

- A. General Conditions: Article 4, Paragraphs 4.02, 4.03 and 4.04; Article 6, Paragraph 6.20.
- B. Division 1 Specifications.
- C. Division 2 Specifications.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. LOCATION OF FACILITIES

- A. Prior to construction, verify location of existing underground facilities near or adjacent to project.
 - 1. Consult with appropriate Underground Facilities Protection Organization (Dig Safely New York), owners of facilities, and arrange for field stake-out or other markings to show locations.
 - 2. Perform exploratory excavation at key junctures and other critical points to aid in ascertaining locations.

- B. Report field stake-out findings and results of exploratory excavations to Engineer if possible changes in project location or design are indicated because of suspected interferences with existing facilities. Allow Engineer sufficient time to determine magnitude of changes, if necessary, and to formulate instructions in that regard.
- C. If location of an existing underground facility is uncertain, apply careful excavation and probing techniques during construction to locate and avoid damage to same.

3.02. NOTIFICATIONS OF OWNERS AND AUTHORITIES

- A. Prior to construction, notify owners of existing facilities, including local Police and Fire Departments, of general scope, nature and planned progress schedule of the work.
- B. Notify owners of nearby underground facilities when excavating is to take place in a particular area, allowing them reasonable time to institute precautionary procedures or preventive measures which they deem necessary for protection of their facilities.
- C. When existing utilities, such as sewer, water, gas, telephone, or electric power are damaged or disturbed during construction, immediately notify affected owner and Project Owner.
- D. Notify Police and Fire Departments, including affected owners, immediately if hazardous conditions are created or have the potential for occurring, as a result of damage to an existing facility or as a result of other activities at project site. Hazardous conditions, for example, could be created from: fire, explosion, escape of gas, escape of fuel oil, gasoline or industrial fluids, downed electrical wires, and disrupted underground electrical cables.

3.03. COORDINATION AND PREPARATION

- A. Discuss anticipated work schedule with local authorities and owners of utilities at preconstruction meeting, including procedures to be followed if one or more utilities are damaged or disrupted. Develop contingency plans to address Contractor's role in repair of damaged utilities.
- B. Make preparations beforehand to repair and restore damaged utilities, including arrangements for standby materials and equipment to be promptly assembled at site and utilized immediately.
- C. Adjust work schedules and personnel assignments as necessary to conform with requirements of utility owner whose utility is to be temporarily interrupted during construction. Cooperate with utility owner in this regard to minimize the time of interruption.
- D. Make preparations for and conform to applicable requirements of New York State Industrial Code Rule 53 (as amended April 1, 1975) entitled, "Construction, Excavation and Demolition Operations at or Near Underground Facilities," issued by State Department of Labor.

3.04. PROTECTION OF FACILITIES

- A. Plan and conduct construction operations so that operation of existing facilities near or adjacent to the work, including electric, telephone, sewer, water, gas or drainage utilities, are sustained insofar as the requirements of the project will permit.

- B. Protect existing facilities from damage or movement through installation of adequate support systems and use of proper equipment, including application of careful excavation and backfilling techniques in sensitive areas.
- C. Existing utilities and other facilities which are damaged by the Contractor's construction operations shall be promptly repaired by Contractor to the satisfaction of the affected owner or, if he so elects, that owner will perform the repairs with his own forces. Under either arrangement, such repair work shall be done at Contractor's expense.
- D. When aboveground visible facilities such as poles, wires, cables, fences, signs or structures constitute an unavoidable interference, notify Engineer and consult with affected owner regarding temporary removal and later restoration of the interfering item. Arrange with that owner to remove and later restore the interfering item to the satisfaction of the owner, subject to approval of the project Owner; or, allow affected owner to perform such work with his own forces. Under either arrangement, such work shall be done at Contractor's expense.
- E. Take all necessary precautions to prevent fires at or adjacent to the work, buildings, and other facilities. No burning of trash or debris is permitted. Fire extinguishers shall be on-site and shall be recharged and in "new" condition.

3.05. PROTECTION OF SEWERS AND STORM DRAINS

- A. Where existing sanitary sewers or storm drain systems are being replaced or interrupted, provide temporary bypass pumping or piping to maintain flow around that segment of the Work such that no back-ups occur in existing systems.
- B. Maintain existing manholes, catch basins, and other utility structures in their pre-work condition. Any material or debris entering same due to the Contractor's operation shall be promptly removed.
- C. Storm drains shall be protected in accordance with the project Stormwater Pollution Prevention Plan and Erosion and Sediment Control Drawings.

3.06. PROTECTION OF WATER MAINS NEAR SEWERS

- A. Where a minimum 10-foot horizontal separation or minimum 18 inch vertical separation (bottom of water pipe to top of sewer pipe) cannot be maintained between a water main and sewer line, one or more of the following remedies shall be incorporated in the work. The Contractor shall contact the Engineer if the separation requirements cannot be met and obtain approval prior to incorporating the following remedies.
 - 1. The sewer lines shall be encased in 4,000 psi mix concrete for a length of 10 feet on either side of the water main.
 - 2. Both the water main and sewer line shall be constructed of pressure type joints of ductile iron pipe, and shall be pressure tested to 100 psi to assure watertightness.
 - 3. One full length of water main pipe shall be centered over the sewer line, so that pipe joints will be as far from the sewer as possible.

4. Relocate water main to obtain 18 inches minimum vertical separation.
5. As directed by the Engineer or federal, state, or local authorities at no additional cost to the project Owner.

3.07. ABANDONMENT OF UTILITIES

- A. Remove existing utilities to be abandoned within limits of trench excavation, or impinging on trench limits.
- B. Open ends of abandoned utilities, or those scheduled for abandonment, shall be bulkheaded by brick masonry and/or 4,000 psi mix concrete; or by cast iron plugs or caps in small diameter piping.
- C. Abandoned sewers 36-inch diameter or larger shall be completely filled with sand or gravel or other approved material prior to bulkheading the open end(s).
- D. Abandoned manholes and water valve casings shall be backfilled to grade with approved trench backfill material.
- E. Frames, covers, grates, water valve casing, sections of water piping, hydrants (including standpipe and boot) valves and other items to be abandoned shall, if ordered by Owner, be salvaged for reuse and be delivered to Owner.

3.08. RESTORATION OF PROPERTY MARKERS

- A. Property corner markers, boundary monuments, etc., disturbed or moved by the Contractor's operation shall be restored, in conformance with the property deed description, by a New York State licensed land surveyor. Restoration of the property corner markers or boundary monuments shall be certified by said surveyor on a map prepared by him which shows the work accomplished. One copy of the map shall be given to the property owner and one copy given to the project Owner.

END OF SECTION

SECTION 02222

EXCAVATING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Excavation for site structures.
- B. Excavating trenches for utilities.
- C. Pipe foundations and bedding.

1.02. RELATED SECTIONS

- A. Division 1 specifications
- B. Section 02205 - PROTECTION OF EXISTING FACILITIES
- C. Section 02223 - BACKFILLING
- D. Section 02228 - COMPACTION

1.03. FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Identify known underground, above ground, and aerial utilities. Stake and flag locations.
- C. Notify utility companies.
- D. Protect above- and below-grade utilities which are to remain.
- E. Protect plant life, lawns, rock outcropping and other features remaining as a portion of final landscaping.

- F. Protect benchmarks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic.
- G. Excavations shall be in complete accordance with all details of applicable codes, rules, and regulations including all local, state, and federal regulations including the Occupational Safety and Health Administration (OSHA) Title 29 Code of Federal Regulations Part 1926, Subpart P - Excavations and Trenching Standards.

3.02. CLASSIFICATION OF EXCAVATED MATERIAL

- A. Classifications of excavated materials are as follows:
 - 1. Unclassified Excavation - "Unclassified excavation" shall include all material excavated within the authorized lines and grades prescribed in the Drawings. Unclassified excavation shall include "rock excavation" as well as "common excavation" as defined herein.
 - 2. Common Excavation - "Common excavation" shall include all excavation except "rock excavation." All unconsolidated and non-indurated material, rippable rock, loose rock, soft mineral matter, weathered rock or saprolite, and soft or friable shale which is removable with normal earth excavation equipment shall be considered "common excavation." All boulders and detached pieces of solid rock or concrete or masonry less than 1 cubic yard in volume shall be classified as "common excavation."
 - 3. Rock Excavation - "Rock excavation" shall include all sound solid masses, layers and ledges of consolidated and indurated rock or mineral matter of such hardness, durability and/or texture that it is not rippable or cannot be excavated with normal earth excavation equipment. Should a conflict arise as to the classification of excavation as either "common" or "rock," the following test shall be used in the appropriate determination:
 - a. Where practicable, a late model tractor mounted hydraulic ripper equipped with a one digging point of standard manufacturer's design adequately sized for use with and propelled by a crawler-type tractor rated between 210 and 240 net fly-wheel horsepower, operating in low gear, shall be utilized. Should the suspect material not be effectively loosened or broken down by ripping in a single pass with the aforementioned ripper, the material shall be classified as "rock."
 - b. In situations where interbedded strata of "common excavation" material and "rock excavation" material are encountered in the same excavation, the individual classification of those materials shall be made on an average percentage basis of the occurrence of those materials as measured in stratigraphic sections and as approved by the Engineer.
 - c. When rock is encountered in excavations, it shall be removed by jackhammering or any other method suitable and safe considering the proximity of existing utilities or facilities, and approval shall be gained by the local jurisdiction prior to start of work.

3.03. EXCAVATING

- A. Underpin adjacent structures which may be damaged by excavation work, including utilities and pipe chases.
- B. Excavate subsoil required to accommodate building foundations, slabs-on-grade, paving, and site structures.
- C. Machine-slope banks to angle of repose or less, until shored.
- D. Excavation cut not to interfere with normal 45-degree bearing splay of foundation. Undercutting of excavation faces will not be permitted.
- E. Grade top perimeter of excavation to prevent surface water from draining into excavation.
- F. Hand trim excavation to required undisturbed subgrade. Remove loose matter.
- G. Remove lumped subsoil, boulders, and rock under 1 cubic yard, measured by volume. Refill voids with Mix "C" concrete or compacted gravel/crushed stone.
- H. Notify Engineer of unexpected subsurface conditions, or of questionable soils encountered at required subgrade elevations, and discontinue work in area until notified to resume operations.
- I. Should the Contractor, through negligence or otherwise carry his excavation below the designated subgrade, granular material used for backfilling shall be spread and compacted in conformance with the requirements of Sections 02223, Backfilling, and 02228, Compaction. The cost of this refilling operation, including any tests associated therewith, shall be borne by Contractor.
- J. Stockpile excavated material in area designated by the Owner on-site and remove excess material not being reused, from site.

3.04. DISPOSAL OF MATERIAL

- A. All excavated material except reusable topsoil or reusable fill shall be classified as surplus material and disposed of off-site unless Owner designates an on-site location.
- B. Reuse of excavated material as on-site fill shall conform with Section 02223, Backfilling.

3.05. FIELD QUALITY CONTROL

- A. Field inspection will be performed under provisions of Section 01400, Quality Control.
- B. Provide for visual inspection of bearing surfaces.

3.06. PROTECTION

- A. Protect excavations by methods required to prevent cave-in or loose soil from falling into excavation.
- B. Protect bottom of excavations and soil adjacent to and beneath foundation from freezing.

- C. Exposed subgrade surfaces shall remain undisturbed, drained, and maintained as uniform, plane areas, shaped to receive the foundation components of the building or structure.

END OF SECTION

SECTION 02223

BACKFILLING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Site filling and backfilling.
- B. Classification of materials.
- C. Backfilling trenches for utilities.
- D. Consolidation and compaction.

1.02. RELATED SECTIONS

- A. Section 01400 - QUALITY CONTROL
- B. Section 01500 - TEMPORARY FACILITIES
- C. Section 02222 - EXCAVATING
- D. Section 02228 - COMPACTION

1.03. REFERENCES

- A. ASTM C136 - Method for Sieve Analysis of Fine and Coarse Aggregates
- B. ASTM D1556 - Density of Soil in Place by Sand-Cone Method
- C. ASTM D1557 - Laboratory Compaction of Soil Using Modified Effort
- D. ASTM D2922 - Density of Soil in Place by Nuclear Methods
- E. ASTM D3017 - Water Content of Soil in Place by Nuclear Methods

1.04. SUBMITTALS

- A. Granular Materials
 - 1. Granular materials required for filling, backfilling, subbase and other purposes shall be as shown on the Drawings. Prior to bidding, prospective contractors shall familiarize themselves with the available quantities of approved on-site and off-site materials.
 - 2. For each on-site and off-site material proposed, notify the Engineer of the source of the material and furnish to the Engineer for approval a certified gradation analysis (ASTM C136)

and a Modified Compaction Test (ASTM D1557) at least 15 days prior to date of anticipated use of such material that has been tested within the last 6 months.

3. The Engineer reserves the right to inspect proposed source of off-site granular material and to order such tests of the materials as he deems necessary to ascertain its quality and gradation of particle size. The Contractor shall, at his own expense, engage an approved testing laboratory to perform such test, and submit certified test results to the Engineer. If similar tests of the material from a particular source were performed previously (within 6 months), submit results of these tests to the Engineer for consideration.
4. No granular materials shall be used on this project for fill, backfill, subbase, or other purpose until approval is obtained from the Engineer, and only material from approved sources shall be used.

PART 2 PRODUCTS

2.01. ON-SITE MATERIALS

- A. Type A, Excavated Material - Material under this classification shall be derived solely from excavations necessary to construct the project to the lines and grades specified. If the excavated material on-site is approved for reuse and is suitable, it shall be used for filling or backfilling purposes. If he so elects, the Contractor may, at his own expense, substitute other types of material in place of Type A material, provided such substitution is approved in advance by the Engineer. All replaced or surplus material shall be disposed of per Specification Sections 02222 and 02110.

- B. OFF-SITE MATERIALS

Within the following specifications where grain size distribution requires a maximum of 10 percent or less material capable of passing the #200 mesh sieve, the percentage of material finer (than the #200 sieve) by weight shall be determined by wet screening in accordance with ASTM D1140. It is the intent of the specifications to allow the use of granular materials from local suppliers. Material specifications shall conform to the requirements of the New York State Department of Transportation, (NYSDOT) and shall conform to the latest NYSDOT Standard Specification.

No gravel, sand, crushed stone or run-of-crusher material shall be used for this project until approval is obtained from the Engineer, and only material from approved sources shall be used. A certified sieve analysis from the supplier shall be submitted for the Engineer's approval prior to the use of any materials specified in this specification section.

- C. Type B – Sand and Gravel

1. Shall be a mixture of hard, durable gravel and sand.
2. Shall be free from organic matter, trash, shale, debris, snow ice and other frozen or mechanically deleterious material.

3. NYSDOT Materials

- a. Subbase course 733.0404, Type 4.
- b. NYSDOT 411.01 gravel surface course meeting the following requirements:

Sieve Size	Percent Passing by Weight
2 inch	100
1/4 inch	30 – 65
No. 200	10 - 20

D. Type D - Crushed Stone

- 1. Shall be clean, hard, durable, angular crushed stone.
- 2. Shall be free from organic matter, trash, debris, snow, ice and other frozen or mechanically deleterious material.
- 3. Unless otherwise specified, crushed stone shall be composed of limestone pieces, chips and fines.
- 4. The material shall be obtained from sources which are approved by the NYSDOT, Material Designation 703-0201.
- 5. NYSDOT Materials
 - a. NYSDOT 703-0201, No. 1 stone.
 - b. NYSDOT 703-0201, No. 2 stone.
 - c. NYSDOT 703-0201, No. 3 stone.

E. Required Materials

- 1. Trench Backfill - NYSDOT subbase course 733.0404, Type 4
- 2. Pavement Subbase - NYSDOT subbase course 733.0404, Type 4.
- 3. Trench Special Bedding - NYSDOT 703-0201, No. 3A stone.
- 4. Pipe Bedding
 - a. NYSDOT 703-0201, No. 1 stone for greater than 4-inch diameter pipes.
 - b. NYSDOT, Cushion Sand 703-06 for less than 4-inch diameter pipes.
- 5. Structural Fill - NYSDOT subbase course 733.0404, Type 4.
- 6. Backfill Adjacent to Structures - NYSDOT subbase course 733.0404, Type 4.

PART 3 EXECUTION**3.01. EXAMINATION**

- A. Verify fill materials to be used are acceptable.
- B. Verify that all subsurface installations for the project have been inspected and are ready for backfilling.

3.02. PREPARATION

- A. Generally, compact subgrade to density requirements for subsequent backfill materials.
- B. Cut out soft areas of subgrade not capable of in situ compaction. Compact to density equal to or greater than requirements for subsequent backfill material.
- C. Inspect spaces to be backfilled and remove all unsuitable materials including sheeting, bracing, forms and debris prior to commencing backfilling operations.

3.03. BACKFILLING

- A. Backfill areas to required contours, grades and elevations with unfrozen materials.
- B. Systematically backfill to allow maximum time for natural settlement. Do not backfill over porous, wet, frozen or spongy subgrade surfaces.
- C. Backfill material shall be inspected prior to placement and all roots, vegetation, organic matter, or other foreign debris shall be removed.
- D. Backfill material shall not be placed when moisture content is more than two percent above optimum or is otherwise too high to allow proper compaction. When material is too dry for adequate compaction, water shall be added to the extent necessary.
- E. Hydraulic compaction by ponding or jetting will not be permitted.
- F. Place and compact fill materials in continuous layers to meet appropriate requirements of Table 1 of Section 02228, Compaction.
- G. Employ a placement and compaction method consistent with Section 02228, Compaction, that does not disturb or damage adjacent walls, drainage systems, dampproofing, waterproofing, protective coverings, utilities in trenches, underground conduits or tanks.
- H. Maintain optimum moisture content of backfill materials to attain required compaction density.
- I. Slope grade away from building minimum 2 inches in 10 feet unless noted otherwise.
- J. Rough grade all backfilled and filled areas to meet subsequent topsoiling or paving requirements. Make grade changes gradual. Blend slopes into level areas.
- K. Remove surplus backfill materials from site.

- L. Leave fill material stockpile areas completely free of excess fill materials.

3.04. TOLERANCES

- A. Top Surface of Backfilling Under Pavement Subgrade - ± 1 inch from required elevations.
- B. Top Surface of Backfilling Under Paved Areas- $\pm 1/2$ inch from required elevations.
- C. Top Surface of General Backfilling - ± 1 inch from required elevations.

3.05. FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400, Quality Control.
- B. Tests and analysis of fill material will be performed in accordance with ASTM D1557 and with Section 02228, Compaction.
- C. Compaction testing will be performed in accordance with ASTM D1556, ASTM D2922, and with Section 01400, Quality Control.
- D. If tests indicate work does not meet specified requirements, remove work, replace, and retest at no cost to Owner.

3.06. PROTECTION OF FINISHED WORK

- A. Protect finished work under provisions of Section 01500, Temporary Facilities.
- B. Regrade and re-compact fills subjected to vehicular traffic.

END OF SECTION

SECTION 02225

TRENCHING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Excavating trenches for utilities.
- B. Pipe foundations and bedding.
- C. Backfilling and compaction.
- D. Materials.

1.02. RELATED SECTIONS

- A. Section 02110 – SITE CLEARING
- B. Section 02141 – REMOVAL OF WATER
- C. Section 02205 – PROTECTION OF EXISTING FACILITIES
- D. Section 02222 – EXCAVATION
- E. Section 02223 – BACKFILLING
- F. Section 02228 – COMPACTION

1.03. REFERENCES

- A. Standard Material Specifications for gravel, sand, crushed stone and gravel-cement mixtures published by the New York State Department of Transportation (DOT).
- B. Occupational Safety and Health Administration (OSHA).

1.04. SUBMITTALS

- A. Submittals for granular material and geotextiles shall be in accordance with Section 02223, Backfilling and Section 02420, Geotextiles.

1.05. FIELD MEASUREMENTS

- A. Verify that survey benchmark and intended elevations for the work are as indicated.

PART 2 PRODUCTS

2.01. ON-SITE MATERIALS

- A. On-site material shall be in accordance with Section 02223, Backfilling.

2.02. OFF-SITE MATERIALS

- A. Off-site material shall be in accordance with Section 02223, Backfilling.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify fill materials to be used are approved.
- B. Verify that all subsurface excavations for the project have been compacted, approved, and are ready for backfilling (including installation of geotextiles where required).

3.02. PREPARATION

- A. Identify required lines, levels, contours, and datum.
- B. Prior to start of construction, notify utility and have staked or marked all underground utilities. Utilities include water, gas, electrical, telephone, cable, storm sewer, sanitary sewers, laterals, and services. In the event such locations indicate a possible interference, or when needed to locate points of connection to existing facilities, perform exploratory excavations to determine the utilities' location and elevation. Provide the Engineer with the results of the exploratory excavations for his review. Allow the Engineer sufficient time to determine any changes required as a result of such exploratory excavations prior to start of construction.
- C. Abandoned pipes and laterals shall be plugged per Specification Section 0220, paragraph 3.07.
- D. Conduct the operations such that no interruptions to the existing utility system shall occur.
- E. Protect plant life, lawns, rock outcropping, and other features remaining as a portion of final landscaping.
- F. Protect control points, bench marks, existing structures, fences, sidewalks, paving, and curbs from excavation equipment and vehicular traffic. Preserve the control points as provided throughout the life of the project, and accurately replace any such point, which is damaged or moved, at Contractor's expense.
- G. Cut out soft areas of subgrade not capable of in-situ compaction. Backfill with specified pipe foundation and compact to density equal to or greater than requirements for subsequent backfill material.
- H. Brace walls and slabs of structures to support surcharge loads and construction loads imposed by backfilling operations.
- I. Maintain a stable, dry backfill area in accordance with Section 02141, Removal of Water.

- J. Remove all water, snow, ice and debris from surfaces to accept fill materials and from the backfill material. No calcium chloride or other chemicals shall be used to prevent freezing.
- K. Areas to receive compacted fill shall be graded to prevent ponding and to provide surface runoff.
- L. Only approved backfill material shall be used.
- M. Only approved geotextile fabrics shall be used.
- N. Backfill operations shall be started at the lowest elevation in the area to be backfilled, and continue, in horizontal layers, upward to the limits specified.
- O. Any crushed gravel stockpiles which have undergone excessive particle segregation shall be remixed.

3.03. TRENCH EXCAVATION

- A. Trench widths shall be held to minimize restoration. If a prefabricated, mobile shield is utilized in lieu of conventional sheeting and bracing in trenches, the bottom of the shield shall be positioned so as to prevent disturbance of the pipe foundation material and to avoid forces which would tend to pull pipe joints apart when the shield is dragged forward.
- B. Gouged openings or troughs left by the shield shall be filled with additional pipe foundation material and compacted. Installation of sheeting and bracing and use of mobile shields shall be in accordance with details of applicable safety codes, rules and regulations including applicable local, state, federal, and OSHA.
- C. Excavation shall be such that a flat bottom trench of allowable width is established at the required subgrade elevation for subsequent installation of pipe foundation material.
- D. If indicated on the Drawings or when required as a result of unsuitable soil conditions, trench excavation shall be carried below the required subgrade and a special pipe foundation installed in conformance with the Contract Documents. In any event, operations shall result in stable trench walls and a stable base free from standing water, consistent with trench width requirements.
- E. Bedrock, boulders and cobbles greater than 6 inches shall be trimmed back or removed on each side of the trench so that no rock protrudes within 6 inches of the installed pipe. Rock shall also be trimmed back across the bottom of the trench so that no rock, boulder or cobble protrudes within 4 inches of the installed pipe.
- F. In general, trenches shall not be opened for more than 50 feet in advance of installed pipe. Excavation of the trench shall be fully completed at least 5 feet in advance of pipe laying operations. Trenches left open overnight shall be protected as specified within this section and to the satisfaction of the Owner. Trenches shall not be left open overnight unless prior approval is approved from the Owner.

3.04. EXCAVATION CLASSIFICATION

- A. All material excavation shall be classified in accordance with Section 02222, Excavating.

3.05. UNAUTHORIZED EXCAVATION

- A. The Contractor shall not be entitled to additional compensation for unauthorized excavations carried beyond or below the lines and subgrades prescribed in the Contract Documents. The Contractor shall refill such unauthorized excavations at his own expense, and in conformance with the following provisions:
1. Should the Contractor, through negligence or for reasons of his own, carry excavations below the designated subgrade, backfill in accordance with Section 02223, Backfilling, in sufficient quantities to reestablish the designated subgrade surface. Granular material used for backfilling shall be spread and compacted. The cost of tests associated with this refilling operation shall be borne by the Contractor.
 2. If the maximum widths of pipe trenches are exceeded, the installed pipes shall be fully cradled using the specified bedding material at the Contractor's expense.
 3. Excavation below subgrade which is ordered by the Engineer because the normal subgrade has been disturbed by the Contractor's operations shall be considered as unauthorized excavation.

3.06. MAINTENANCE OF EXCAVATIONS

- A. All excavations shall be properly and legally maintained while they are open and exposed. Sufficient and suitable barricades, warning lights, flood lights, signs, etc., to protect life and property shall be installed and maintained at all times until the excavation has been backfilled and graded to a safe and satisfactory condition. All signs, markers, barricades shall conform to the requirements of the Manual of Uniform Traffic Control Devices. All barricades, signs and markers shall be reflectorized.
- B. To maintain traffic and safety, temporary plating over trenches consisting of steel plates shall be used to temporarily bridge trench excavations. Plates shall be of size and positioned to provide adequate bearing at plate edges, shall be securely anchored, and shall be fitted in place in a manner to minimize noise when crossed by traffic. Plates shall be of sufficient thickness to safely carry heavy traffic without detrimental deflection; however, unless otherwise specified, the minimum thickness of plates shall be 1-inch.
- C. Plate edges exposed to traffic shall be feathered with asphalt mix as part of trench excavation work. Work includes surveillance and adjustment of plating over trenches which shall be provided by the Contractor during non-working hours, weekends, and holidays.

3.07. PIPE FOUNDATIONS

- A. All pipes, fittings, or specials which are to be installed in the open trench excavation shall be properly bedded in, and uniformly supported on pipe foundations of the various types as specified and shown on the Drawings. Flat-bottom trenches of required width shall be excavated to the necessary depth shown on the Drawings and maintained in accordance with this section prior to installing the foundation. Trenches shall be dewatered and all work performed in a dry trench.
- B. Bedding material shall be spread in maximum of 6-inch layers to the midpoint of the pipe and each layer shall be compacted until the required total depth of the bedding has been built up. Compaction methods include hand tamping with T-bars, flat heads, shovel slicing, as well as mechanical compactors. The Contractor shall perform his bedding operations with care to maintain line and grade.

- C. The pipe foundation above the midpoint of the pipe shall be spread and compacted in 12-inch layers to 12 inches above the top of the pipe. When PVC, plastic or polyethylene pipe is used, do not compact directly over pipe until the depth of backfill has reached 2 feet above the top of the pipe.
- D. Type I - Normal Soil Conditions - Unless shown otherwise in the Drawings, all pipe shall be supported on Type I foundation. The trench shall be excavated 4 to 8 inches deeper than the bottom of the pipe, depending on the pipe's diameter. Acceptable bedding as described in the Contract Specifications shall be furnished, placed and compacted in the trench for its full width such that, after the pipe has been uniformly bedded in this material, the required minimum depth of material remains between pipe and undisturbed trench bottom. Suitable holes shall be provided in the trench bottom to permit adequate bedding of bells, couplings, or similar projections. The bedding shall extend upward to a point 12 inches over the top of the pipe. Minimum width of pipe foundation shall be outside diameter of pipe plus 2 feet 0 inches.
- E. Type II - Moderately Unstable Soil Conditions - When specifically called for on the Drawings, or when ordered by the Engineer as existing conditions dictate, and as approved by the Engineer, the pipe shall be supported on Type II foundation. The foundation shall be installed where a suitable supporting soil or rock stratum occurs within 2 feet, more or less of the bottom of the pipe. The trench shall be excavated to the depth necessary to reach the suitable supporting stratum. Install a reinforcing geotextile in accordance with Section 02420, Backfilling, followed by trench special bedding which is then furnished and placed in the trench for its full width. The material shall be spread in 12-inch layers and each layer shall be compacted. Trench special bedding shall extend from the supporting stratum up to an elevation 4, 6 or 8 inches below the bottom of the pipe depending upon the pipe diameter. The bedding material shall then be installed in accordance with Type I pipe foundation requirements.
- In the event an underground pipe is shown under a base slab (12 inches thick or greater), the pipe shall be encased in concrete for its entire length under the slab in accordance with details shown on the Drawings.
- F. Type III – Unstable Soil Conditions – When specifically called for on the Drawings, or as existing conditions dictate, and as approved by the Engineer, the pipe shall be supported on a Type III foundation. The trench shall be excavated to the depth necessary to reach the suitable supporting stratum and approved by the Engineer. Backfilling with a loosely compacted base material of larger material shall be provided. This shall be followed by trench special bedding installed with a reinforcing geotextile extending up the walls of the trench to the springline of the pipe. Each of these backfill materials shall be placed in the trench for its full width.
- G. Unless otherwise shown on the Drawings, the minimum total finished cover over the top of the pipe barrel of all pressure pipe shall be 4 feet.

3.08. GENERAL BACKFILLING REQUIREMENTS

- A. Follow requirements of Sections 02223, Backfilling and 02228, Compaction.
- B. Backfilling shall be started as soon as practicable and after structures or pipe installations have been completed and inspected, concrete has acquired a suitable degree of strength, and subgrade waterproofing materials have been in place for at least 48 hours. Backfilling shall be carried on expeditiously thereafter. Backfill shall be started at the lowest section of the area to be backfilled. Natural drainage shall not be obstructed at any time.

- C. Backfill spaces shall be inspected prior to backfilling operations and all unsuitable materials, including sheeting, bracing forms and debris, shall be removed. No backfill shall be placed against foundation walls on structural members unless they are properly shored and braced or of sufficient strengths to withstand lateral soil pressures.
- D. No backfill material shall be placed on frozen ground nor shall the material itself be frozen or contain frozen soil fragments when placed. No calcium chloride or other chemicals shall be added to prevent freezing. Material incorporated in the backfilling operation which is not in satisfactory condition shall be subject to rejection and removal at the Contractor's expense.
- E. If the Contractor fails to stockpile and protect on-site excavated material acceptable for backfill, then the Contractor shall provide an equal quantity of acceptable off-site material at no expense to Owner.
- F. Remove surplus backfill material from site.

3.09. PIPE TRENCH BACKFILL

- A. Pipe foundations, to a depth of 1 foot above the pipe, shall be placed in 12-inch layers and compacted by approved mechanical methods to ensure firm bedding and side support. Refer to Section 02228, Compaction, for density requirements. For plastic or polyethylene pipe materials, do not compact directly over pipe until the 2 feet of cover has been installed.
- B. The remainder of the trench shall be backfilled and consolidated in accordance with Section 02228, Compaction, with backfill material placed in layers not exceeding 12 inches thick and each layer compacted by a backhoe mounted hydraulic or vibratory tamper, up to 4 feet under pavement (below top of subgrade). The upper 4 feet shall be compacted using hand-guided or small self-propelled vibratory or static rollers or pads in layers not exceeding 6 inches in thickness.

3.10. TRENCH BACKFILL BELOW STRUCTURES

- A. Backfill shall be placed in layers not exceeding 8 inches thick and compacted by mechanical means.
- B. Where pipelines or conduits are to be placed on structural backfill, all backfill under the pipes shall be No. 57 stone placed in 8-inch layers and mechanically tamped, unless an alternate method of supporting such pipes is specified.
- C. Hydraulic compaction by pounding or jetting will not be permitted.

3.11. PERIODIC CLEAN-UP AND BASIC RESTORATION

- A. When work involves installation of sewers, drains, water mains, manholes, underground structures, or other disturbances of existing features in or across streets, rights-of-way, easements or private property, the Contractor shall (as the work progresses) promptly backfill, compact, grade and otherwise restore the disturbed area to a basic condition which will permit resumption of pedestrian or vehicular traffic and any other critical activity or function consistent with the original use of the land. The requirements for temporary paving of streets, walks, and driveways are specified elsewhere. Unsightly mounds of earth, large stones, boulders and debris shall be removed so that the site presents a neat appearance.

- B. Perform clean-up work on a regular basis and as frequently as required. Basic site restoration in a particular area shall be accomplished immediately following the installation or completion of the required facilities in that area. Furthermore, such work shall also be accomplished if partially completed facilities must remain incomplete for some time period due to unforeseen circumstances.
- C. Upon failure of the Contractor to perform periodic clean-up and basic restoration of the site, the Owner may, upon five days prior written notice to the Contractor, without prejudice to any other rights to remedies of the Owner, cause such work for which the Contractor is responsible to be accomplished to the extent deemed necessary by the Contract Documents, and all costs resulting therefrom shall be charged to the Contractor and deducted from the amounts of money that may be due him.

3.12. TOLERANCES

- A. Reference Section 02223, Backfilling.

3.13. FIELD QUALITY CONTROL

- A. Field inspection and testing will be performed under provisions of Section 01400, Quality Control.
- B. Tests and analysis of fill material will be performed in accordance with Section 02223, Backfilling.
- C. Compaction testing will be performed in accordance with Section 02228, Compaction.

3.14. PROTECTION OF FINISHED WORK

- A. Protect finished work under provisions of Section 01500, Temporary Facilities.
- B. Re-grade and re-compact disturbed fill areas subjected to vehicular traffic.

END OF SECTION

SECTION 02228

COMPACTION

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Compaction requirements and test methods.
- B. Compact all subgrades, foundations, embankments, trench backfills, filled and backfilled material as specified.

1.02. RELATED SECTIONS

- A. Section 01400 - QUALITY CONTROL: Inspection and testing by laboratory services.
- B. Section 02223 - BACKFILLING

1.03. REFERENCES

- A. ASTM D698 - Laboratory Compaction of Soil Using Standard Effort
- B. ASTM D1556 - Density of Soil in Place by the Sand-Cone Method
- C. ASTM D1557 - Laboratory Compaction of Soil Using Modified Effort
- D. ASTM D2922 - Density of Soil in Place by Nuclear Methods
- E. ASTM D3017 - Water Content of Soil in Place by Nuclear Methods

1.04. SUBMITTAL

- A. Submit in writing a description of the equipment and methods proposed to be used for compaction.

1.05. QUALITY ASSURANCE

- A. The Contractor shall adopt compaction methods which will produce the degree of compaction specified herein, prevent subsequent settlement, and provide adequate support for the surface treatment, pavement, structure and piping to be placed thereon, or therein, without damage to the new or existing facilities.
- B. The natural subgrade for all footing, mats, slabs-on-grade for structures or pipes shall consist of firm undisturbed natural soil, at the grades shown on the Drawings.
- C. After excavation to subgrade is completed, the subgrade shall be compacted if it consists of loose granular soil or if its surface is disturbed by the teeth of excavating equipment.

1. This compaction shall be limited to that required to compact loose surface material and shall be terminated in the event that it causes disturbance to underlying fine-grained soils, as revealed by weaving or deflection of the subgrade under the compaction equipment.
2. If the subgrade soils consist of saturated fine or silty sands, silts, or clay or varved clays, no compaction shall be applied.

PART 2 PRODUCTS

2.01. MATERIALS

- A. Materials to be compacted shall be as specified in Section 02223, Backfilling.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Examine spaces to be filled beforehand and remove all unsuitable materials and debris including sheeting, forms, trash, stumps, plant life, etc.
- B. Inspect backfill and fill materials beforehand and remove all roots, vegetation, organic matter, or other foreign debris.
- C. No backfill or fill material shall be placed on frozen ground nor shall the material itself be frozen or contain frozen soil fragments.
- D. Spaces to be filled shall be free from standing water so that placement and compaction of the fill materials can be accomplished in "dry" conditions.

3.02. PREPARATION

- A. Brace walls and slabs of structures to support surcharge loads and construction loads imposed by compaction operations.
- B. Proof-roll all subgrade surfaces to accept fill material.
- C. Each layer of fill shall be compacted to the specified density the same day it is placed.
 1. The moisture content of backfill or fill material shall be adjusted, if necessary to achieve the required degree of compaction.
- D. Compact each lift in accordance with Table 1.
- E. Match compaction equipment and methods to the material and location being compacted in order to obtain specified compaction, with consideration of the following guidelines:
 1. Rubber-tired rollers are preferred for most areas to prevent bridging of softer materials.

2. Double smooth drum rollers may be used provided that careful inspection can prevent bridging.
3. Compaction roller should be lighter in weight than proof-rolling equipment, with a minimum compaction force of 350 lbs. per linear inch (PLI).
4. Vibratory compaction is preferred for dry, granular materials.
5. Hand compaction equipment such as impact rammers, plate or small drum vibrators, or pneumatic buttonhead compactors should be used in confined areas.
6. Hydraulic compaction by ponding or jetting will not be permitted.
7. Backhoe-mounted hydraulic or vibratory tampers are preferred for compaction of backfill in trenches under pavements over 4 feet in depth. The upper 4 feet shall be compacted as detailed above or with hand-guided or self-propelled vibratory compactors or static roller.
8. For plastic pipelines (HDPE, PVC, PE, or PB), do not compact directly over center of pipe until backfill has reached 2 feet above top of pipe.

TABLE 1
COMPACTION REQUIREMENTS

Construction Element	Maximum Compaction Layer Thickness (Inches)	ASTM	Minimum Compaction
I. STRUCTURES*			
a. Fill beneath foundation elements and under slabs-on-grade - hand-guided compaction	6	D1557	95%
Fill beneath foundation elements and under slabs-on-grade - self-propelled or tractor-drawn compaction	8	D1557	95%
b. Fill around structures and above footings	12	D1557	95%
II. TRENCHES**			
a. Fill under pipelines and pipe bedding	8	D1557	95%
b. Pipe sidefills and top 4 feet of pipe backfill under pavements	12	D1557	95%
c. Backfill below 4 feet under pavement	12	D1557	95%
d. Backfill under lawns, gardens and cultivated fields	12	D1557	90%
e. All other trenches***	12	D698	85%
III. EMBANKMENTS AND FILLS			
a. Fill under streets, parking lots, and other paved areas	12	D1557	95%
b. Embankments not supporting pavement or structures	12	D1557	90%
c. Rough site grading	12	D698	85%

* Where structural loads are carried by piles, caissons or other deep foundations, minimum compaction may be reduced to 92 percent.

** The first 1 foot above non-plastic pipelines shall have a compacted thickness of 12 inches.

*** For cross-country pipelines, lifts may be compacted with a backhoe bucket or other means, and slightly mounded at the surface provided that regrading is performed within the guarantee period.

3.03. FIELD QUALITY CONTROL

A. Material Testing

1. The Engineer reserves the right to order testing of materials at any time during the work. The Contractor shall provide testing at no additional cost to the Owner.
2. Testing will be done by a qualified, independent testing laboratory in accordance with this section and Section 01400, Quality Control.
3. The Contractor shall aid the Engineer in obtaining representative material samples to be used in testing.

4. For each material which does not meet specifications, the Contractor shall reimburse the Owner for the cost of the test and shall supply an equal quantity of acceptable material, at no additional compensation.
 5. The Contractor shall anticipate these tests and incorporate the time and effort into procedure.
- B. Compaction Testing
1. The Engineer reserves the right to order the qualified independent testing laboratory to conduct in-place density tests of compacted lifts.
 2. Testing shall be conducted at every valve replacement location. Tests are required for each lift of fill or backfill placed.
 3. The Contractor shall dig test holes and provide access to all backfill areas at no additional compensation when requested by the Engineer.
 4. For each test which does not meet specifications, the Contractor shall retest at his cost. If the retest does not meet specifications, the Contractor shall replace and recompact material to the specifications at no additional cost to the Owner.
 5. The Contractor shall anticipate these tests and incorporate the time and effort into procedures.
 6. Nuclear moisture density testing by "probe" methods will be acceptable for compacted layers not exceeding 12 inches in thickness.
 - a. Nuclear "backscatter" methods will be acceptable only for testing asphalt paving layers not in excess of 3 inches in thickness.
 - b. Only certified personnel will conduct nuclear testing.
 - c. If the nuclear method is utilized, the results shall be checked by at least one in-place density test method described above.
- C. Unacceptable Stockpiled Material - Stockpiled material may be tested according to material testing materials.
- D. Alternate Methods of Compaction - The Contractor may employ alternate methods of compaction if the desired degree of compaction can be successfully demonstrated to the Engineer's satisfaction.
- E. Select Material - On-Site
1. Any on-site material may be used for select fill material provided it meets all the requirements of the equivalent off-site material.
 2. No on-site material shall be used without prior review and approval of the Engineer.
- F. Systematic Compaction - Compaction shall be done systematically, and no consideration shall be given to incidental coverage due to construction vehicle traffic.

3.04. PROTECTION

- A. Prior to terminating work for the day, the final layer of compacted fill, after compaction, shall be rolled with a smooth-wheel roller if necessary to eliminate ridges of soil left by tractors or equipment used for compaction or installing the material.
- B. As backfill progresses, the surface shall be graded so as to drain off during incidence of rain such that no ponding of water shall occur on the surface of the fill.
- C. The Contractor shall not place a layer of fill on snow, ice or soil that was permitted to freeze prior to compaction.
 - 1. These unsatisfactory materials shall be removed prior to fill placement.

END OF SECTION

SECTION 02576
PAVEMENT PATCHING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Bituminous pavement patching.
- B. Concrete pavement patching.
- C. Compaction.
- D. Testing.

1.02. RELATED SECTIONS

- A. Section 02112 - PAVEMENT CUTTING
- B. Section 02223 - BACKFILLING
- C. Section 02228 - COMPACTION
- D. Section 02229 - PAVEMENT SUBGRADE
- E. Section 02510 - ASPHALT PAVING

1.03. REFERENCES

- A. New York State Department of Transportation Standard Specifications dated May 1, 2018.
- B. NYSDOT - Manual of Uniform Traffic Devices.

1.04. SUBMITTALS

- A. Refer to Section 02510, Asphalt Paving.

1.05. ENVIRONMENTAL LIMITATIONS

- A. Patching to be performed only when temperature and weather meet the requirements as described in Section 02510, Asphalt Paving.

1.06. SCHEDULING

- A. Schedule patching work in coordination with local authorities having jurisdiction over the site.

PART 2 PRODUCTS

2.01. MATERIALS

- A. Refer to Section 02223, Backfilling and Section 02229, Pavement Subgrade, for pavement backfill and subgrade requirements.
- B. Refer to Section 02510, Asphalt Paving, for description of bituminous material for patching.
 - 1. Patches up to 2 inches deep install wearing course asphalt concrete.
 - 2. Patches over 2 inches deep use a combination of courses of base, binder and wearing course as approved by the Engineer.
- C. Provide asphalt emulsion for tack coating of existing edges of patch.

PART 3 EXECUTION

3.01. EXAMINATION

- A. All bituminous pavement patching shall be done with asphalt concrete material matching existing pavement.

3.02. PREPARATION

- A. Prior to all patching, the affected area shall be cut out as per Section 02112, Pavement Cutting, in a rectangular or square shaped manner.
 - 1. Cutting and removal of existing material to extend 12 inches outside the affected area.
 - 2. Two sides of the area shall be at right angles to the direction of traffic.
 - 3. All material within the cut-out area to be removed down to a firm subgrade and disposed off-site as surplus material.
 - 4. The surface area to be cleaned of all partially weathered or disturbed material and compacted to provide a clean hard foundation and clean interface between patch and existing pavement.
 - 5. As directed by Owner, pavement patching may be required perpendicular to curb lines; therefore, pavement cutting in same alignment will be necessary.

3.03. INSTALLATION

- A. Subbase shall be brought to grade with specified base material.
 - 1. For bituminous patching a tack coat shall be applied to the vertical faces of the existing pavement prior to placing asphalt material. Refer to Section 02510, Asphalt Paving.

- B. A bituminous (asphalt concrete) patch shall then be applied to a depth equal to the original bituminous material, but not less than two courses of 1-1/2 inches each (material to be placed against the edges of the hole first).
1. Avoid pulling material from center of patch to the edges, instead if more material is needed at the edge, it should be deposited there, and the excess raked away.
 2. Sufficient material should be used to ensure that after compaction, the patched surface will be at the correct grade and slope, slightly higher than the adjacent pavement, and not below the adjacent pavement.
 3. Each course shall be thoroughly compacted by the use of mechanical tampers, vibratory plate compactors and hand tampers for small areas and roller for large areas.

3.04. TOLERANCES

- A. After completion of patching, the Contractor shall check smoothness with straight edge or stringline. Deviations of 1/8 inch or more shall be corrected.

END OF SECTION

SECTION 02980
SITE REHABILITATION

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Site rehabilitation of lawns and existing cultivated or landscaped areas.
- B. Restoration of uncultivated lands.
- C. Topsoil, fertilizer, seeding, mulching and planting.
- D. Site rehabilitation of walls, terraces, fences, ditches, drains, culverts, drives, posts, patios, outdoor recreational equipment, garden decorations and appurtenances, small structures, and all other artificial features.
- E. Site modifications and development to meet new conditions.
- F. Removal and disposal of all excess materials, equipment, trash and debris used for, or resulting from, the work included in this section.

1.02. RELATED SECTIONS

- A. Division 1 specifications.
- B. Division 2 specifications.

1.03. REFERENCES

- A. The American Association of Nurserymen Standards - ANSI Standard 2-60.1, "Nursery Stock".
- B. Soil Conservation District of the Department of Agriculture.

1.04. QUALITY ASSURANCE

- A. Areas and Features to be Restored
 - 1. All areas, including natural features occurring thereon, which are damaged or disturbed by the Contractor's operations, shall be restored, repaired or replaced to the same or superior condition which existed prior to construction or as modified herein or as shown on the Drawings.
 - 2. Artificial features shall be restored equal to a new condition or as modified herein or as shown on the Drawings.

1.05. SUBMITTALS

- A. Submit under provisions of Section 01300, Submittals.
- B. Topsoil - Submit sieve analysis and characteristics of topsoil as listed in Part 2.
- C. Seed mixture data.

1.06. PACKING AND SHIPPING

- A. All seed furnished for this project shall be delivered in standard size unopened bags of the vendor, showing weight, mixture, vendor's name and guaranteed analysis.

1.07. STORAGE

- A. Seed shall be properly stored in dry conditions at the site of the work.
 - 1. Any seed damaged or spoiled during storage shall be replaced by the Contractor.

1.08. ENVIRONMENTAL CONDITIONS

- A. Topsoil shall not be delivered or placed in a frozen or muddy condition.
- B. Seeding is to be done on dry or moderately dry soil.
 - 1. Seeding is to be done when the wind velocity does not exceed 5 miles per hour.

1.09. SCHEDULE

- A. The Contractor is advised to do all seeding during the periods of May 1st to June 15th, or August 15th to October 1st.
 - 1. Seeding may be conducted under unseasonable conditions without additional compensation, and at the option and full responsibility of the Contractor.

1.10. GUARANTEE

- A. Any new, reestablished, replaced or disturbed seed material that fails to respond properly within the one-year guarantee period shall be replaced as specified above at the Contractor's expense.

PART 2 PRODUCTS

2.01. MATERIAL

- A. Topsoil
 - 1. Topsoil shall be natural, fertile, friable agricultural soil capable of sustaining healthy vegetative growth.

2. Topsoil shall meet the following gradation requirements free of stones, roots, sticks and other foreign substances:

Grain Diameter	Sieve Size	Percent Passing by Weight
6.3 mm	6.3 mm	100
4.75 mm	No. 4	60-85
0.075 mm	No. 200	20-45
0.002 mm	--	7-27

- a. Topsoil shall contain less than 52 percent sand.
3. The pH of topsoil shall be between 5.0 and 7.0.
4. Topsoil shall contain no less than 6.0 percent organic matter.
5. Topsoil may be from previously excavated, stockpiled and protected materials, provided the materials meet the requirements for topsoil.

B. Fertilizer

1. General Fertilizer
 - a. Fertilizer shall be a complete, partially organic, commercial 10-6-4 fertilizer.
 - b. All fertilizer shall contain a minimum of 10 percent nitrogen, 6 percent available phosphorous and 4 percent potash.
 - c. Other commercially available fertilizers, such as 20 10-10 and 12-6-6, may be utilized provided that spreading rates are adjusted to provide the aforementioned minimum requirements for nitrogen.
2. Plant Fertilizer - As recommended by local Soil Conservation District of the Department of Agriculture for the type(s) of soil(s) and plant(s).

C. Seed

1. All seed shall be fresh, re-cleaned and of the latest crop year.
2. Each component shall meet or exceed the minimum State and Federal requirements for purity and germination for that component.
3. The weed content of each component shall not exceed 0.1 percent.
4. The following seed mixture is suggested for lawns or cultivated (landscape) areas:

Percent by Weight	Variety	Purity	Germination
50	Kentucky Blue Grass	85%	80%
20	Red or Chewing Fescue	97%	80%
30	Red Top	92%	90%

- a. Variations may be recommended by qualified personnel, but shall not be used without approval by the Engineer.
- 5. For uncultivated areas furnish perennial rye grass seed.
- D. Mulch for Tree or Shrub Plantings - Mulch shall consist of dry, clean, hardwood chips.
- E. Mulch for Seeded Areas - Mulch shall be oat, wheat or rye straw, or hay, free from noxious weeds and other materials which may interfere with the establishment of a healthy stand of grass.
- F. Plantings - Trees, shrubs, vines, ground cover and other vegetation to be replaced or installed new as specified which meet the requirements of the American Association of Nurserymen.
 - 1. Classifications of plants, dimensions, planting procedures, etc., shall conform to ANSI Standard Z 60.1, "Nursery Stock".
- G. Peat Moss - As recommended by the supplier of nursery stock.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Determine that surface area is ready for fine grading and/or to receive topsoil and seeding or plantings.
 - 1. Remove trash, debris, large stones and other foreign materials from surface areas to be restored or rehabilitated.
 - 2. Topsoil shall be free of frozen fragments, debris, large stones, and other foreign materials.

3.02. PREPARATION

- A. Fine Grading - Areas requiring topsoil shall be fine graded to within 4 inches of finished grade to provide a minimum compacted thickness of 4 inches of topsoil at all locations.
 - 1. All such areas, whether in cut or fill, shall be raked to a depth of 1 inch, be parallel to finished grade as shown or required and shall be free of all stones, larger than 1 inch, roots, rubbish and other deleterious material.

3.03. INSTALLATION

- A. The Contractor shall reestablish all existing cultivated or landscape items, trees, shrubs, vines and ground covers.

1. Contractor shall provide additional or modify existing vegetation, as shown on the Drawings.
2. Existing trees, plants, shrubs, saplings, ground cover, vines, etc., which are disturbed or damaged by the Contractor's operations shall be replaced with new plant materials.

3.04. TOPSOILING

- A. Topsoil shall be furnished and spread in the required areas to a depth of approximately 4 inches.
 1. Stockpiled topsoil may be used if approved by the Engineer.
 2. In the event this topsoil is not satisfactory, or is inadequate to cover the required areas, the Contractor shall furnish the required amount of satisfactory topsoil from approved sources off the site.
- B. The soil shall be uniformly compacted with a light hand roller to a final depth of not less than 2 inches.
 1. When finished, the surface shall conform to the finished grades shown or required and shall have a smooth pulverized surface at the time of seeding.
 2. Any irregularities shall be corrected before the fertilizer and seed are placed.
 3. Any subsequent settlement or displacement of the topsoil shall be restored to an acceptable condition at the Contractor's expense.

3.05. FERTILIZING

- A. The fertilizer shall be uniformly spread by a mechanical spreader at the rate of 25 lbs. per 1,000 square feet.
 1. The fertilizer shall be incorporated into the upper 2 inches of topsoil immediately after spreading.
 2. Other commercial fertilizers, such as 20-10-10 or 12 6-6 may be used at rates adjusted to provide the same quantity of nitrogen per 1,000 square feet.

3.06. SEEDING

- A. Seed shall be applied at a rate of not less than 5 lbs. per 1,000 square feet, using a mechanical spreader.
 1. Upon completion of the seeding, the area shall be raked lightly and rolled with a light hand roller.
- B. The process of spraying grass seeds, water, fertilizer and mulch known as hydro-seeding or hydro-mulching may be utilized provided that water hazards are minimized.
 1. Presoaking, the spraying of the materials and watering after spraying shall be in strict accordance with the manufacturer's instructions.

2. All materials, protection, maintenance, etc., shall be in conformance with this specification.
3. The mulch may be a wood fiber material compatible with the spray equipment.

3.07. MULCHING AND PROTECTION

- A. The Contractor shall protect and maintain seeded areas to assure a full even stand of grass.
 1. Immediately after seeding and rolling, the Contractor shall apply oat, wheat or rye straw, or hay, free from noxious weeds, as a mulch, to a loose depth of about 1 inch.
 2. The Contractor shall perform all watering and reseeding as necessary for a minimum of 30 days and until final acceptance of the Contract, to ensure the establishment of a uniform stand of specified grasses.

3.08. MAINTENANCE

- A. Any portion of seeded areas failing to produce a full uniform stand of grass from any cause, shall be reseeded at full rate and re-fertilized at one-half rate and protected and maintained until such a full stand has been obtained.

3.09. RESTORATION OF UNCULTIVATED LANDS

- A. Areas of uncultivated land shall be restored as follows:
 1. The disturbed surfaces shall be rough-graded to the original elevations (± 1 inch) and general appearance which existed prior to construction (or to the new elevations and grades which are required), all debris, loose stones over 1 inch, boulders, etc., being removed in the process.
 2. The surface shall then be seeded with perennial rye grass, being spread at the rate of 1 lb. per 800 square feet.
- B. The area need not be raked or rolled after completion of seeding.

3.10. SPECIAL CONDITIONS

- A. Damaged Trees - Vegetation which has been damaged by site preparation activities and deemed non-functional by the Owner or engineer, shall be replaced by the Contractor with vegetation of the same caliper, genus and species at no additional compensation to the Contractor.

END OF SECTION

SECTION 03001

CONCRETE

PART 1 GENERAL

1.01. WORK INCLUDED

- A. All cast-in-place concrete structures.
- B. Equipment pads.
- C. Reinforcing steel bars and accessories.
- D. Concrete mixes.
- E. Concrete testing.
- F. Concrete finishes.
- G. Concrete curing and protection.
- H. Bonding agent.
- I. Concrete slab sealer.
- J. Repair to new defective (and existing) concrete.
- K. Saw cutting concrete and repair to exposed steel reinforcement.
- L. Leakage testing.
- M. Non-shrink grout.

1.02. RELATED SECTIONS

- A. Section 05500 - MISCELLANEOUS FABRICATIONS

1.03. REFERENCES

The publications listed below form a part of this specification to the extent referenced. The publications are referred to in the text by the basic designation only.

A. American Concrete Institute (ACI)

ACI 201.1	Guide for Conducting a Visual Inspection of Concrete in Service
ACI 211.1	Selecting Proportions for Normal, Heavyweight, and Mass Concrete
ACI 301	Specifications for Structural Concrete
ACI 302.1	Guide for Concrete Floor and Slab Construction
ACI 304	Measuring, Mixing, Transporting and Placing Concrete
ACI 305	Hot Weather Concreting
ACI 306	Cold Weather Concreting
ACI 308	Guide to Curing Concrete
ACI 309	Guide for Consolidation of Concrete
ACI 315	Details and Detailing of Concrete Reinforcement
ACI 315R	Manual of Engineering and Placing Drawings for Reinforced Concrete Structures
ACI 318	Building Code Requirements for Structural Concrete
ACI 347	Recommended Practice for Concrete Formwork
ACI 350	Code Requirements for Environmental Engineering Concrete Structures

B. American Society for Testing and Materials (ASTM)

ASTM A185	Steel Welded Wire Reinforcement, Plain, for Concrete
ASTM A497	Steel Welded Wire Reinforcement, Deformed, for Concrete
ASTM A615	Deformed and Plain Billet Steel Bars for Concrete Reinforcement
ASTM C31	Making and Curing Concrete Test Specimens in the Field
ASTM C33	Concrete Aggregates
ASTM C39	Compressive Strength of Cylindrical Concrete Specimens
ASTM C88	Soundness of Aggregates
ASTM C94	Ready-Mixed Concrete
ASTM C136	Sieve Analysis of Fine and Coarse Aggregates
ASTM C143	Test Method for Slump of Hydraulic-Cement Concrete
ASTM C150	Portland Cement
ASTM C172	Sampling Freshly Mixed concrete
ASTM C231	Air Content of Freshly Mixed Concrete by the Pressure Method
ASTM C260	Air-Entraining Admixtures for Concrete
ASTM C309	Liquid Membrane Forming Compounds for Curing Concrete

ASTM C494	Chemical Admixtures for Concrete
ASTM C595	Specification for Blended Hydraulic Cements
ASTM C618	Fly Ash and Raw or Calcined Natural Pozzolan for Use in Concrete
ASTM C989	Ground Granulated Blast-Furnace Slag for Use in Concrete

1.04. SUBMITTALS

- A. Submit Concrete Mix Designs - Concrete mixes used on this project shall be either established mixes verified by "Field Test Data" or new custom laboratory designed "Trial Mixtures." Requirements for either option are as follows.

All data shall be dated within the last 12 months. Partial submittal will not be reviewed.

1. List amount and sources of mix ingredients:
 - a. Cement.
 - b. Pozzolans (fly ash and slag).
 - c. Fine aggregate.
 - d. Coarse aggregate.
 - e. Water.
 - f. Admixtures (including fibers).
 2. Strength Test Reports - The average strengths shall be higher than the required average compressive strengths (f'_{cr}) as per ACI 301, paragraph 4.2.3.3.
 3. Typed letter signed by an official from concrete supplier stating that all ingredients for proposed mix(es) are identical and from the same source as ingredients used for concrete in provided strength test reports.
 4. Certified tests of fine and coarse aggregates meeting requirements in Part 2 of this specification.
 5. Certified statement from source of fine and coarse aggregates pertaining to history of alkali-aggregate reactivity (ASR) or State DOT confirmation that ASR issues are not evident at the aggregate source.
 6. Certified mill test of cement and fly ash or slag.
 7. One-page admixture catalog cuts.
- B. Submit one-page catalog cut for bonding agent.
- C. Submit one-page catalog cut for retarding admixture.

- D. Submit one-page catalog cut for surface-applied hot weather evaporation reducer.
 - E. Submit a written statement regarding Contractor's anticipated curing procedures.
 - F. Reinforcing Steel - Submit shop drawings in accordance with ACI 301, ACI 315 and ACI 315R, as modified below.
 - 1. Drawings shall be clearly drawn and show enough details to locate every bar without the need to refer to the Contract Drawings. All construction and control joints must be shown. Photocopies of Contract Drawings, in whole or in part, will not be acceptable.
 - 2. No fabrication shall commence until shop drawings are approved. All bars shall be shop fabricated.
 - G. Submit catalog cuts for non-shrink grout.
 - H. Submit catalog cuts for chemical adhesive system used to install dowels and threaded anchor bolts into hardened concrete and masonry.
 - I. Submit catalog cuts for joint filler and sealant.
 - J. Submit catalog cut for slab sealer.
 - K. Submit catalog cuts for waterstops and waterstop accessories, clearly indicating which item(s) are to be used.
 - L. Submit catalog cut for curing compound with fugitive dye specifically indicated.
 - M. Submit catalog cut for dampproofing.
 - N. Submit special requests for embedment of conduit, etc. Reference restrictions in Part 3 of this specification.
- 1.05. COORDINATION
- A. Coordinate all concrete placements with work indicated in all specifications and on all Contract Drawings.
 - B. Coordinate the installation of all cast-in (embedded) items (i.e., grating frames, access hatches, anchor rods, etc.) prior to start of concrete placement. Post-installation of cast-in (embedded) items will not be allowed.
 - C. Contractor shall receive approval on anticipated curing and protection procedures prior to placement of all concrete.
 - D. Coordinate all concrete placements with testing and inspection requirements specified herein.
- 1.06. QUALITY ASSURANCE
- A. The concrete batch plant providing concrete to this project shall be certified by the New York State DOT.

- B. Bar Identification and Mill Test Reports - All reinforcing bars shall have the manufacturer's mill marking rolled into the bar which shall indicate the producer, size, type, and grade.
- C. Concrete testing shall be performed prior to and during placement.

PART 2 PRODUCTS

2.01. FORMWORK

- A. Form materials shall be new wood, new plywood, or steel. Worn, used forms will not be allowed on exposed work.
- B. Chamfer forming strips for exposed edges of concrete.
 - 1. Exposed edges and outside corners of concrete shall be formed with 3/4-inch by 3/4-inch chamfer forming strips.
 - 2. Downstream side of weir plates shall be formed with 3-inch by 3-inch chamfer forming strips.
- C. Forms shall be coated with a release agent which will not stain concrete or absorb moisture.
- D. Form Ties
 - 1. Form ties shall leave no metal closer than 1-inch to the surface of the finished concrete. The ends of the form ties shall create cone-shaped tie holes for sealing with plug mortar. Coordinate special requirements of the formed tie holes with the architectural drawings.
 - 2. Ties used for watertight and below-grade structures shall consist of a waterstop.

2.02. REINFORCING STEEL

- A. Deformed Reinforcing Bars - ASTM A615, Grade 60.
- B. Threaded rebar splicing system shall be a fabricated assembly with a mechanical splice capable of developing 125 percent of the specified yield strength (75 ksi for Grade 60 bars).

Use Barsplice Products, Inc. "BPI Barsplicer System," ERICO "Lenton Form Saver," Dayton Superior "Threaded Splicing Systems," or equal.
- C. Expansion joint dowel and sleeve system shall consist of a deformed or smooth dowel provided with a close fitting sleeve of plastic, or of steel pipe or conduit.
- D. Welded Wire Reinforcement (WWR)- ASTM A185 for plain wire or A497 for deformed wire, supplied in flat sheets only.
- E. Bar Supports and Bolsters
 - 1. Bar supports and bolsters shall be a non-bleeding and non-staining material where concrete surfaces remain exposed. Plastic, plastic tipped, or stainless steel bar supports shall be used

for this purpose.

2. Bar supports bearing on grade, insulation, or fill material shall be continuous runner type supplied with continuous welded on plates, or minimum 4000 psi precast concrete blocks specifically cast for this intended use to assure proper support of reinforcement. Individual high chair supports will not be considered adequate.

The use of pavers, brick, or concrete masonry units (CMU) to support reinforcement shall not be permitted.

2.03. CONCRETE

A. Concrete Classes and Their Use

1. Mix A - All general uses including liquid containment structures
2. Mix C - Concrete fill topping (not exposed to flowing water) and pipe supports and encasements
3. Mix D - Concrete thrust blocks (below grade)
4. Mix E - Sidewalks, curbs, bench walls, exterior slabs

Mix	28-Day Compressive Strength (psi)	Coarse Aggregate Size Per ASTM C33	Minimum Total Cementitious Content (lbs/CY)	Maximum Water/Cement Ratio (w/c) ⁽¹⁾	Air Content % ⁽²⁾	Maximum Water Soluble Chloride Ion (CL ⁻)
A	4,000	#57	550	0.44	6.0	0.30
C	4,000	#7	550	0.44	7.0	0.15
D	3,000	#57	450	0.50	--	--
E	5,000	#57	600	0.40	6.0	0.15

⁽¹⁾These maximum water/cement ratios shall be considered for selection of supplier's mix designs. The water/cement ratio specified in the approved mix designs shall be the maximum used in production.

⁽²⁾Tolerance for air content is $\pm 1-1/2$ percent.

- B. All concrete exposed to weather or freezing temperatures shall be air-entrained as specified in the above chart.
- C. For interior concrete, where finishes require a lower air content than specification requires (for instance, slabs-on-grade with "shake-on" applications), the air content shall be adjusted accordingly with the approval of the Engineer.
- D. Without plasticizers, concrete slump for flatwork shall not exceed 3 inches. Wall concrete, columns, deep beams, and other vertical placements (without plasticizers) shall be placed with a maximum slump of 4 inches.
- E. Concrete with superplasticizer shall be designed for a target slump of 6 inches. Mixed concrete with a

slump greater than 7 inches shall not be placed on this project.

2.04. MATERIALS

- A. Cement shall be Portland cement Type I or Type II and shall conform to ASTM C150.
- B. Pozzolans
 - 1. Fly ash shall meet the requirements of ASTM C618 Class F, except as modified below:
 - a. Loss of Ignition, Maximum - 5.0 percent.
 - b. Maximum Retained on #325 Sieve - 30 percent.
 - 2. A blend of Portland cement and fly ash shall be between 15 to 25 percent of total cementitious content.
 - 3. Blastfurnace slag shall meet the requirements of ASTM C989 and be specifically manufactured to produce higher concrete strengths and provide greater resistance to chloride penetration and sulfate attack.
 - 4. A blend of Portland cement and ground iron blastfurnace slag shall contain no more than 50 percent slag. The resulting blend of cementitious material shall meet the requirements of ASTM C595.
- C. Aggregates
 - 1. Fine Aggregate (Sand)
 - a. Natural or manufactured siliceous sand.
 - b. Quantity of deleterious substances as approved by State DOT or as limited by Table 1 of ASTM C33.
 - c. Graded within the limits of ASTM C33.
 - 2. Coarse Aggregate
 - a. Crushed stone or crushed gravel.
 - b. Quantity of deleterious substances as approved by State DOT or as limited by Table 3 of ASTM C33 for Class 3S 4S aggregates.
 - c. Graded within the limits of ASTM C33.
 - 3. Five cycle soundness tests for fine and coarse aggregates shall meet the requirements of ASTM C33.

PERCENT LOSS

	Magnesium Sulfate	Sodium Sulfate
Fine Aggregate ⁽¹⁾	15	10
Coarse Aggregate ⁽²⁾	18	12

⁽¹⁾ If provided results of soundness tests exceed these limits, it would be acceptable to provide a certified letter attesting to the favorable performance of the fine aggregates as outlined in ASTM C33, Article 8.

⁽²⁾ Soundness tests for coarse aggregates do not need to be provided if they are approved by State DOT for use with concrete. Submit verification of such.

4. Source of fine and coarse aggregates shall not have a history pertaining to alkali-aggregate reactivity. In the event that aggregate source with potential alkali-aggregate reactivity is unavoidable, at least two of the following measures shall be taken to minimize this reaction:
 - a. Provide low alkali cement (<0.60 percent alkalies).
 - b. Use lithium-based additives.
 - c. Test aggregates to show non-reactive.
 - d. Use fly ash (minimum 20 percent content) or slag.
- D. Mixing Water - Clear and potable.
- E. Acceleration admixtures are only allowed to shorten cold weather protection periods.

2.05. ADMIXTURES

- A. General - Admixtures other than those specified may only be used after written approval by the Engineer.
- B. Admixtures shall be as manufactured by BASF Chemical Company; Sika Corporation; The Euclid Chemical Company; W.R. Grace, Inc.; or equal.
- C. Air Entrainment Admixture - All concrete requiring air entrainment shall contain an air entrainment admixture meeting the requirements of ASTM C260.
- D. Water Reducing Admixture - All concrete shall contain a water reducing admixture that meets the requirements of ASTM C494 Type A (water reducing) or Type F (superplasticizer). This admixture shall not contain chlorides.
- E. Retarding Admixture - If air temperatures are expected to exceed 85 degrees F during the placement and/or finishing of any flatwork, a retarding admixture shall be used that meets the requirements of ASTM C494 Type D.
- F. Evaporation Reducer - For all concrete flatwork during hot and/or windy weather conditions, apply to freshly placed concrete prior to finishing. Use BASF Chemical Company "Confilm," L&M Construction

Chemicals "E-Con," Conspec (by Dayton Superior) "Aquafilm," or equal.

- G. Acceleration admixture shall meet the requirements of ASTM C494, Type C, and shall not contain calcium chloride. Acceleration admixture is only allowed for cold weather concrete conditions.

2.06. OTHER PRODUCTS

- A. Bonding Agent - For all equipment and housekeeping pads, and when placing freshly-mixed concrete against existing hardened concrete, use a corrosion inhibiting, non-vapor barrier, extended open time bonding compound.

Use Sika Corporation "Armotec 110 EpoCem," The Euclid Chemical Company "Duralprep A.C.," Larsen Products Corporation "Weld-Crete," or equal.

- B. Liquid curing compound shall only be used during cold weather conditions and curing of foundation wall strip footings. When allowed, use a dissipating, VOC-compliant, water-based membrane forming with fugitive dye, conforming to ASTM C309, Type 1-D. Curing compound shall be applied at twice the manufacturer's recommended application rate.

Use Euclid Chemical Company "Tammsecure WB 30D," SYMONS Corporation "Resi-Chem Clear Cure 1D," W.R. Meadows, Inc. "1100-Clear" (with optional fugitive dye), or equal.

- C. Slab sealer shall be Sika Corporation "Sikagard 701W," Euclid Chemical Company "Euco-Gard 100," BASF Chemical Company "Enviroseal 20," or equal.

- D. Waterstop material shall be PVC 6-inch x 3/8-inch ribbed center bulb waterstop No. CR-6380 by Wirestop of Paul Murphy Plastics Company; No. RB6-38 by Vinylex; No. 705 by Greenstreak; or equal.

For expansion joints, use PVC 9-inch by 3/8-inch ribbed center bulb (nominal 1 inch in diameter) waterstop.

- E. Where shown on the Drawings and where new concrete is cast against hardened concrete:

1. Provide a premolded 1-inch by 3/4 inch bentonite self-adhering waterstop strip which expands on contact with water, applied with primer adhesive. The bentonite waterstop material shall meet the requirements of ASTM D217. Waterstop and adhesive shall be "Waterstop-RX" and "CetSeal" by CETCO Building Materials Group; "Swellstop" and "Swellstop Primer" by Greenstreak; or equal.
2. Use a bolt-on (retrofit), L-shaped PVC waterstop set in epoxy adhesive against existing concrete and fastened down with stainless steel fasteners through stainless steel batten strips.
 - a. In walls or slabs 15 inches or greater, use a T shaped waterstop with a nominal 3- inch stem. Use Item #609 by Greenstreak, Item RET638 by Vinylex, or equal.
 - b. In walls or slabs less than 15 inches, use an L shaped waterstop with a nominal 3- inch stem. Use Item #581 by Greenstreak, Item KK611 by Vinylex, or equal.
 - c. At expansion joints, use a T shaped waterstop with a nominal 6-inch stem. Use Item #667 by Greenstreak, or equal.

- F. Expansion and isolation joint filler shall be performed, closed cell, high grade polyethylene or non-extruding PVC, such as "Expansion Joint Filler" by BASF Chemical Company; "Plastic Expansion Board" by Westec Barrier Technologies; "Deck-O-Foam" by W.R. Meadows, Inc.; or equal.
1. Joint fillers shall be held back for sealants.
 2. The joint filler shall be compatible as a back-up material, with regard to the sealant not bonding to or being stained by the backup.
- G. Sealant for expansion joints in concrete structures designed for submerged conditions to either contain or hold out liquids (including groundwater) such as tankage, basements, flow channels, galleries, etc. shall be a two-component NSF approved polyurethane material.
- Use Sika Corporation "Sikaflex-2c," The Euclid Chemical Company "Eucolastic II," or equal.
- H. Sealant for non-submerged conditions is as specified in Section 07900.
- I. Non-Shrink Grout - Shall be a fluid or flowable non-gas liberating cement base product which is manufactured premixed, requiring only the addition of water at the job site. All components shall be inorganic.
- Non-shrink grout (mixed as a plastic state) shall have a minimum compressive strength of 5000 psi in 7 days and 7000 psi in 28 days.
- J. Chemical adhesive anchor system to install threaded anchor bolts and dowels into concrete or masonry shall be a high-strength, premeasured, two part, self-mixing, cartridge-type epoxy adhesive, such as "HIT RE 500" by Hilti; "Epcon G5" by ITW Red Head; "ET Epoxy-Tie" by Simpson Strong-Tie Company, Inc.; or equal.
1. All framing connections for steel or aluminum members into concrete shall be a minimum of two bolts. Bolts into concrete and masonry shall not be closer than 6 inches on center, unless indicated otherwise.
 2. Grout fill masonry cores to accept adhesive anchors. Where otherwise indicated or allowed by the Engineer, manufacturer's masonry screen tube shall be used to install anchors into hollow (ungrouted) masonry.
- K. After material sources have been established and approved, these sources shall not be changed for the duration of the project.

PART 3 EXECUTION

3.01. FORMS

- A. Earth cut forms shall not be used; all footings, base slabs, etc., shall be formed.
- B. Contractor is responsible for design and bracing of all forms for strength, integrity, and to produce the desired tolerances and finishes.

3.02. TOLERANCES FOR FORMED SURFACES

- A. Tolerances apply to concrete dimensions only, not to positioning of reinforcing steel or cast-in/embedded items.

1. Variation from Plumb:	
a. In the lines and surfaces of columns, piers, walls, and other vertical members:	1/4 inch
b. For exposed corners of walls and columns, construction/ control joint grooves, and other conspicuous vertical lines:	1/4 inch
2. Variation from Level or from Grades Specified:	
a. In slab soffits, ceilings and beam soffits, measured before removal of supporting shores:	1/4 inch
b. In exposed lintels, sills, parapets, grooves, tops of walls, slab edges, and other conspicuous horizontal lines:	1/4 inch
3. Variation of the linear building lines of structures from position in plan and related position of columns, walls, and partitions:	1/2 inch
4. Variation in the sizes and location of sleeves, floor openings, and wall openings:	+1/4 inch
5. Variation in cross-sectional dimensions of columns and beams and in the thickness of slabs and walls:	-1/4 inch; +1/2 inch
6. Footings and thickened edges of slabs:	
a. Variations in dimensions in plan:	-1/2 inch; +2 inches
b. Misplacement or eccentricity:	
• 2% of the footing width in the direction of misplacement but not more than 2 inches	
c. Thickness:	
• Decrease in specified thickness	5%
• Increase in specified thickness. No limit but increased thickness must be maintained for minimum 5 feet 0 inch length	

3.03 CONCRETE COVER

- A. Clear concrete cover not indicated on Drawings shall conform to ACI 318 and ACI 350, as applicable. However, in no case shall the clear cover be less than 1-1/2 inches.
- B. Contrary to the practice permitted by CRSI, the use of brick or CMU block supports for reinforcement shall not be permitted. Only special made wire bar supports or special cast, precast concrete blocks shall be allowed.
- C. All metal and plastic bar supports bearing on grade shall have continuous runners to prevent settlement during construction activities.

3.04 CLEANING

- A. Prior to concrete deposition, reinforcing steel shall be free from mortar, mud, loose mill and rust scale, grease, oil or any other coatings, including ice, that would destroy or reduce bond with the concrete.

3.05 PREPARATION, MIXING, AND HANDLING OF CONCRETE

- A. Batch Plant Requirements - Measurement of materials at the batch plant shall be in accordance with ASTM C94.
- B. Mixing Methods - All concrete shall be ready mixed to meet the requirements of ASTM C94.

A written delivery slip or ticket, prepared and signed by the plant operator shall be made out at the proportioning plant for each truck load batch. Each slip shall show the following information:

1. Truck number
2. Date and time truck is batched
3. Ticket number
4. Mix designation of concrete (per paragraph 2.03.A)
5. Cubic yards of concrete
6. Cement brand, type and weight in pounds
7. Weight in pounds of each size and type of aggregate
8. Admixtures, brand and weight in pounds and ounces
9. Moisture content of fine and coarse aggregates
10. Water added to the batch at the plant
11. Water added to the batch during transport
12. Water added to the batch at the job site

The driver shall record the number of gallons of water added during transport and at the job site. In no case shall the w/c ratio be exceeded.

Any truck delivering concrete to the job site without a delivery slip will be rejected and shall immediately depart from the job site.

- C. Heating and Cooling of Materials - The batch plant shall be equipped to heat aggregates and water, or cool water with ice, and cool aggregates by shading and/or spraying with cool water to obtain acceptable concrete delivery temperatures in the range of 55 to 85 degrees F. Aggregates shall not contain ice or have frozen lumps nor shall they be heated to a temperature over 120 degrees F.

3.06 EMBEDMENTS IN CONCRETE

- A. Install and secure all cast-in components in accordance with manufacturer's recommendations, prior to concrete placement.
- B. Embed no pipes other than electrical conduit in structural concrete.

Obtain approval from Engineer for any variation from the following requirements unless shown on the Drawings. Make request in writing accompanied by suitable sketch.

1. Do not cut or displace any reinforcement.
2. Do not place conduit between concrete surfaces and reinforcement.
3. Restrict O.D. of conduit to 1/4 of slab thickness. Keep within middle half of that thickness.
4. Place parallel conduits apart at least six times O.D. of conduit being used.
5. Conduits that cross must be bent such that they cross between 45 and 90 degrees from each other.
6. Conduits that cross can touch each other, but no more than three conduits can cross at any given location.
7. Do not embed conduit in beams.

3.07 CONCRETE PLACEMENT

- A. The Contractor shall notify the Engineer (and Special Inspector when required) a minimum of 48 hours in advance of placement to allow sufficient time for inspection and for any corrective measures which are subsequently required.
- B. Concrete shall be placed in accordance with ACI 304 and ACI 318.
- C. Concrete shall be placed and vibrated in lifts not exceeding 30 inches.
- D. Curing and protection of the concrete shall begin immediately after completion of the finishing operation.
- E. Adjacent concrete placements (sections) shall not be placed any sooner than three days since newly cast sections.

3.08 FORM REMOVAL

- A. The Contractor shall assume full responsibility for the strength of all components from which forms are removed.
- B. Forms and supports shall remain undisturbed until the concrete has attained sufficient strength to support its own weight in addition to any anticipated loads (temporary or permanent) that may be placed upon it during subsequent work. In no event shall forms be loosened or removed prior to 24 hours' wet cure time. Re shore at mid-span where necessary.

- C. Vertical forms such as beam side forms, column forms, and wall forms may be removed at any time after 24 hours, provided that stripping does not damage surfaces and such action does not endanger any part of the structure. Coordinate timing of form removal with rub finish requirements.
- D. No structural forms supporting suspended slabs or beams shall be removed prior to concrete attaining at least 80 percent of the required design strength and less than 14 days. During cold weather conditions, field cured cylinders shall also be made to determine in-place concrete strengths.
- E. Residue of the form release agent shall be completely cleaned off the concrete surface.

3.09 FINISHING

- A. The finish of all walls and slabs (vertical and horizontal surfaces, respectively) shall be as described below.
- B. As-Cast Wall Finishes
 - 1. Type I - Rough Form Finish - Tie holes and defects shall be filled with patching mortar. Fins exceeding 1/4 inch in height shall be chipped off or rubbed off. Otherwise, surfaces shall be left with the texture imprinted by the forms.
 - 2. Type II - Smooth Form Finish - The form facing material shall produce a smooth, hard, uniform texture on the concrete.

Tie holes and defects (including bug holes) shall be patched with a grout rubbing mixture as defined below. All fins shall be completely removed.
- C. Rubbed Wall Finishes - The following finishes shall be produced on concrete with a Type II smooth form finish. Where a rubbed finish is to be applied, the forms shall have been removed and necessary patching completed.
 - 1. Type III - New Concrete, Smooth Rubbed Finish - New concrete is defined here as concrete less than seven days old.
 - a. The finishing shall be applied no later than the day following form removal (green concrete maximum seven days old). Surfaces shall be wetted and rubbed with a carborundum brick until uniform color and texture are produced.
 - b. No cement grout shall be used other than the cement paste drawn from the concrete itself by the rubbing process. Delayed application of Type III finish will not be accepted. A Type IV finish will be required.
 - 2. Type IV - Old Concrete, Grout-Cleaned Rubbed Finish - Old concrete is defined here as concrete over seven days old that cannot be "green rubbed."
 - a. The walls shall have previously received a Type II finish. This finish will not hide projections caused by form slippage and alignment problems.
 - b. Large areas more than 12 feet high or 24 feet long shall be marked off with chalk lines to produce a uniform overall pattern.

- c. A grout rubbing mixture shall be 1 part Portland cement and 1 1/2 parts fine sand mixed to a stiff masonry mortar consistency.

The sand and the Portland cement shall be obtained from the concrete plant where the concrete was purchased and shall be the same as used in the concrete.

- d. The surface shall be soaked with water. The surface being worked on shall not be in direct sunlight while finishing. Curing in direct sunlight is acceptable.
- e. Immediately after soaking, apply the grout rubbing mixture with a rubber or cork float. The material is spread to form a paste over the area being worked on.

The applicator shall always work to a wet edge.

If the area starts to visually lighten up or dry, water can be added by shaking a wetted brush onto the surface.

The coated area shall be permitted to set similar to waiting for a concrete floor to set.

- f. The applicator shall use a carborundum brick to vigorously work the material in a circular motion to a smooth rubbed finish. It is not intended to leave a thin grout coating or a "swirl" or "fan" pattern in the surface.
- g. Should the mixture start to dry out or get too stiff to work, the applicator may re wet the wall with either a pump or brush.
- h. When the area is complete, it will be smooth and dark to medium grey in color. The smooth surface will be equal to a medium grade of sand paper with no evidence of patterns or individual rubbing strokes. No globs of excess material shall remain.
- i. Spray surface with liquid curing compound.
- j. When viewed from a distance about 10 to 20 feet, the concrete will appear to be a uniform grey, creamy smooth surface.

D. Slab Finishes - The finish of all slabs and top of walls shall be described below:

- 1. Type A - Floated Finish - After the concrete has been placed, consolidated, struck off, and leveled, the concrete shall not be worked further until ready for floating. Preferably a magnesium float will be used.

Floating shall begin when the water sheen has disappeared and when the surface has stiffened sufficiently to permit the operation. During or after the first floating, planeness of surface shall be checked with a 10 foot straightedge.

If water has been brought to the surface by the rough floating operation, additional floating shall not proceed until this water has evaporated.

The slab is further floated, with all high spots cut down and all low spots filled during this procedure. The slab shall be finish floated to a uniform sandy texture.

2. Type B - Troweled Finish - The surface shall first receive a Type A floated finish. It shall then be power troweled and finally hand troweled for thorough consolidation. Additional trowelings shall be done by hand after the surface has hardened sufficiently. The final troweling shall produce a ringing sound as the trowel is moved over the surface.

The finished surface shall be essentially free of trowel marks, uniform in texture and appearance.

Apply only a light troweled finish on tank base slabs or if the area is to receive a chemical-resistant finish (CRF).

3. Type C - Broom Finish - First, finish the concrete with a Type A floated finish. The concrete shall be given a transverse scored texture by drawing a coarse broom across the surface, perpendicular to the line of travel along the walking surface.
4. Type D - Concrete Floor Sealer - All concrete surfaces identified in the Finish Schedule, not scheduled to receive other coatings or coverings, shall be sealed as follows:
 - a. Prior to applying floor sealer, thoroughly clean the concrete surface.
 - 1) At new concrete floors, remove all dirt, oil, grease, and other foreign matter with caustics and detergents.
 - 2) At existing concrete floors, the concrete shall first be cleaned using an abrasive brush-off blast, followed by caustics and detergents as needed.
 - b. Thoroughly rinse and apply two coats of sealer in accordance with manufacturer's recommendations.
 - 1) At new concrete floors, the first coating shall be applied as soon as possible after finishing and curing. The second coating shall be applied near project completion after installation of all equipment and piping and after completion of other related construction activities.
 - 2) At existing concrete floors, apply the first coating as soon as possible after the floor is cleaned. Apply the second coating near project completion after installation of all equipment and piping and after completion of other related construction activities.

3.10. CONCRETE EQUIPMENT PADS

- A. If sizes are not shown on the Drawings, provide concrete pads 6 inches wider than the approved equipment in all directions.
- B. Prior to placing concrete for equipment pads, use a bonding agent.
- C. The sides and top of the equipment pad shall be finished similar to a Type II smooth form finish Type III or Type IV rubbed wall finish and Type B troweled finish, respectively.

3.11. CURING AND PROTECTION

- A. All freshly placed concrete shall be protected from adverse weather elements, and from defacement. As soon as the concrete has been placed and horizontal top surfaces have received their required finish, provision shall be made for providing sufficient water for hydration and preventing loss of moisture from the concrete for at least a seven day period.
- B. For the first 24 hours after concrete finishing, no work shall commence nor shall any material be placed on the newly cast concrete. The exposed concrete surfaces shall be protected from any potential damage with plywood or other means for the remaining six days of the curing period.
- C. Interruptions, not to exceed a total of four hours are permitted for the purpose of layout or other required construction needs as long as the surface is not allowed to completely dry. Be prepared to spray the exposed surface every 15 to 30 minutes.
- D. Slabs and Other Flatwork
 - 1. After finishing and immediately after the concrete surface has hardened enough to prevent dilution of the cement paste, spray the surface with water to provide continuous moist curing for at least the first 24 hours.
 - 2. After the initial 24 hour period, soak with water and cover for an additional six days with waterproof paper or white polyethylene blankets. Wet burlap coverings may be used if the burlap is kept wet by continuous sprinkling with water. Lap the cover material at least 12 inches, covering the top and sides of the concrete.
 - 3. If cover material is not used, the concrete surfaces shall be kept continuously wet by spraying or other approved methods.

3.12. SEALING OF CONCRETE

- A. The concrete surfaces identified in the Finish Schedule shall be sealed as follows:
 - 1. The first coating shall be applied as soon as possible after finishing and curing, and the second coating shall be applied near project completion after installation of all equipment and piping and after completion of other related construction activities.
 - 2. Apply sealer in accordance with manufacturer's recommendations.

3.13. TESTING FOR QUALITY ASSURANCE

- A. The Contractor shall hire and pay for the services of an independent testing laboratory to perform the testing for quality assurance.
- B. This testing shall consist of calculation of w/c ratio; measuring slump; air content; and tests for the compressive strength. Four 6-inch diameter cylinders shall be made with 1 cylinder to be tested at 7 days, 2 cylinders to be tested at 28 days, and 1 cylinder to be tested at 56 days if the 28-day strengths are inadequate. These test results will be used by the Contractor to assist his control of quality.
- C. The Contractor shall schedule and provide 48 hours' notice to the independent testing laboratory. The

Contractor shall provide free access to work and cooperate with the testing laboratory.

- D. In general, testing shall be required for each placement in excess of 5 cubic yards.
- E. Copies of all test reports shall be mailed directly to the Owner and Engineer by the testing laboratory as soon as they become available.
- F. The Contractor shall accept all test results reported by the testing laboratory. Any disputed results shall be validated by an independent testing laboratory hired by the Contractor at their expense.

3.14. REPAIR OF CONCRETE

- A. Areas of concrete in which cracking, spalling, or other signs of deterioration develop during initial curing or thereafter until the end of the guarantee period shall be removed and replaced, or repaired in accordance with this Article and Section 03732.

The Contractor may propose to use a specific method most suitable to the situation and have the method approved by the Engineer prior to repair. The Contractor shall submit manufacturer's product data sheets and recommended application procedures to the Engineer for approval prior to performing repairs.

- B. Structural Cracks (as determined by Engineer) - Random shrinkage or structural cracks shall be repaired utilizing a low viscosity, 100 percent solids, two-component epoxy resin system as specified in Section 03732.

Crack or void must be dry at time of application. Remove all dust, debris or disintegrated material from crack or void by use of oil-free compressed air or vacuuming or by other approved methods as may be required by manufacturer. After successful crack repair, remove temporary seal and excess adhesive. Clean surfaces adjacent to repair and blend finish.

Surface preparation, mixing, and application shall be in conformance with manufacturer's recommendations.

Prior to repair, Contractor shall submit a suitable remedial product and installation procedures to the Engineer for approval.

- C. Leaking and/or Active Cracks (that are not structural cracks) - Leaking and active cracks shall be repaired utilizing a low viscosity, hydrophobic, closed cell polyurethane foam injection system as specified in Section 03732.

Inject water into the crack to thoroughly flush out the crack and remove dirt, dust, and contaminants. Follow flush water by injecting urethane foam with accelerating catalyst as required. After successful crack repair, continue wall preparation by removing injection ports and grind to remove excess injection material and surface seal. Patch port holes and blend wall finish with surrounding area.

Surface preparation, mixing, and application shall be in conformance with manufacturer's recommendations.

Prior to repair, Contractor shall submit a suitable remedial product and installation procedures to the Engineer for approval.

- D. Excessive surface cracking in concrete slabs as defined herein shall receive a penetrating epoxy resin sealer to seal the cracks as specified in Section 03732.

Excessive cracking shall be defined as areas containing "craze cracking" or "map cracking" as defined by ACI 201.1. In the event that excessive cracking occurs in isolated areas of a given concrete slab, sealer could only be required in the area of the cracks bounded by construction or control joints pending Engineer approval.

Surface preparations, priming, mixing, application and finishing shall be in accordance with the manufacturer's recommendations.

Epoxy resin penetrating sealer shall be "Sikadur 55 SLV" by Sika Corporation, or equal. Contractor shall submit a suitable remedial product and installation procedures to the Engineer for approval.

- E. All spalled, weakened, damaged or disintegrated concrete and areas of honeycombing shall be removed to sound concrete. Repair concrete in accordance with Section 03732.

For spalled or honeycombing areas involving depths generally less than 3 inches, utilize a polymer-modified cementitious repair mortar, such as Sika Corporation "Sikatop 122 or 123," Euclid Chemical Company "Verticoat," BASF Construction Chemicals "HB2 Repair Mortar," or equal.

Surface preparation, mixing, priming and application shall be in conformance with manufacturer's recommendations.

3.15. REPAIR AT SAW CUTS TO CONCRETE

- A. After saw cutting concrete, repair exposed rebar as follows:
1. Chip back concrete around rebar end with maximum 20-lb. chipping hammer.
 2. Cut off exposed rebar minimum 1-1/2 inches past concrete surface.
 3. Coat area with bonding agent and patch hole with non-shrink grout.

END OF SECTION

SECTION 03600

GROUT

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Non-shrink grout for setting of equipment, column baseplates, precast units, and other accessories.
- B. Non-shrink grout to patch voids around slab and wall penetrations.

1.02. RELATED SECTIONS

- A. Section 03001 - CONCRETE
- B. Section 05505 - CONCRETE AND MASONRY ANCHORS

1.03. REFERENCES

The publications listed below form a part of this specification.

- A. American Concrete Institute
 - 1. ACI 304 - Recommended Practice for Measuring, Mixing, Transporting, and Placing Concrete
 - 2. ACI 309 - Practice for Consolidation of Concrete
- B. American Society for Testing and Materials
 - 1. ASTM C31 - Method of Making and Curing Concrete Test Specimens in the Field
 - 2. ASTM C109 - Test Method for Compressive Strength of Hydraulic Cement Mortars (Using 2 inch or 50 mm Cube Specimens)
 - 3. ASTM C143 - Test Method for Slump of Portland Cement Concrete
 - 4. ASTM C150 - Portland Cement
 - 5. ASTM C1019 - Standard Method of Sampling and Testing Grout
 - 6. ASTM C1107 - Packaged Dry, Hydraulic-Cement Grout (Non-shrink)

1.04. SUBMITTALS

- A. Submit catalog cut for non-shrink grout.

PART 2 PRODUCTS

2.01. GROUT

- A. Non-Shrink Grout - Shall be a flowable, non-staining, premixed, cement-based, manufactured product, requiring only the addition of water or latex mix solution (supplied by the grout manufacturer) at the job site.
 - 1. For support of equipment and column baseplates, for setting of precast units or other accessories, and for plugging voids around slab and wall penetrations, use grout specifically manufactured for such applications.

Plastic consistency of grout shall achieve minimum compressive strength of 5,000 psi in 7 days and 7,000 psi in 28 days.
 - 2. Non-shrink grout shall be applicable for damp, corrosive environments.
- B. Grout for patching and plugging concrete surfaces shall be as specified in Section 03001, Concrete.
- C. Adhesive anchor systems shall be used to install all bolts, anchors, and reinforcing bar dowels into concrete and/or masonry, as specified in Section 05505, Concrete And Masonry Anchors.

PART 3 EXECUTION

3.01. INSTALLATION

- A. Prepare surfaces, mix product, and install grout per manufacturer's instructions.
- B. Provide curing of the grout per manufacturer's recommendations.

END OF SECTION

SECTION 05500

MISCELLANEOUS FABRICATIONS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Ferrous and non-ferrous metal and fiberglass components, including miscellaneous framing, structural and miscellaneous shapes, plates, anchor rods, bolts and accessories, etc.
- B. Shop-fabricated items including bollards, lintels, shelf angles, bearing plates, overhead door frames, wall brackets, custom pipe supports, etc.
- C. Manufactured items including ladders, floor access hatches, etc.
 - 1. Access hatch conditions include new hatch in an existing framed opening (reusing existing hatch frame), new hatch and frame in a new opening, and new (hingeless) aluminum cover over a new or existing opening.

1.02. RELATED SECTIONS

- A. Section 05505 - CONCRETE AND MASONRY ANCHORS
- B. Section 09900 - PAINTING

1.03. REFERENCES

AAMA	American Architectural Manufacturers Association
ANSI A14.3	Ladders - Fixed - Safety Requirements
ASTM A6	General Requirements for Rolled Structural Steel Bars, Plates, Shapes, and Sheet Piling
ASTM A36	Specification for Carbon Structural Steel
ASTM A48	Gray Iron Coatings
ASTM A53	Specification for Pipe, Steel, Black and Hot-Dipped
ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Steel Products
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A276	Specification for Stainless Steel Bars and Shapes
ASTM A307	Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength
ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength
ASTM A489	Carbon Steel Lifting Eyes
ASTM A500	Cold-Formed Welded and Seamless Carbon Steel Structural Tubing in Rounds and Shapes
ASTM A536	Ductile Iron Castings
ASTM A572	High-Strength Low-Alloy Columbium-Vanadium Structural Steel
ASTM A992	Specification for Structural Steel Shapes

ASTM B209	Aluminum and Aluminum-Alloy Sheet and Plate
ASTM B221	Aluminum and Aluminum-Alloy Extruded Bars, Rods, Wire, Profiles, and Tubes
ASTM B241	Aluminum-Alloy 6063 Seamless Pipe and Extruded Tube
ASTM B308	Aluminum-Alloy 6061-T6 Standard Structural Profiles
ASTM B632	Aluminum-Alloy Rolled Tread Plate
ASTM D4385	Classifying Visual Defects in Thermosetting Reinforced Plastic Pultruded Products
ASTM E84	Class 7, Fire Retardant Fiberglass Materials
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F1554	Anchor Bolts, Steel, 36, 55, and 105 ksi Yield Strength
ASTM F2329	Zinc Coating, Hot-Dip, Requirements for Carbon and Alloy Steel Bolts, Screws, Washers, Nuts, and Special Threaded Fasteners
AWS A2.4	Standard Symbols for Welding, Brazing, and Nondestructive Examination
AWS D1.1	Structural Welding Code - Steel
AWS D1.2	Structural Welding Code - Aluminum
AWS D1.3	Structural Welding Code - Sheet Steel
AWS D1.6	Structural Welding Code - Stainless Steel
OSHA 1910.27	Fixed Ladders
SSPC	The Society for Protective Coatings

1.04. SUBMITTALS

A. Shop Drawings

1. Include detailed fabrication drawings with Bill of Materials and finishes, erection drawings, and applicable details such that the Contractor does not need to reference the Contract Drawings.
2. Indicate profiles, sizes, connections, attachments, reinforcing, anchorage, size and type of welds, holes, fasteners, and accessories.
3. Shop drawings shall be submitted in sets of similar fabricated items. Large submittals, generally over 10 sheets, consisting of several different fabricated items will be returned to the Contractor unreviewed.
4. All resubmittals of shop drawings shall have all revisions/corrections clearly highlighted to the Engineer (e.g., labeled, clouded, etc.).

- B. Submit manufacturer's product data (i.e., catalog cuts) for floor access hatches, ladders, telescoping safety posts, and other manufactured items that include details of manufactured product with installation instructions.

1.05. COORDINATION

- A. Coordinate work with existing field conditions.
- B. Field verify all dimensions prior to submittal of shop drawings.
- C. Coordinate placement of concrete and grouting of masonry with installation of cast-in (embedded) items.

1.06. QUALIFICATIONS

- A. Weld procedures and welder personnel shall be AWS qualified. Keep procedures and certifications on file. Submit only when requested.

PART 2 PRODUCTS

2.01. MATERIALS

- A. "W"-Shaped Steel Beams - ASTM A992, Grade 50.
- B. "S"-Shaped Steel Beams - ASTM A36 or ASTM A992, Grade 50.
- C. "C"-Shaped or "MC"-Shaped Steel Channels - ASTM A36 or ASTM A572 Grade 50.
- D. Steel Angles and Plates - ASTM A36.
- E. Hollow Structural Sections (HSS)
 - 1. Rectangular and Square Sections - ASTM A500, Grade B, 46 ksi.
 - 2. Round Sections - ASTM A500, Grade B, 42 ksi.
- F. Aluminum Sections - ASTM B308, Alloy 6061-T6. Use Aluminum Association shapes.
- G. Aluminum Sheet and Plates - ASTM B209, Alloy 5052.
- H. Aluminum Checkered Floor Plate - ASTM B632, Alloy 6061-T6.
- I. Aluminum Rectangular Bars - ASTM B221, Alloy 6061-T6.
- J. Stainless Steel Structural Shapes - ASTM A276, Type 316 or Type 316/316L, annealed.
- K. Stainless Steel Angles and Plates - ASTM A276, Type 316 or Type 316/316L.
- L. Pipe
 - 1. Steel - ASTM A53, Grade B.
 - 2. Aluminum Alloy - 6061-T6.

- M. Fiberglass Fabrications - All structural shapes shall be manufactured using the pultrusion process with a minimum glass content of 45 percent. Use extra corrosion-resistant vinyl ester resin material for all shapes and plates. All fiberglass resin shall contain an integral UV inhibitor and be produced with a resin-rich surface to protect against exposure and wear.
- N. Bolts - ASTM F593 stainless steel, Type 316; ASTM A325 carbon steel; galvanized (A325) bolts as a manufactured fastener assembly to comply with ASTM A153 or F2329; ASTM A489 steel lifting eyes.
- All bolt accessories including nuts, washers, etc. shall be of the same material as the bolt. Dielectric separation (i.e., neoprene washers) shall be used when a fastener material may be reactive to the base material.
- O. Bolted Attachment to Concrete and Masonry – For structural connections, use stainless steel threaded rods with chemical adhesive anchor system as specified in Section 05505, Concrete and Masonry Anchors. (Expansion anchors are not allowed unless specifically requested by Contractor for a particular application and approved by Engineer.)
- P. Cast-In Anchor Rods (Bolts) – ASTM F1554 anchor rods galvanized to ASTM A153. Reference Section 05505, Concrete and Masonry Anchors.
- Q. Welding Filler Metals and Electrodes - AWS D1.1, D1.2, D1.3, and D1.6.
1. For steel welding, filler metal shall conform to AWS 5.1 or 5.5 and E70xx SMAW electrodes shall be used.
 2. Required type(s) for other materials being welded.
- R. Touch-Up Primer for Galvanized Surfaces - Zinc-rich paint.

2.02. SHOP-FABRICATED ITEMS

- A. Bollards - 6-inch galvanized steel, Schedule 80 pipe; concrete filled (crowned cap); prime and finish paint unless a plastic sleeve is indicated on the Contract Drawings.
- B. Steel Shelf Angles (Galvanized)
1. Provide hot-dip galvanized steel lintels as shown on Contract Drawings for support of masonry and veneer.
 2. Prime paint galvanized steel angles before installation; exposed surfaces to be finish painted.
- C. Steel Lintels (Galvanized)
1. Provide hot-dip galvanized steel lintels as shown on Contract Drawings and where masonry lintels are not indicated for masonry openings larger than 16 inches for concrete block and 8 inches for brick. At doors, windows, HVAC accessories, access panels, and utility penetrations, extend only lintels supporting CMU 8 inches beyond opening (each side).
 2. Prime paint galvanized steel lintels before installation; exposed surfaces to be finish painted.
- D. Bearing plates with minimum two 5/8-inch diameter by 4 inch long welded studs to be cast in concrete

or embedded in grout-filled masonry bond beams.

- E. Anchorage for miscellaneous metal items cast in concrete shall have, as a minimum, welded- on strap anchors 2 feet o.c., made from 1/4 inch thick x 1-inch wide x 6-inch long bar stock with each end bent 90 degrees.
- F. Overhead Door Frames - Use hot-dip galvanized structural channel or bent plate as indicated with 1/4-inch x 2 inches x 2 feet long welded strap anchors at 2 feet o.c. vertically, turn up ends. Prime paint prior to installation and finish coat exposed surfaces per Finish Schedule.
- G. Pipe Supports
 - 1. Provide pipe supports constructed of structural shapes and materials as detailed on the Contract Drawings.
 - 2. Entire pipe support assembly shall be hot-dip galvanized after fabrication, unless specifically indicated otherwise in the Contract Documents.

2.03. MANUFACTURED ITEMS

A. Floor Access Hatches

- 1. Exterior - Hatch shall consist of 1/4-inch aluminum checkered plate cover with watertight gasket seal, aluminum channel frame with drain coupling, backpainted, complete stainless steel hardware including slam lock with cover plug. Contractor to extend hatch drain to exterior or to sump as directed by Owner's representative.
 - a. For H20 load capacity, use standard size single- or double-leaf Bilco, Type J-AL H20 or JD-AL H20; EJ Group, Model DT HD-AOSG or DTD-HD-AOSG; Halliday Products, Series H1W or H2W; or equal.
 - b. Only at exterior hatches in surfaces located a minimum of 1 foot above grade or roadway, and not accessible to vehicles, are allowed to have a reduced 300 psf load capacity if not otherwise specified as an H20 hatch in the Contract Documents. Use standard size single- or double-leaf Bilco, Type J-AL or JD-AL; EJ Group, Model DT AOSG or DTD-AOSG; Halliday Products, Series W1R or W2R; or equal.
- 2. Interior - Hatch shall be rated for 300 psf loading and shall consist of 1/4-inch aluminum checkered plate cover with watertight gasket seal, aluminum angle frame, backpainted, complete stainless steel hardware including slam latch with flush lift handle.
 - a. Use standard size single- or double-leaf Bilco, Type K-AL or KD-AL; EJ Group, Model LEC-AOSG or LECD AOSG; Halliday Products, Series S1S or S2S; or equal.
 - b. Provide exterior H20 rated hatches for interior applications where H20 hatches are specified.
- 3. Watertight – Use 1/4-inch aluminum checkered plate hatch with watertight gasket seal, backpainted, complete stainless steel hardware including standard slam lock with cover plug. Hatch must withstand and prevent leakage for a minimum of 10 feet of water pressure and shall set flush with top of concrete.

Use single-leaf Bilco, Type WT; U.S.F. Fabrications, Model W-APS; or equal.

4. Provide a hinged FRP or aluminum safety grate fall-through protection system at all floor access hatches. The safety grate shall not reduce the clear opening of the specified hatch size.

B. Aluminum Ladders

1. Ladders to conform in all respects to the requirements of OSHA 1910.27.
 2. 6061-T6 or 6063-T5 mill finish aluminum. All welds and sharp edges to be ground smooth.
 3. Rungs
 - a. Square or rectangular in profile with ridged or serrated non-slip top surface, capable of supporting a 300-lb. concentrated load at any point along the length of the rung without failure or permanent deformation.
 - b. Vertical spacing of rungs to be equal throughout the length of the ladder, from floor to top of roof slab or upper walking surface, and not to exceed 12 inches.
 - c. Centerline of rungs to be minimum 7 inches from wall (climbing surface) or obstruction opposite climber.
 4. Side Rails
 - a. Rectangular tube or channel in profile.
 - b. Supported by brackets at base and at maximum spacing of 48 inches o.c. along vertical length. Secure brackets with 5/8-inch diameter Type 316 stainless steel adhesive anchors, 4-inch minimum embedment.
 5. See Drawings for specific configurations.
- C. Provide stainless steel or aluminum telescoping safety post that automatically locks in the fully raised position at all ladders below access hatches. Use "Ladder UP" by Bilco, "Safety Post" or "Safety Extensions" by U.S.F. Fabrication, or equal.

2.04. FINISHES

- A. Prepare steel surfaces in accordance with SSPC SP 6.
- B. Shop prime paint steel items, not galvanized, and top coat after installation. Prime paint shall be compatible with paint (coating) system specified in Section 09900, Painting. Do not prime surfaces where field welding is required.
- C. Galvanized items shall be hot-dip galvanized in accordance with ASTM A123 or A153. Provide minimum 2.0 oz/sq.ft. galvanized coating.
- D. Unless noted otherwise, aluminum shall be mill finish.

- E. Aluminum in contact with concrete or masonry shall be backpainted with bituminous paint.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Ensure that field conditions are acceptable and are ready to receive work. Measurements and dimensions to be field verified.
- B. Beginning of installation means Contractor has verified and accepts existing conditions.

3.02. FABRICATION

- A. Fit and shop assemble in largest practical sections, for delivery to site.
- B. Fabricate items with joints tightly fitted and secured.
- C. Welds shall be continuous unless noted otherwise. Grind down welds smooth to remove excess material.
- D. Exposed Mechanical Fastenings - Unobtrusively located, consistent with design of component.
- E. Supply components required for anchorage of fabrications.
- F. Fiberglass Fabrications - All cuts and drilled holes shall be sealed with vinyl ester resin to provide maximum corrosion resistance.

3.03. FABRICATION TOLERANCES

- A. Squareness - 1/8-inch maximum difference in diagonal measurements.
- B. Maximum Offset Between Faces - 1/16-inch.
- C. Maximum Misalignment of Adjacent Members - 1/16-inch.
- D. Maximum Bow - 1/8-inch in 48 inches.
- E. Maximum Deviation From Plane - 1/16-inch in 48 inches.

3.04. INSTALLATION

- A. Allow for erection loads and provide sufficient temporary bracing to maintain true alignment until completion of erection and installation of permanent attachments.
- B. Install items plumb and level, accurately fitted, free from distortion or defects.
- C. Install manufactured items in accordance with manufacturer's instructions.
- D. Install and secure all cast-in (embedded) items prior to placement of concrete or grouting of masonry.

- E. Perform field welding in accordance with AWS.
- F. Fasten aluminum fabrications using Type 316 stainless steel bolts and accessories.
- G. Fasten galvanized steel fabrications using A325 galvanized bolts and accessories unless Type 316 stainless steel bolts and accessories are otherwise indicated in the Contract Documents.
- H. Fasten fiberglass fabrications using Type 316 stainless steel bolts and accessories.
- I. Carbon steel bolts shall only be used for painted carbon steel framing connections.
- J. Isolate dissimilar metals with dielectric and use appropriate fasteners.
- K. Obtain Engineer approval prior to site cutting or making adjustments not indicated on shop drawings.
- L. Prior to installation, aluminum surfaces in contact with concrete and/or masonry require backpainting.
- M. After erection, touch up paint welds, bolts, connection material, and abrasions.
- N. Top paint all exposed steel that is not galvanized, except for bollards, overhead door frames, shelf angles, and lintels.
- O. Touch-up all galvanized surfaces with zinc-rich paint.
- P. Fiberglass Fabrications - All field cuts and drilled holes shall be sealed with vinyl ester resin as supplied by the manufacturer to provide maximum corrosion protection.

3.05. INSTALLATION TOLERANCES

- A. Maximum Variation From Plumb - 1/4-inch.
- B. Maximum Offset From True Alignment - 1/4-inch.
- C. Maximum Out-of-Position - 1/4-inch.

END OF SECTION

SECTION 05505

CONCRETE AND MASONRY ANCHORS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Post-installed chemical adhesive anchor system for installing threaded rods (bolts) and reinforcing bar dowels into concrete and masonry. Both threaded rods (bolts) and dowels are referred to as anchors herein.
- B. Limited use of post-installed mechanical anchors in concrete and masonry.
- C. Cast-in anchors for attachment to concrete.
- D. Embedded anchors for attachment to masonry.

1.02. RELATED SECTIONS

- A. Section 03001 - Concrete
- B. Section 05500 - MISCELLANEOUS FABRICATIONS

1.03. REFERENCES

ACI 355.1R	State-of-the-Art Report on Anchorage to Concrete
ASTM A153	Zinc Coating (Hot-Dip) on Iron and Steel Hardware
ASTM A307	Carbon Steel Bolts and Studs, 60 ksi Tensile Strength
ASTM A325	Structural Bolts, Heat Treated, 120/105 ksi Tensile Strength
ASTM A449	Hex Cap Screws, Bolts and Studs, Steel, Heat Treated, 120/105/90 ksi Minimum Tensile Strength, General Use
ASTM A615	Deformed and Plain Carbon-Steel Bars for Concrete Reinforcement
ASTM E488	Strength of Anchors in Concrete and Masonry Elements
ASTM E1512	Testing Bond Performance of Bonded Anchors
ASTM F593	Stainless Steel Bolts, Hex Cap Screws, and Studs
ASTM F594	Stainless Steel Nuts
ASTM F1554	Anchor Bolts, Steel, 36, 55, and 105-ksi Yield Strength
ICC AC 308	Acceptance Criteria for Post-installed Adhesive Anchors in Concrete Elements

1.04. SUBMITTALS

- A. Submit catalog cuts for chemical adhesive grout product to be used for anchoring threaded rods (bolts) and dowels into concrete and/or masonry. Catalog cuts (do not submit whole catalogs) shall be clearly marked to include:

1. Tension and shear strength design values for each anchor size used on this project.
 2. Manufacturer's installation instructions.
 3. Allowable temperature range for proper anchor installation.
- B. Submit the ICC-ES Evaluation Service Report (ESR) for proposed adhesive anchor system if not a named product below in Part 2.
- C. Submit data on adhesive anchor threaded rods to be used, including materials, sizes, lengths, etc.
- D. Submit catalog cuts on mechanical, expansion-type anchor bolts and drop-ins, and clarification on the requested use.

1.05. QUALITY ASSURANCE

- A. If the Contractor is not experienced in installing chemical adhesive anchors, or as requested by the Engineer, a representative from the adhesive anchor manufacturer shall be present at start of project to instruct the Contractor on how to properly install the adhesive anchors.
- B. Upon request, 5 percent of all adhesive anchors shall be proof-loaded by an independent testing laboratory. The location(s) shall be determined by Engineer. These tests shall be paid for by the Contractor and the results shall be submitted to the Engineer.
- C. Adhesive anchor systems shall have a current ICC-ES Evaluation Service Report that states recommended design capacities. Reports shall be performed in accordance with ICC AC 308 and ASTM E1512.

1.06. COORDINATION

- A. Coordinate the placement of anchor bolts with approved items and fabrications.

PART 2 PRODUCTS

2.01. MATERIALS

- A. Adhesive anchor system shall be a high-strength, premeasured, two-part, self-mixing, cartridge-type epoxy adhesive such as "HIT HY 200" by Hilti, Inc.; "Epcon S7" by ITW Red Head, "Set-XP" by Simpson Strong-Tie Company, Inc.; or equal.
1. Provided adhesive anchor system shall meet or exceed the minimum loading capacities of these specified products.
 2. Where anchors or dowels are to be drilled and embedded into hollow (ungrouted) masonry, provide adhesive and sleeve (screen tube) system for this specific application.
- B. Mechanical Anchors – Mechanical (expansion-type) anchors are not allowed unless specifically requested (for a special application) by the Contractor and approved by Engineer in writing. Refer to limitations of use stated in Part 3.

1. If approved, they shall be hot-dip galvanized or stainless steel expansion-type bolts or drop-in anchors.
 2. Anchors shall be rated for a minimum of twice the required load capacity.
- C. Cast-in Anchor Rods (Bolts) – ASTM F1554 anchor rods galvanized to ASTM A153. Use minimum 3/4-inch diameter headed rods (with welded nut) 18 inches long, or as shown on the Contract Drawings.
- D. Stainless Steel Threaded Rods – ASTM A593, Type 316.
- E. Stainless Steel Nuts – ASTM A594, Type 316.
- F. Reinforcing Steel Dowels – ASTM A615, Grade 60 deformed bar.
- G. All threaded rods and anchor bolt accessories, including nuts, washers, etc. shall be of the same material as the rods/bolts.

PART 3 EXECUTION

3.01. INSTALLATION OF ADHESIVE ANCHOR SYSTEMS

- A. All bolted connections to concrete and masonry shall utilize an adhesive anchor system as specified above.
- B. Threaded stainless steel rods shall be used for all anchor bolt applications, unless noted otherwise in the Contract Documents.
- C. Provide templates or other means to accurately locate anchors.
- D. Drilled holes shall be cleaned out and shall be free of dust and trapped water.
- E. Masonry wall (cores) shall be filled with grout where anchors are to be installed. In existing construction where masonry cores are not (and cannot be) grout filled, manufacturer's masonry screen tube shall be used with anchor installation.
- F. Install adhesive anchors in accordance with manufacturer's recommendations.
- G. Anchor bolts installed into concrete and/or masonry shall not be closer than 6 inches o.c. unless indicated otherwise.
- H. All structural members bolted to concrete and/or masonry shall be made with a minimum of two 5/8-inch diameter anchors at each connection.
- I. Anchor bolts and dowels shall be clean and free of coatings or other contaminants that would impair bonding to the chemical adhesive.
- J. Threaded rods shall be long enough to project through the entire depth of nut and shall be cut off at 1/2 inch beyond the top of nut.

- K. Anchor bolts and dowels shall not be installed in concrete less than seven days old, or older if recommended by the manufacturer.
- L. Adhesive anchors shall be fully cured prior to applying load on anchor.

3.02. INSTALLATION OF CAST-IN AND EMBEDDED ANCHORS

- A. All cast-in and embedded anchors shall be hot-dip galvanized unless noted otherwise in the Contract Documents.
- B. Provide templates or other means to accurately place anchors.
- C. Anchors shall be secured in place to not allow displacement during placement of concrete or masonry grout.
- D. Concrete or masonry grout shall be thoroughly vibrated around the anchors for proper bonding of the anchors.
- E. Anchor rods shall be long enough to project through the entire depth of nut and shall be cut off at 1/2 inch beyond the top of nut.
- F. Concrete or masonry shall be at full 28-day compressive strength prior to applying load on anchor.

3.03. INSTALLATION OF MECHANICAL ANCHORS

- A. Mechanical (expansion-type) anchors are only allowed for overhead (ceiling) applications where thru-bolting cannot be performed. Mechanical anchors are not allowed for any other use unless specifically requested (for a special application) by the Contractor and approved by Engineer in writing.
- B. Mechanical anchors shall support static tension loads not exceeding 200 lbs. per anchor.
- C. Drilled holes shall be cleaned out and free of dust.
- D. Anchors shall be fully seated prior to pretension. Pretension in accordance with manufacturer's instructions.
- E. Engineer may request any/all these mechanical anchors to be proof-loaded.

END OF SECTION

SECTION 09900

PAINTING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Field preparation and painting of:
1. Surfaces and materials indicated to receive paint/coatings in the Room Finish Schedule, Tank Finishes Schedule, or Exterior Color and Finish Schedule on the architectural drawings.
 2. Equipment, fabrications, and surfaces listed in Table A-2, Equipment Finish Schedule or where field preparation or painting is called for in the specification for that equipment or fabrication.
 - a. Any equipment, whether listed in Table A-2 or not, that is not provided by its manufacturer with surface preparation, prime coat, and finish coats suitable to protect the equipment for its service life in the environment where it is to be installed. If equipment manufacturer proposes their standard coating, they shall submit a certification as specified.
 3. Pipes, fittings, valve bodies and other components of piping systems listed in Table A-3, Piping Color and Label Schedule.
 - a. In addition to all new piping, all existing interior piping to remain in buildings in which work is being performed shall be repainted and relabeled in accordance with the provisions listed herein.
 4. All miscellaneous steel fabrications, steel stairs and structural steel. This includes galvanized steel where a paint/coating finish is called for in schedules, on Drawings, or in the specifications. Stainless steel is not to be coated except where specifically noted or scheduled.
 5. Any equipment or fabrications where field preparation or painting is called for in the specification for that equipment or fabrication.
 6. Any surface or object indicated as painted/coated in the Drawings.
- B. Supply and installation of pipe labels per Table A-3, Piping Color and Label Schedule and Section 10426, Pipe Identification.
- C. Work not to be painted/coated under this section includes:
1. Any surfaces not listed, specified, noted or scheduled to receive paint/coating as listed in paragraph 1.01.A.
 2. Cast-in-place concrete surfaces scheduled, specified, or noted to receive other finishes specified in Section 03001, Concrete.
 3. Clay masonry or concrete masonry unless specifically scheduled or called out.

4. Factory finished interior or exterior equipment, furnishings or materials except as listed in paragraph 1.01.A.
5. Safety labels, equipment tags, UL, or other standards compliance certification labels, or other features required to be visible to meet codes or regulations, or to facilitate equipment operation.

1.02. RELATED SECTIONS

A. Section 05500 - MISCELLANEOUS FABRICATIONS

1.03. REFERENCES

ASTM B117	Standard Practice for Operating Salt Spray (Fog) Apparatus
ASTM D522	Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (Method A, Conical Mandrel)
ASTM D870	Standard Practice for Testing Water Resistance of Coatings Using Water Immersion
ASTM D1014	Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates
ASTM D1653	Moisture Vapor Transmission
ASTM D2794	Impact
ASTM D3363	Hardness
ASTM D4541	Adhesion (Type II Fixed Alignment Adhesion Tester)
ASTM D4541	Adhesion (Type V Self-Aligning Adhesion Tester)
ASTM D4585	Standard Practice for Testing Water Resistance of Coatings Using Controlled Condensation
ASTM D16	Standard Terminology for Paint-Related Coatings, Materials, and Applications
ASTM D4060	Abrasion Resistance (CS-17 Wheel, 1000 Grams Load)
ASTM D3359	Adhesion by Tape Test
ASTM G53	QUV Exposure (UVA-340 Bulbs, 4 Hours Light, 4 Hours Dark)
ASTM G85	Prohesion
NACE	NACE International (formerly "National Association of Corrosion Engineers") – certification program
NSF International	ANSI/NSF Standard 61
SSPC-Volumes 1 and II	Steel Structures Painting Council - Steel Structures Painting Manual
SSPC-SP1	Solvent Cleaning
SSPC-SP2	Hand Tool Cleaning
SSPC-SP3	Power Tool Cleaning

SSPC-SP5	White Metal Blast Cleaning
SSPC-SP6	Commercial Blast Cleaning
SSPC-SP7	Brush-Off Blast Cleaning
SSPC-SP10	Near-White Metal Blast Cleaning
SSPC-SP11	Power Tool Cleaning to Bare Metal
SSPC-SP13 / NACE No. 6	Surface Preparation of Concrete
SSPC-SP16	Brush-Off Blast Cleaning of Coated and Uncoated Galvanized Steel, Stainless Steels, and Non-Ferrous Metals
	N.S.F. (National Sanitation Foundation)

1.04. DEFINITIONS

- A. Conform to ASTM D16 for interpretation of terms used in this section.

1.05. SUBMITTALS

- A. Painting experience record and qualifications of proposed subcontractor/Contractor. The subcontractor/Contractor shall have a minimum of five years' experience and provide references for at least three projects of similar size and type that have been successfully completed.
- B. Submit a complete schedule of paint/coating systems and surface preparations.
1. List all interior and exterior surfaces and all major equipment to be painted.
 2. The schedule is to reflect the approved manufacturer's recommendations. Schedule shall include certification that a qualified manufacturer's representative has reviewed and approved the schedule. The qualified manufacturer's representative shall hold current NACE certification as a Coating Inspector, Protective Coatings Specialist, or Materials Selection/Design Specialist.
 3. As a minimum, schedule shall itemize each painted item or surface and shall contain the following information in tabular format:
 - a. Type of surface preparation (note whether shop or field preparation).
 - b. Paint or coating system (generic name).
 - c. Prime coat (product, number of coats, dry mil thickness per coat, square feet coverage per gallon).
 - d. Intermediate coat, if required (product, number of coats, dry mil thickness per coat, square feet coverage per gallon).
 - e. Finish coat (product, number of coats, color, dry mil thickness per coat, square feet coverage per gallon).

- f. Painting/coating status at time of installation.
 - g. Remarks (any special treatment or application requirements, etc.)
4. The schedule shall follow the sample format attached to the end of this section. It shall also contain the name of the paint/coating manufacturer and name, address, and telephone number of the manufacturer's representative who will inspect the work. The schedule shall be in conformance with the criteria of Table A-1 and the schedules contained in the architectural drawings. Manufacturer's recommended dry mil thickness shall be incorporated into the schedule. Schedule shall be submitted to the Engineer as soon as possible following the award of Contract so that the approved schedule may be used to identify colors and to specify shop paint/coating systems for fabricated equipment.
5. Contractor shall provide a tabulation of equipment manufacturer's preparation and coating system with remarks specifying which equipment coatings meet the requirements specified herein and which equipment requires field painting.
6. Where applicable, submit a certification from the equipment manufacturer if they propose to utilize their standard coating system. Certification shall provide the following:
- a. Tabular comparison of the specified coating system and the manufacturer's proposed coating system, including, at a minimum; coating manufacturer, coating material, number of coats, thickness by coat, and as specified in the painting schedule.
 - b. Statement that manufacturer has reviewed the Contract Documents and is providing a coating system for the environmental exposure and service of their equipment.
 - c. Statement that coating system meets or exceeds requirements as specified in this specification section.
 - d. Statement that application of manufacturer's coating system does not affect the manufacturer's equipment warranty.
 - e. Statement that if manufacturer's coating system is determined to be defective or fails, manufacturer will investigate and provide the required materials, labor, and shipping to repair or recoat the equipment at no additional cost to the Owner.
- C. Submit color chips for selection. Color names and/or numbers shall be identified according to the appropriate color chart published by the manufacturer.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Provide paint, stain, varnish, coating, and other products identified in this Section by the manufacturers shown in Table A-1. The naming of a manufacturer for one paint/coating system in Table A-1 (example: M-3) is not to be construed as approval of that manufacturer for other systems. Listed manufacturers include:
- 1. Sherwin-Williams

2. PPG
 3. Tnemec
 4. Minwax
 5. Pratt & Lambert
 6. General Finishes
 7. Behr
- B. Equivalent materials of other manufacturers may be substituted only by approval of Engineer. Requests for substitution shall include manufacturer's literature for each product giving the name, generic type, descriptive information, solids by volume, and coverage rate or recommended dry film thicknesses.
1. Requests for substitution shall also include a list of five projects where each product has been used and rendered satisfactory service; which list shall include the following information:
 - a. Name and location of the project.
 - b. A contact (name and telephone number) at the project who is in a position to be aware of the performance of the proposed coatings; typically the maintenance director or superintendent of buildings and grounds.
 - c. Information about which coatings were used on which surfaces at the referenced project.
 2. No request for substitution shall be considered that does not provide equal or better performance than the specified products. Provide manufacturer's certified test reports of characteristics relevant to the proposed product installation, showing that substitute product(s) equal or exceed performance of specified products as tested according to the standards listed below, or tests of equal relevance and severity:
 - a. ASTM D5894 – Corrosion Weathering (cycle testing).
 - b. ASTM D522 - Standard Test Methods for Mandrel Bend Test of Attached Organic Coatings (Method A, Conical Mandrel).
 - c. ASTM D870 - Standard Practice for Testing Water Resistance of Coatings Using Water Immersion.
 - d. ASTM D1014 - Standard Practice for Conducting Exterior Exposure Tests of Paints and Coatings on Metal Substrates.
 - e. ASTM D4060 - Abrasion Resistance: CS17 wheel, 1000 cycles, 1 kg load.
 - f. ASTM D4541 - Abrasion Resistance.

- g. ASTM D5894 – Adhesion.
 - h. ASTM D4585 – Humidity Resistance.
- C. Products for each specified function and system shall be of a single manufacturer.
 - D. Where thinning is necessary, only the products of the particular manufacturer furnishing the paint/coating shall be used, and all such thinning shall be done in strict accordance with the manufacturer's instructions.

2.02. MATERIAL

- A. For all coatings, refer to Table A-1, Coating System Schedule.
- B. All materials which will be in contact with potable water shall be approved by the National Sanitation Foundation and appropriate state and local health departments. Contractor shall submit evidence of approval for all applicable materials.
- C. All materials used on this project, whether shop applied by equipment manufacturer or field applied by Contractor, shall comply with all current federal, state and local Clean Air Act- related regulations. It shall be the responsibility of equipment manufacturers to comply with laws in effect at their painting/coating facilities. Where laws or regulations prohibit field applications of any scheduled paint /coating product, Contractor shall submit for Engineer's approval, an alternate product of similar performance characteristics which complies with those laws. If approved, those products shall be provided at no additional cost to the Owner.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Ensure that substrate conditions are ready to receive work as instructed by the product manufacturer and in accordance with the approved schedule of paint/coating systems and surface preparations.
- B. Examine surfaces scheduled to be finished prior to commencement of work. Correct any condition that may potentially affect proper application.

3.02. SURFACE PREPARATION

- A. Prepare surfaces in accordance with the direction and referenced standards shown in Table A-1.
- B. If, for any reason, Contractor deems the surface preparation shown in Table A-1 to be inappropriate for a specific surface or location; Contractor to submit a proposed alternative preparation, in the form of a signed recommendation by the manufacturer's NACE-certified representative for Engineer's approval.

3.03. APPLICATION

- A. Contractor shall be responsible for cleanliness of all painting/coating operations and use covers and masking tape to protect work. Contractor shall protect not only his own work, but also all adjacent work and materials by adequate covering with drop cloths.

- B. Contractor shall maintain a daily epoxy coatings induction record (log) showing each epoxy coating mixing event in the format demonstrated at the end of this section. A signed copy of this log shall be turned over to the Engineer's field representative before the end of each working day during which epoxy coatings are mixed or applied.
- C. Any unwanted coating shall be carefully removed without damage to finished coating or surface. If damage does occur, the entire surface adjacent to and including damaged area shall be recoated without visible lap marks.
- D. Do not use plumbing fixtures or waste piping for mixing of paint/coatings or disposal of any refuse material. All waste shall be disposed of properly into a suitable receptacle located outside of building.
- E. All coatings shall be applied without runs, sags, thin spots, or unacceptable marks. Coatings shall be applied at the rate specified to achieve minimum dry mil thickness required.

Additional layers of coating shall be applied, if necessary, to obtain dry film thickness specified.
- F. Application shall be by spraying where recommended by manufacturer. If material has thickened or must be diluted for application by spray gun, each coat shall be built up to the same film thickness achieved with undiluted brushed-on material. Where thinning is necessary, such thinning shall be done in strict accordance with manufacturer's instructions.
- G. A minimum of 24 hours drying time shall elapse between application of any two layers of coating on a particular surface, unless otherwise recommended by coating manufacturer. Longer drying times may be required for abnormal conditions in concert with manufacturer's recommendations.
- H. No coating whatsoever shall be accomplished in rainy or excessively damp weather when the relative humidity exceeds 85 percent, or when the general air temperature cannot be maintained at 50 degrees F (10 degrees C) or above throughout entire drying period.
- I. Apply color coding to all new piping, in accordance with Piping Color and Label Schedule in Section 10426, Pipe Identification, and/or Engineer's instructions. Piping shall be painted solid colors unless otherwise specified. Coordinate with requirements of Section 10426, Pipe Identification.

3.04. FINISHING SHOP PRIMED EQUIPMENT

- A. All fabricated steel work and equipment scheduled to be delivered to job site shop primed, and scheduled for field finish painting/coating, shall receive at factory at least one shop layer of approved prime paint/coating compatible to be applied in concert with paint system required by these Specifications. Surface preparation prior to shop painting shall be as scheduled in Table A-1. All shop primed items shall be properly packaged and stored until they are incorporated in work. Any primed surfaces that are damaged during handling, transportation, storage, or installation shall be cleaned, scraped, and patched before field painting/coating begins so that work shall be equal to original painting/coating at shop. Equipment or steel work that is to be assembled on the site shall likewise receive a minimum of one shop layer of paint/coating at factory. Paint and surface preparation used for shop coating shall be identified on equipment shop drawings submitted to Engineer.
- B. Where exact identity of shop primer cannot be determined, or where primer differs from that specified, Contractor shall perform blast cleaning appropriate for service, followed by specified paint/coating system. In lieu of above, Contractor has the option of shipping bare metal to job site and performing

appropriate blast cleaning, followed by field prime of specified material immediately thereafter.

3.05. FIELD QUALITY CONTROL

- A. Prior to receiving a Certificate of Substantial Completion, Contractor shall arrange for manufacturer to inspect the application of his product and shall submit his report to Engineer identifying products used and verifying that said products were properly applied and that paint/coating systems were proper for the exposure and service. The manufacturer's representative shall also certify that all coats in each system are compatible with one another.
- B. The Contractor shall follow a system of tinting successive paint/coating layers so that not two coats for a given surface are exactly the same color. Areas to receive black protective coatings shall be tick-marked with white or actually gaged as to thickness when finished.

3.06. LEAD PAINT

- A. The Contractor is notified that lead paint has been found in painting systems at the subject work site. See the reports referenced in the Supplementary Conditions (SC-4.06).

3.07. SHOP PAINTING

- A. Shop painting/coating of manufactured items (such as lockers, furnishings, and electrical and mechanical equipment) is not included in the scope of this work, unless specifically scheduled; as in the case of fabricated steel items (steel stairs, structural and miscellaneous steel), steel doors and frames). Manufactured items shall be finished as noted in the specification section related to that item.

(continued)

TABLE A-1
COATING SYSTEM SCHEDULE

Non-Submerged Concrete Walls and Ceilings – Interior

SYSTEM C-1	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to ASTM D4258			Allow concrete to cure 28 days prior to beginning coating operations
Prime coat	--	--	--	--
Intermediate coat	Macropoxy 646 3.5-5.0 mils/coat	Amerlock 2/400	Series 66HS 2.0-5.0 mils/coat	--
Finish coat	Macropoxy 646 3.5-5.0 mils/coat	Amerlock 2/400	Series 66HS 2.0-5.0 mils/coat	Total DFT – 8. mils, minimum

Concrete in Contact with Sewage (paint/coat only when scheduled in Table A-2 or on the architectural drawings)

SYSTEM C-2	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP 13 Surface preparation of concrete			Allow concrete to cure 28 days prior to beginning coating operations
Prime coat	Macropoxy 646 3.5-5.0 mils/coat	Amerlock 2/400	Series 218 at 1/16" - 1/4"	--
Intermediate coat	--	--	--	--
Finish coat	TARGUARD Coal Tar Epoxy	Amercoat 78HB	Series G435 at 60-80 mils	Top of wall to 3 feet below water line. Total DFT-80 mils minimum

Concrete Block, Open Porous or Rough Masonry - Interior

SYSTEM C-3	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to ASTM D4261			Allow mortar joints to cure 28 days prior to beginning coating operations
Prime coat	Cement-Plex 875 Acrylic Block Filler	Amerlock 400 BF	130-6602 Enviro-Fill 100-120 sf/gal	Fill all voids.
Intermediate coat	Macropoxy 646 3.0-5.0 mils	Amerlock 2/400	Series 66HS 4.0-5.0 mils/coat	--
Finish coat	Macropoxy 646 3.0-5.0 mils	Amerlock 2/400	Series 66HS 4.0-5.0 mils/coat	Total DFT – 16 mils minimum

Concrete - Exterior (paint/coat only when scheduled in Table A-2 or on the architectural drawings)

SYSTEM C-4	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to ASTM D4258			Allow concrete to cure 28 days prior to beginning coating operations
Prime coat	ConFlex XL Textured High Build Coating A05W00800	Perma-Crete Matte Flex 4-310 Series	Series 157-Color Enviro-crete 111-148 sf/gal	--
Intermediate coat	--	--	--	--
Finish coat	ConFlex XL Textured High Build Coating A05W00800	Perma-Crete Matte -Flex 4-310 Series	Series 157-Color Enviro-crete 111-148 sf/gal	Total DFT – 12 mils minimum

Concrete in Contact with Raw or Potable Water (paint/coat only when scheduled in Table A-2 or on the architectural drawings)

SYSTEM C-5	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP 13 Surface preparation of concrete			Allow concrete to cure 28 days prior to beginning coating operations
Prime coat	Macropoxy 646 PW Epoxy B58Wx610 – Mill White B58Wx600 – Light Blue B58VX600 – Hardener B58VX605 (3-coats, total DFT – 14 mils minimum)	Amerlock 2	Series 218 at 1/16” – 1/4”	Fill all voids.
Intermediate coat		Amerlock 2	--	--
Finish coat		Amerlock 2	Series 22/FC22 at 20-30 mils DFT	Total DFT – 30 mils minimum

Non-Submerged Masonry Walls – Glazed Wall Finish - Interior

SYSTEM C-6	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to ASTM D4261			Allow concrete to cure 28 days prior to beginning coating operations
Prime coat	Macropoxy 646 Fast Cure Epoxy	Amerlock 2/400	Series 27WB at 3.0-5.0 mils DFT	--
Intermediate coat	--	--	--	--
Finish coat	Macropoxy 646 Fast Cure Epoxy	Amerlock 2/400	Series 27WB at 3.0-5.0 mils DFT	Total DFT – 16 mils minimum

Non-Submerged Ferrous Metal

SYSTEM M-1	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime coat	Pro Industrial ProCryl	Pitt Tech Plus 1300 Series	Series 1 2.0-3.5 mils	Shop
Intermediate coat	Sher-Cryl HPA- High Performance Acrylic B66W00350	Pitt Tech Plus 1300 Series	Series 1029-Color Enduratone, 2.0-3.0 mils	--
Finish coat	Macropoxy 646 Fast Cure Epoxy B58W00610	Pitt Tech Plus 1300 Series	Series 1029-Color Enduratone, 2.0-3.0 mils	Total DFT – 7.5 mils minimum

General Ferrous Metal - Interior

SYSTEM M-2	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime coat	Macropoxy 646	Amerlock 2/400	Series 1 2.5-3.0 mils	Shop
Intermediate coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	--
Finish coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	Total DFT – 12 mils minimum

Submerged Ferrous Metal

SYSTEM M-3	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			--
Prime coat	Macropoxy 646	Amerlock 2/400	Series 1 2.5-3.0 mils	Shop
Intermediate coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	--
Finish coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	Total DFT – 12 mils Minimum

General Ferrous Metal - Exterior

SYSTEM M-4	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime coat	Macropoxy 646	Amerlock 2/400	Series 1 2.5-3.0 mils	Shop
Intermediate coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	--
Finish coat	Hi-Solids Polyurethane 250 Polyurethane Semi-Gloss	Amercoat 450H	Series 1095-Color Endura-Shield 3.0-5.0 mils	Total DFT – 10.5 mils minimum

Ferrous Metal – Below Grade

SYSTEM M-5	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			--
Prime coat	--	--	--	--
Intermediate coat	--	--	--	--
Finish coat	TARGUARD Coal Tar Epoxy	Amercoat 78HB	46H-413 Hi-Build Tneme-Tar 16.0-20.0 mils	Total DFT – 16.0 mils minimum

Ferrous Metal Moving Parts Submerged in Sewage

SYSTEM M-6	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			Shop
Prime coat	Macropoxy 646	Amercoat 240	Series 66HS 3.0-5.0 mils	--
Intermediate coat	--	--	--	--
Finish coat	--	--	--	Total DFT – 4 mils, minimum

Ferrous Metal Submerged in Raw or Potable Water

SYSTEM M-7	SHERWIN-WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP10/NACE 2 Near White Metal Blast Cleaning			--
Prime coat	Macropoxy 646 PW Epoxy B58LX610 – Mill White B58VX600 – Light Blue B58VX600 – Hardener B58VX605- OAP Hardener	Amerlock 2	Series 1 2.5-3.0 mils	--
Intermediate coat	Macropoxy 646 PW as above	Amerlock 2	--	--
Finish coat	Macropoxy 646 PW as above	Amerlock 2	Series 22/FC22 at 30-40 mils DFT	Total DFT – 32.5 mils, minimum

Uncertain Base Coat

SYSTEM M-8	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	Wash with Great Lakes No-Rinse Pre-Paint Cleaner and water, rinse thoroughly with clean water and allow to dry.			
Prime coat	Macropoxy 5000	Amercoat 68MCZ	Series 1 2.5-3.5 mils	
Intermediate coat	--	--	--	Follow with appropriate system for exposure (minus the normal specified primer).
Finish coat	--	--	--	--

Aluminum Surfaces in Contact with Concrete

SYSTEM M-9	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	--
Intermediate coat	--	--	--	--
Finish coat	--	--	--	Total DFT – 5.0 mils minimum

Interior Insulated Piping

SYSTEM M-10	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	Clean and dry			--
Prime coat	DTM Acrylic Primer/Finish B66W00001	Pitt Tech Plus 1300 Series	1026-Color Tneme-Cryl 2.0-3.0 mils	--.
Intermediate coat	--	--	--	--
Finish coat	DTM Acrylic Primer/Finish B66W00001	Pitt Tech Plus 1300 Series	1026-Color Tneme-Cryl 2.0-3.0 mils	Total DFT – 5.0 mils minimum

Non-Submerged Ferrous Metal – Extra Corrosion Protection - Exterior

SYSTEM M-11	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP6/NACE 3 Commercial Blast Cleaning			Shop
Prime coat	Corothane 1 Gal-Va-Pac Zinc Primer B65G00010	Amercoat 68MCZ	Series 1 2.5-3.0 mils	Shop
Intermediate coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	--
Finish coat	Hi-Solids Polyurethane 250 Polyurethane Semi- Gloss	Amercoat 450H	Series 1095 Endurashield 2.5-3.0 mils	Total DFT – 9.5 mils minimum

Nonferrous Metal - Interior

SYSTEM M-12	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime coat	Macropoxy 646	Amerlock 2/400	Series 66HS 2.0-3.0 mils	--
Intermediate coat	--	--	--	--
Finish coat	Macropoxy 646	Amerlock 2/400	Series 66HS 2.0-3.0 mils	Total DFT – 6.0 mils minimum

Nonferrous Metal - Exterior

SYSTEM M-13	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime coat	Macropoxy 646	Amerlock 2/400	Series 66HS 2.0-3.0 mils	--
Intermediate coat	--	--	--	--
Finish coat	Hi-Solids Polyurethane 250 Polyurethane	Amercoat 450H	Series 1095 Endurashield 2.5-3.0 mils	Total DFT – 6.0 mils minimum

Galvanized Steel - Exterior

SYSTEM M-14	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime coat	Corothane 1 Gal-Va-Pac Zinc Primer	Amercoat 68MCZ	Series 66HS 3.0 mils	--
Intermediate coat	Macropoxy 646	Amerlock 2/400	Series 1095 3.0-4.0 mils	Total DFT – 6.0 mils minimum

Galvanized Steel - Interior

SYSTEM M-15	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance to SSPC-SP16 Brush-off Blast cleaning of coated and uncoated galvanized steel, stainless steel and non-ferrous metals.			--
Prime coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	--
Intermediate coat	--	--	--	--
Finish coat	Macropoxy 646	Amerlock 2/400	Series 66HS 3.0-5.0 mils	Total DFT – 8.0 mils minimum

East River Street Pump Station Steel Wet Well

SYSTEM M-16	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	In accordance with SSPC-SP10 Near White Metal Standard, pressure wash and abrasive blast clean. Surface clean and dry.			--
Prime coat	--	--	Series G435 30.0-40.0 mils	--
Intermediate coat	--	--	--	--
Finish coat	--	--	Series G435 30.0-40.0 mils	Total DFT – 60.0 mils minimum

Gypsum Board or Plaster Walls, Ceilings and Soffits – Interior

SYSTEM G-1	SHERWIN WILLIAMS	PPG	BEHR	REMARKS
Surface preparation	Clean and dry			--
Prime coat	ProMar 200 Zero VOC 100% Acrylic Primer	Pure Performance 9-900 Interior Latex Primer	Premium Plus Interior Semi- Gloss Enamel	--
Intermediate coat	DTM Acrylic Coating – Semi- Gloss	SPEEDHIDE 6-8510 Series 100% Acrylic – Semi-Gloss	Premium Plus Interior Semi- Gloss Enamel	--
Finish coat	DTM Acrylic Coating – Semi- Gloss	SPEEDHIDE 6-8510 Series 100% Acrylic – Semi-Gloss	Premium Plus Interior Semi- Gloss Enamel	Total DFT – 6.0 mils minimum

Gypsum Board Walls, Ceilings, and Soffits. High Performance - Interior

SYSTEM G-2	SHERWIN WILLIAMS	PPG	TNEMEC	REMARKS
Surface preparation	Clean and Dry			--
Prime coat	Macropoxy 646	Amerlock 2/400	Series 1029 2.0-3.0 mils	--
Intermediate coat	--	--	--	--
Finish coat	Macropoxy 646	Amerlock 2/400	Series 1029 2.0-3.0 mils	Total DFT – 5.0 mils minimum

Natural Wood - Interior

SYSTEM W-1	GENERAL FINISHES	PPG	MINWAX	REMARKS
Surface preparation	Clean and Dry			--
Prime coat	Enduro Ready to Match (RTM) Water Based Stain	Deft Wood Stain Interior – Oil-Modified, Water Based DFT300 Series	Water Based Pre-Stain Wood Conditioner followed by Water Based Wood Stain	--
Intermediate coat	Enduro-Var Water Based Urethane - Satin	Deft Clear Wood Finish Interior Water Based Acrylic – Satin DFT109	Polycrylic Protective Finish - Satin	--
Finish coat	Enduro-Var Water Based Urethane - Satin	Deft Clear Wood Finish Interior Water Based Acrylic – Satin DFT109	Polycrylic Protective Finish - Satin	--

Wood – Acrylic/Alkyd Stain – Exterior Semi-Transparent

SYSTEM W2	SHERWIN WILLIAMS	PPG	PRATT & LAMBERT	REMARKS
Surface preparation	Clean and Dry			--
Prime coat	WoodScapes Exterior Polyurethane Semi-Transparent Stain A15T	Sun Proof Acrylic/Oil Semi-Transparent Stain 77-1460	StainShield Semi-Transparent Waterborne Deck & Siding Stain Z1497	--
Intermediate coat	--	--	--	--
Finish coat	WoodScapes Exterior Polyurethane Semi-Transparent Stain A15T	Sun Proof Acrylic/Oil Semi-Transparent Stain 77-1460	StainShield Semi-Transparent Waterborne Deck & Siding Stain Z1497	--

Wood – Acrylic Stain – Exterior Solid Color

SYSTEM W3	SHERWIN WILLIAMS	PPG	PRATT & LAMBERT	REMARKS
Surface preparation	Clean and Dry			--
Prime coat	WoodScapes Exterior Acrylic Solid Color Stain A15 Series	Sun Proof 100% Acrylic Latex Solid Color Stain 77-1110	Stainshield Solid Hide Latex Siding Stain Z1490	--
Intermediate coat	--	--	--	--
Finish coat	WoodScapes Exterior Acrylic Solid Color Stain A15 Series	Sun Proof 100% Acrylic Latex Solid Color Stain 77-1110	Stainshield Solid Hide Latex Siding Stain Z1490	--

Wood – Painted – Exterior

SYSTEM W4	SHERWIN WILLIAMS	PPG	PRATT & LAMBERT	REMARKS
Surface preparation	Clean and Dry			--
Prime coat	Exterior Oil-based Wood Primer Y24W8020	Seal Grip 17-921 Series	Multi-Purpose Waterborne Primer P1003	--
Intermediate coat	A-100 Exterior Latex Satin A82-100 Series	Weather King Exterior 100% Acrylic, Lo-Luster, DRW66891XI Series	Accolade Exterior Waterborne – Eggshell RZ4200	--
Finish coat	A-100 Exterior Latex Satin A82-100 Series	Weather King Exterior 100% Acrylic, Lo-Luster, DRW66891XI Series	Accolade Exterior Waterborne – Eggshell RZ4200	--

TABLE A-2
EQUIPMENT FINISH SCHEDULE

Building or Area	Equipment	Paint/Coating System	Color
East River Street Pump Station	Raw sewage pumps	M-3	Black
General equipment	Aluminum in contact with concrete	M-9	Black
	Wall sleeves (interior portion only)	M-5	Black
	Non submerged slide gate operators and non-aluminum parts (unless otherwise specified)	M-4	Light Brown
	Duplex strainers, backflow preventers, water meters	M-2	Match pipe color
	Hydrants – fire	M-4	As selected by Owner
	Submerged ductile iron and steel pipe, supports, valves	M-3	Black
	Non-submerged interior ductile iron and steel pipe, supports, valves	M-2	Per pipe schedule
	Miscellaneous interior non-submerged ferrous metal	M-2	As selected by Owner
	Pipe bollards	M-4	Yellow
	Flow elements	M-2	Light Brown
	Floor drains	M-3	Black
	Lintels	M-13	Match masonry color
	Chemical feed system, feed pumps and supports (unless otherwise listed)	M-2	Light Gray
	Interior motors, drives, pump operators – non-submerged	M-2	Light Gray
	Interior ferrous metal – submerged or exposed to sewage	M-3	Black
	Interior ferrous metal – non-submerged	M-2	Light Gray
Monorails, hoists and portable davit cranes (non-galvanized only)	M-2	Safety Yellow	
General	Exterior motors	M-4	
	Interior pipe supports (per Section 15140)	As applicable	Match abutting surface
	Exterior pipe supports (per Section 15140)	As applicable	Match abutting surface
	Valves and operators (per Section 15060)	As applicable	Match pipe
Miscellaneous fabrications	All applicable items in Section 05500	As applicable	

NOTE: Table A-1 and the Equipment Finish Schedule (Table A-2) are not intended to list every structure or equipment item to be painted.

TABLE A-3

PIPING COLOR AND LABEL SCHEDULE

Legend	Pipe Color ⁽¹⁾
Raw Influent (DIP only)	Gray

Notes:

1. Pipe color and labels shall be in accordance with the NYS Fuel Gas Code.
2. Paint/coat all metal electrical conduits to match background. Do not paint/coat PVC or PVC-coated conduit.
3. Do not paint/coat aboveground stainless steel, copper, FRP, or PVC pipe. Provide pipe labels only.
4. This table may not list every pipe to be painted/coated or labeled. All ferrous piping and conduit shall be painted/coated.
5. All piping shall be painted except as noted above.
6. Where applicable pipe color and label color shall match existing conditions. If there is a discrepancy between the existing pipe colors and scheduled colors, coordinate color with Owner and Engineer

PAINT SCHEDULE

Reviewed by Paint Mfg. Rep. _____

Interior or Exterior Surfaces to be Painted and Major Equipment	Surface Preparation		Paint System	Product, Number of Coats, Dry Film Thickness, Coverage, Color, Shop Painting/Field Painting ⁽¹⁾			Painting Status	Remarks (Any Special Treatment or Application Requirements)
	Shop	Field		Prime Coat	Intermediate Coat	Finish Coat		

⁽¹⁾Indicate whether the coating is provided by the Contractor (field painting) or equipment manufacturer (shop painting), where applicable.

DAILY EPOXY COATINGS INDUCTION RECORD

Date	Product	Location	Ambient Temperature (°F)	Mix Start Time	Induction End Time	Total Induction Time Before Use

END OF SECTION

SECTION 11303
SUBMERSIBLE PUMPS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Furnish, install, and test submersible pumps complete with motors, pump discharge flanges, guide rails, brackets, accessories, spare parts, manufacturer's services, and all other required appurtenances in accordance with the Contract Documents.

1.02. RELATED SECTIONS

- A. Division 1 Specifications
- B. Section 09900 – PAINTING
- C. Section 15170 – MOTORS
- D. Section 17100 – PROGRAMMABLE LOGIC CONTROLLERS
- E. Section 17101 – PLC PROGRAMMING
- F. All electrical equipment and wiring shall be in full compliance with Division 16, Electrical Specifications.
- G. All controls shall be in full compliance with Division 17, Instrumentation and Controls Specifications.

1.03. REFERENCES

- A. American National Standards Institute (ANSI).
- B. Hydraulic Institute Standards, latest edition.

1.04. PERFORMANCE REQUIREMENTS

- A. Submersible pumps shall be capable of pumping liquid with 0 to 3 percent solids without clogging.
- B. All equipment and appurtenances installed in the wet well shall be rated for use in NEC Class I, Division 1, Groups C and D hazardous locations.
- C. Submersible pumps shall be capable of continuous stable operation under the following conditions:

Pump Parameters	
Quantity	2
Drive type	Submersible
Pumped liquid	Raw wastewater
Primary design point (each unit) Rated flow Total dynamic head	200 gpm 40 feet
Minimum efficiency at design point	35 percent
Maximum pump speed	1,800 RPM
Minimum sphere passing size	3.0 inches

1.05. SUBMITTALS

- A. Provide in accordance with Sections 01300, Submittals, and 01640, Equipment-General, and as supplemented herein. Submittals shall include, but not be limited to, the following:
 - 1. Shop Drawings
 - a. Operating characteristics and nameplate data.
 - b. Manufacturer’s catalog information, descriptive literature, specifications, etc. for pumps, motors, and accessories.
 - c. Manufacturer’s certified installation drawings containing all critical dimensions, piping connection sizes, weights, etc. required for installation of the equipment.
 - d. Certified pump curves.
 - e. Electrical schematics.
 - f. List of recommended spare parts other than those specified.
 - g. Motor information as required by Section 15170, Motors.
 - h. Shop and field painting information. If no field painting is proposed, submit a certification from the manufacturer in accordance with Section 09900, Painting.
 - i. Shop and field testing procedures, pump and piping set-up, equipment to be used and ANSI/HL testing tolerances to be followed.
 - j. Warranty.
 - 2. Performance affidavit.
 - 3. Shop test results.
 - 4. Manufacturer’s installation certificate.

5. Preliminary Field Test Reports.
 6. Functional Test Reports.
 7. Training Plans.
 8. Recordings of training sessions (to be completed by and coordinated with the Contractor).
 9. Written training reports.
- B. Provide operation and maintenance manuals and data where scheduled in Section 01640, Equipment-General.
- 1.06. SPARE PARTS
- A. Furnish the following spare parts for each pump in accordance with the Section 01640, Equipment-General, in clearly identified dust-proof containers:
1. One set of bearings.
 2. One set of all seals.
 3. One impeller bolt.
 4. One seal fail relay and relay socket.
- 1.07. EQUIPMENT WARRANTIES AND SPECIAL GUARANTEES
- A. The supplier shall provide the following warranties and special guarantees in accordance with Section 01640, Equipment-General.
1. The equipment manufacturer shall guarantee for a period of three years starting at the time of equipment delivery to the job site or one year starting at the time of Substantial Completion (whichever is shorter), that the equipment supplied is free from defects in materials or workmanship and will meet the specified performance requirements when operated in accordance with the manufacturer's recommendations. The manufacturer shall correct any breach in this warranty at their expense.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Barnes Pumps, Model 4SHVB
- B. Or equal.

2.02. OR EQUAL AND SUBSTITUTIONS

- A. In the case of an "or-equal" or a substitution, demonstrate in writing, to the satisfaction of Owner that the manufacturer has produced the specified type and size of equipment for sanitary wastewater

service that has been in successful operation for a minimum period of five years prior to the Bid date.

- B. Submit information for an "or-equal" or substitution as outlined in the General Conditions and Supplementary Conditions.

2.03. EQUIPMENT DESIGN

A. General

1. Pumps shall be wet pit mounted, submersible, non-clogging, centrifugal type with vertical mounted, direct-connected motors and bottom inlet.
2. All major components of the pumping unit (including impeller, volute casing and stator housing) shall be manufactured from ASTM A48 Class 30 or 40 gray cast iron with smooth surfaces devoid of blow holes or other irregularities.
3. All exposed nuts and bolts shall be AISI Type 316 stainless steel.
4. All metal surfaces coming into contact with the pumped liquid, except for stainless steel and brass materials, shall be protected by a factory applied spray coating of acrylic dispersion zinc phosphate primer with a polyester resin paint finish.
5. Sealing design shall incorporate metal-to-metal contact between machined surfaces. Critical mating surfaces where watertight sealing is required shall be machined and fitted with Nitrile or Viton rubber O-rings. Fittings will be the result of controlled compression of rubber O-rings in two planes and O ring contact on four sides without a specific torque limit requirement.

B. Pump Volute Casing

1. Casing shall be constructed of close-grained cast iron and shall be designed to withstand hydrostatic heads equal to 1.5 times the maximum shutoff head without leakage or undue distortion or deflection.
2. The discharge connection shall match the discharge hose or base elbow for the pump assembly.

C. Impeller

1. Impeller shall be grey cast iron, non-clog, semi-open design. The impeller vanes shall have vortex, radial flow open channel, or screw-type design. Impellers shall be dynamically balanced and capable of handling solids, scum, fibrous materials, heavy sludge, and other matter normally found in wastewater.

D. Pump Shaft

1. The shaft shall be constructed of stainless steel, AISI Type 416 with tapered impeller fit..
2. The pump shaft shall be an extension of the motor shaft. Shafts using mechanical couplings will not be acceptable.
3. All gaskets shall be of the angular gland compression o-ring type.

E. Mechanical Seals

1. Pumps shall be provided with two pressure-compensating or spring activated mechanical seals. Seals shall be composed of tungsten carbide, silicon carbide or carbon.
2. The lower compression spring shall be protected against exposure to the pumped liquid.
3. Each pump shall be provided with a lubricant chamber for the shaft sealing system. The drain and inspection plug, with anti-leak seals, shall be easily accessible from the outside.
4. Seal lubricant shall be FDA approved and non-toxic.

F. Bearings

1. Each pump shall have two radial bearings independent of the casings. The upper bearing shall be single ball-type bearing, and the lower bearing shall be angular-type contact bearing.
2. Bearings shall be sized to carry the loads imposed under continuous service without undue heating.
3. Motor bearings shall be sealed and permanently grease lubricated.
4. Minimum B-10 life for bearings shall be 50,000 hours at maximum operating conditions.

2.04. ACCESSORIES

A. Power Cable

1. Power cable, moisture detection sensor cable, and motor thermal overload sensor cable shall be attached together and protected by a common heavy-duty flexible protective hose. If separate instrumentation cables are required, they shall be shielded. The protective hose shall safeguard the power cable from abrasion and/or piercing objects in the liquid.
2. Each pump shall be provided with a sufficient length of cable with the number and size of conductors required for the motor power leads and thermal switches to reach the junction box or manufacturer's control panel as shown on the Contract Drawings. Contractor shall field verify the required cable length prior to shop drawing submittal.
3. Cable entry shall be watertight, with strain relief at the junction chamber. Strain relief and water sealing shall function separately.

B. Moisture Detection

1. Each pump shall be supplied with a leakage sensor for the detection of water in the oil casing or bottom of motor housing. Detection shall generate an alarm but shall not result in an immediate shut down of the pump.
2. Pump manufacturer shall provide a sensor interface relay and compatible relay socket for each device.

C. Discharge Assembly

1. Pump manufacturer shall provide a discharge assembly. Discharge assemblies shall consist of a discharge connection claw and a discharge connection elbow.
2. For pumps with a fixed base elbow discharge assembly, the pump shall be provided with a flat-faced discharge flange which shall connect to a permanently mounted discharge elbow by a simple downward motion, without rotation, guided by guide rails.
 - a. The pump and discharge assembly shall be constructed so that when the pump is lowered to the discharge base/elbow, the knifing action of the vertical metal-to-metal seal provides a self-cleaning, non-sparking, explosion-proof assembly. An elastomeric profile gasket is also acceptable to prevent leakage.
 - b. The discharge base/elbow shall be secured to the bottom of the wet well and support the guide rails for the pump. The base shall be sufficiently rigid to firmly support the guide rails, discharge piping, and pumping unit under all operating conditions. The diameter and drilling of the elbow outlet flange shall conform to ANSI B16.1, Class 125. The discharge base shall be coated with an epoxy coating to prevent corrosion.

D. Pump Mounting

1. Pump mounting accessories shall be made of Type 316 stainless steel and shall include a safety hook assembly.
2. Pumps shall be easily removable from the space in which they operate without requiring personnel to remove bolts, nuts or other fastenings. Pumps shall be able to be lifted from the space without personnel entering or dewatering the space.
3. Pump manufacturer shall provide stainless steel lifting chain of adequate length that can be securely attached to guardrail when pumps are not hooked to davit cranes.
4. Manufacturer shall provide guide rails and guide rail supports to guide the pump when being raised or lowered into the tank.
 - a. The guide rails shall be Type 304 or 316 stainless steel.
 - b. The guide rails shall mount on the discharge base/elbow for the pump and shall align the pump with the discharge elbow as it is lowered into place.
 - c. A Type 316 stainless steel upper rail guide bracket shall be furnished to support and align the guide rails at the top of the sump. For rail lengths greater than 20 feet, a stainless steel intermediate rail guide bracket shall be included at the recommendation of the pump manufacturer.

E. Nameplate

1. Furnish nameplates for each pump.
2. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or

drive pins.

3. Nameplates shall identify the manufacturer, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings including primary pump rating point in gallons per minute and total dynamic head, speed, efficiency at primary rating point, pump size, model number, and serial number.

2.05. MOTORS AND DRIVES

- A. Provide in accordance with Section 15170, Motors, unless otherwise specified herein.
- B. Motors and drives shall be furnished by the equipment supplier and shall be designed specifically for use with the equipment provided.
- C. Motors shall be oil filled and be capable of proper operation at the design conditions with an operating level of at least 12-inches of wastewater in the wet well. Provide a cooling jacket if necessary, to meet the design requirements and provide adequate cooling.
- D. Motors shall be provided with motor winding thermal protection.
- E. Motors shall be provided with motor overload protection.

2.06. CONTROLS

1. Principal items of equipment comprised in the control panels shall meet or exceed the requirements outlined in Specification Section 16095.
2. Panel Heater - The control panel shall be equipped with a 120V panel heater to minimize the effects of humidity and condensation. The heater shall include a thermostat.
3. The control panel enclosure, at minimum, shall include all electrical and control devices necessary to provide a complete and functional system.
4. At a minimum, the following items shall be monitored in the OIT for each pump station control panel:
 - a. Individual pump HAND-OFF-AUTO selector switch.
 - b. Individual pump RUNNING indication.
 - c. Individual pump FAULT indication.
 - d. Individual pump OVER TEMPERATURE indication (motor winding thermal protection).
 - e. Individual pump MOTOR OVERLOAD indication.
 - f. Individual SEAL LEAK indication.
 - g. FAULT RESET pushbutton.
 - h. Individual pump elapsed run time.

- i. Wet well level indication.
 - j. HIGH LEVEL indication
 - k. PHASE FAULT indication
5. Wet Well Level Indicator - Indicator to be installed as an integral part in the face of the pump control panel as follows. Panel mount, 24-volt loop-powered process control meter. Meter shall have a single four-digit LED numeric display with tricolor programmable LED bar graph (51 segments minimum). There shall be automatic color change capabilities as well as dimming and blinking for visual alarm indication. Meter shall be capable of accepting a 4-20 mA as input and have an internal processor to allow for implementation of different process control algorithms. Resistance of meter shall be 250 HMS to provide for minimal voltage drop. Provide panel mounting kit to allow for mounting in the face of the control panel. Mounting height shall be 5 feet A.F.F. Location to be determined in field but shall be consistent throughout all control panels.
 6. The main power disconnect operating mechanism shall be flanged mounted type. An interlock shall be provided to prevent the control panel door from being opened where the main circuit breaker is in the On position. Provide a defeater mechanism. Provide circuit breakers for each pump motor, control circuits, convenience receptacle, as a minimum.
 7. Phase Monitor - A phase monitor shall be provided to monitor incoming power. The phase monitor shall have a normally open contact, held closed on normal operation, wired as an input to the pump station controller. The contact will open if the phase monitor senses loss of power, phase loss, low voltage, or voltage unbalance. An integral time delay shall be provided to minimize nuisance trips.
 8. Motor winding thermal protection and seal leak detection monitoring relay shall be provided by the pump manufacturer and mounted inside the control panel.
 9. Elapsed Time Meters - Shall be provided for each pump. Elapsed time meters shall be six-digit, non-resettable, rated for operation on 120 volts AC. Elapsed time meters shall be wired to an auxiliary motor run contact.
 10. Control Panel Alarm/Indicating Lights – Shall be as specified herein. Pump run indicating lights shall be red. All other alarm/indicating lights shall be amber. Lights shall be 30 millimeters in diameter and shall be rated for operation on 12 volts DC. Lights shall be push-to-test type, or control panel shall be provided with one master lamp test momentary pushbutton.
 11. Control Relays - Shall be provided as required to achieve operation as specified herein. Relays shall be provided with plug-in socket and retainer clip. Relay contacts shall be rated for up to 120 volts AC. Relays shall be provided with a minimum of two normally open and two normally closed contacts.
 12. High level wet well level float switch shall be provided. The level float switch shall be a non-mercury magnetic-type float switch, incorporating intrinsically safe relays. Float switches shall be sealed in a polypropylene housing, with polypropylene mounting hardware and 30 feet of cable. Manufacturer shall provide a vertical pipe in the wet well for mounting the float switch. The float switch shall be shipped loose for installation by the installing contractor. A NEMA 7 explosionproof junction box shall be provided and installed. Junction box shall be provided

with labeled terminal blocks. Intrinsically saferelays shall be provided, installed in the control panel by the manufacturer. Intrinsically safe relays shall be rated for use on 120-volt AC. Intrinsically safe relays shall be recognized and listed as intrinsically safe by a nationally recognized testing laboratory. Station manufacturer shall make all connections from relays to feeder lines and motor controls. Installing contractor shall make connections from relays to float switch junction box.

13. Provide a minimum of 12-inch by 12-inch clear mounting space on the control panel backboard for installation of radio communication equipment as specified and provided in Section 17100, PLC.

2.07. FABRICATION REQUIREMENTS

- A. Manufacturer shall provide surface preparation and prime coating in accordance with the coating system specified in Section 09900, Painting. Manufacturer's standard surface preparation and prime coating are acceptable if the equipment manufacturer certifies that the coating meets or exceeds requirements specified in Section 09900, Painting, and is approved by the Engineer.
- B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- C. Welds shall be continuous unless noted otherwise.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.
- E. Furnish nameplates for each equipment.
 1. Equipment nameplates of stainless steel shall be engraved or stamped and fastened to the equipment in an accessible location with No. 4 or larger oval head stainless steel screws or drive pins.
 2. Nameplates shall contain the manufacturer's name, model, serial number, size, characteristics, and appropriate data describing the equipment performance ratings.

2.08. SHOP TESTING

- A. The equipment shall be tested in the manufacturer's shop in accordance with the requirements of Section 01640, Equipment-General, and as specified herein.
 1. Test pump casings under a hydrostatic head of at least 75 psi or 150 percent of rated shutoff head, whichever is greater. Test casing with pump assembled.
 2. Provide certified performance tests as specified herein. Conduct performance test of all pumps under simulated design conditions in factory prior to shipment
 3. Certified Performance Testing
 - a. Run pump at full speed rating point prior to start of any testing.
 - b. Full Speed Tests

- 1) Test pumps at the conditions specified and indicated and take not less than five operating points between shutoff and runout. Test points must be at the conditions specified and indicated.
 - 2) Take readings to determine flow, differential pressure, rpm, horsepower, and efficiency.
 - 3) Operate each pump for not less than one hour and take readings to determine that the pump will operate as specified and indicated without cavitation at the specified minimum head condition with not more than the specified NPSH available.
 - 4) Record motor amperage and brake horsepower and efficiency at each data point at the pump curve. Develop pump curve for each pump type using at least 10 actual data points for each curve.
 - 5) Deviation of actual data from specified performance criteria shall not exceed ± 3 percent.
- B. The manufacturers shall submit certified copies of the test data to Engineer before shipment of the pumps to the site. Include results of factory testing in the O&M Manual.
- C. Final acceptance of the equipment will be dependent upon the satisfactory operation and performance after installation.

PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

- A. Install in accordance with the Contract Documents and the manufacturer's written instructions.
- B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.
- C. Field verify all dimensions and elevations. Notify Engineer of specific differences.
- D. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for testing and startup.
- E. Surface preparation and field painting shall be in accordance with Section 09900, Painting.
- F. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- G. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.
- H. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series 66-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.

- I. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.02. TESTING AND STARTUP

- A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.
 1. Preliminary field testing.
 2. Functional testing.
 3. Startup
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Preliminary field tests shall be made after installation of the pumps. Functional testing shall demonstrate the following:
 1. That the units have been properly installed and are in proper alignment.
 2. That the units operate without overheating or overloading of any parts and without objectionable vibration.
 3. That there are no mechanical defects in any of the parts.
 4. That the pumps can deliver the specified flow rate and quantity at the rated speed. All Functional Tests shall be conducted with clean water unless otherwise noted. Contractor shall provide all temporary flow measurement devices as necessary to achieve accurate measurement of the pumped flow during the field tests.
 5. That the pumps can pass the size of solids specified and the type of liquid for which the pumps are to be used.
- D. During Functional Testing, readings of all essential data shall be recorded at a minimum of four operating points. Data taken shall include suction and discharge pressure, flow, pump speed, and motor amperage. All field testing information shall be summarized in a report and submitted to Engineer for approval. Deviation of actual data from specified performance criteria shall not exceed ± 3 percent.

3.03. SERVICES OF MANUFACTURER'S REPRESENTATIVE

- A. Provide services of the equipment manufacturer or their approval representative in accordance with Section 01640, Equipment-General, and as specified herein.
- B. A qualified representative of the equipment manufacturer shall be on site for the following activities:
 1. Preliminary field testing.
 2. Functional testing.

3. Startup
4. Training.
5. As necessary to provide submittals in accordance with Article 1.05.

END OF SECTION

SECTION 15018
HVAC REQUIREMENTS

PART 1 GENERAL

1.01. WORK INCLUDED

- A. Provide all labor, tools, materials, accessories, parts, transportation, taxes, and related items, essential for installation of the work and necessary to make work complete and operational. Provide new equipment and material unless otherwise called for. References to codes, specifications, and standards called for in the specification sections and on the Drawings mean the latest edition, amendment, and revision of such referenced standard in effect on the date of these Contract Documents.-
- B. The Contractor is advised that there is lead-based paint and lead-containing and asbestos building components within the existing structures. The Contractor and his respective subcontractors shall be responsible for compliance with OSHA 29 CFR 1910 and 29 CFR 1926.62 as well as Section 02833, Removal and Disposal of Material Containing Lead.

1.02. LICENSING

- A. The Contractor shall hold a license to perform the work as issued by the local jurisdiction.
- B. The Contractor shall be responsible for reviewing the local jurisdiction requirements prior to bidding.

1.03. PERMITS

- A. Apply for and obtain all required permits and inspections, pay all fees and charges including all service charges.

1.04. CODE COMPLIANCE

- A. Provide work in compliance with the following:
 - 1. The Building Code of New York State including The Fire Code; Property Maintenance Code; Plumbing Code, Mechanical Code and Fuel Gas Code; and The Energy Code of New York.
 - 2. New York State Department of Labor Rules and Regulations.
 - 3. Occupational Safety and Health Administration (OSHA).
 - 4. National Fuel Gas Code, NFPA 54.
 - 5. National Electrical Code, NFPA 70.
 - 6. Local Codes and Ordinances.
 - 7. Life Safety Codes, NFPA 101 (2003).

8. New York Board of Fire Underwriters.
9. Part 4 of Title 12 Rules and Regulations of the State of New York Industrial Code Rule No. 4 (12NYCRR4)

1.05. GLOSSARY

- A. AGA - American Gas Association
- B. AMCA - Air Moving and Conditioning Association, Inc.
- C. ANSI - American National Standards Institute
- D. ASHRAE - American Society of Heating, Refrigeration, and Air Conditioning Engineers, Inc.
- E. ASME - American Society of Mechanical Engineers
- F. ASPE - American Society of Plumbing Engineers
- G. ASTM - American Society for Testing Materials
- H. NEC - National Electrical Code
- I. NFPA - National Fire Protection Association
- J. SMACNA - Sheet Metal and Air Conditioning Contractors National Association
- K. UL - Underwriter's Laboratories, Inc.
- L. OSHA - Occupational Safety and Health Administration

1.06. SHOP DRAWINGS/PRODUCT DATA/SAMPLES

- A. Submit Shop Drawings on all items of equipment and materials to be furnished and installed. Submission of Shop Drawings and samples shall be accompanied by a transmittal letter, stating name of project and Contractor, number of drawings, titles, and other pertinent data called for in individual sections. Shop Drawings shall be dated and contain name of project; name of prime professional; name of prime contractor; description or names of equipment, materials and items; and complete identification of locations at which materials or equipment are to be installed. Individual piecemeal or incomplete submittals will not be accepted. Similar items, (all types specified) shall be submitted at one time. Number each submittal by trade. Indicate deviations from contract requirements on Letter of Transmittal. Shop Drawings will be given a general review only. Corrections or comments made on the Shop Drawings during the review do not relieve Contractor from compliance with requirements of the drawings and specifications. The Contractor is responsible for confirming and correcting all quantities; checking electrical characteristics and dimensions; selecting fabrication processes and techniques of construction; coordinating his work with that of all other trades; and performing his work in a safe and satisfactory manner.
- B. See Section 01300, Submittals, for submittal procedures.

1.07. PROTECTION OF PERSONS AND PROPERTY

- A. Contractor shall assume responsibility for construction safety at all times and provide as part of contract all trench or building shoring, scaffolding, shielding, dust/fume protection, HVAC/electrical protection, special grounding, safety railings, barriers, and other safety features required to provide safe conditions for all workmen and site visitors.

1.08. EQUIPMENT ARRANGEMENTS

- A. The Contract Documents are prepared on basis of one manufacturer as "design equipment," even though other manufacturer's names are listed as acceptable makes. If Contractor elects to use one of the listed makes other than "design equipment," submit detailed drawings, indicating proposed installation of equipment. Show maintenance arrangement. Make required changes in the work of other trades, at no increase in any contract. Provide larger motors, feeders, breakers, and equipment, additional control devices, valves, fittings and other miscellaneous equipment required for proper operation, and assume responsibility for proper location of roughing and connections by other trades. Remove and replace door frames, access doors, walls, ceilings, or floors required to install other than design make equipment. If revised arrangement submittal is rejected, revise and resubmit specified "design equipment" item which conforms to Contract Documents.

1.09. CONTINUITY OF SERVICES

- A. The building will be in use during construction operations. Maintain existing systems in operation within all rooms of building at all times. Refer to "General Conditions of the Contract for Construction" for temporary facilities for additional contract requirements. Schedules for various phases of contract work shall be coordinated with all other trades and with Owner's Representative. Provide, as part of contract, temporary HVAC connections and relocations as required to accomplish the above. Obtain approval in writing as to date, time, and location for shutdown of existing HVAC facilities or associated services.

1.10. ROUGHING

- A. Due to small scale of Drawings, it is not possible to indicate all offsets, fittings, changes in elevation, interferences, etc. Make necessary changes in contract work, equipment locations, etc., as part of a contract to accommodate work to obstacles and interferences encountered. Before installing, verify exact location and elevations at work site. DO NOT SCALE plans. If field conditions, details, changes in equipment or shop drawing information require an important rearrangement, report same to Owner's Representative for review. Obtain written approval for all major changes before installing.
- B. Install work so that items both existing and new are operable and serviceable. Eliminate interference with removal of coils, motors, filters, belt guards and/or operation of doors. Provide easy, safe, and code mandated clearances at controllers, motor starters, valve access, and other equipment requiring maintenance and operation. Where Contractor could not reasonably be expected to find such trade interferences due to concealment in walls, ceiling or floors, such relocations will be done by Change Order, if not, included in contract work. Contractor shall relocate existing work in way of new construction. VISIT SITE BEFORE BIDDING TO DETERMINE SCOPE OF WORK SINCE FEW OF SUCH ITEMS CAN BE SHOWN. Provide new materials, including new piping and insulation for relocated work.

- C. Coordinate work with other trades and determine exact route or location of each duct, pipe, conduit, etc., before fabrication and installation. Coordinate with architectural drawings. Obtain from Owner's Representative exact location of all equipment in finished areas, such as thermostat, fixture, and switch mounting heights, and equipment mounting heights. Coordinate all work with the architectural reflected ceiling plans and/or existing architecture. HVAC drawings show design arrangement only for diffusers, grilles, registers, air terminals, and other items. Do not rough-in contract work without reflected ceiling location plans.
- D. Before roughing for equipment furnished by Owner, obtain from Owner approved roughing drawings giving exact location for each piece of equipment. Do not "rough in" services without final layout drawings approved for construction. Cooperate with other trades to insure proper location and size of connections to insure proper functioning of all systems and equipment. For equipment and connections provided in this contract, prepare roughing drawing as follows:
 - 1. Existing Equipment - Measure the existing equipment and prepare for installation in new location.
 - 2. New Equipment - Obtain equipment roughing drawings and dimensions, then prepare roughing-in-drawings. If such information is not available in time, obtain an acknowledgement in writing, then make space arrangements as required with Owner's Representative.

1.11. REMOVAL WORK

- A. Where existing equipment removals are called for, submit complete list to Owner's Representative. All items that Owner wishes to retain that do not contain asbestos or PCB material shall be delivered to location directed by Owner. Items that Owner does not wish to retain shall be removed from site and legally disposed of. Removal and disposal of material containing asbestos and/or PCB's shall be in accordance with federal, state, and local law requirements. Where equipment is called for to be relocated, contractor shall carefully remove, clean and recondition, then reinstall. Remove all abandoned piping, equipment, ductwork, tubing, supports, fixtures, etc. Visit each room, crawl space, and roof to determine the total scope of work. The disturbance or dislocation of asbestos-containing materials causes asbestos fibers to be released into the building's atmosphere, thereby creating a health hazard to workmen and building occupants. Consistent with Industrial Code Rule 56 and the content of recognized asbestos control work, the Contractor shall apprise all of his workers, supervisory personnel, subcontractors, Owner and consultants who will be at the job site of the seriousness of the hazard and of proper safeguards and work procedures which must be followed, as described in New York State Department of Labor Industrial Code Rule 56.

1.12. EQUIPMENT AND MATERIAL INSTALLATION

- A. Provide materials that meet the following minimum requirements:
 - 1. Materials shall have a flame spread rating of 25 or less and smoke developed rating of 50 or less, in accordance with NFPA 255.
 - 2. All equipment and material for which there is a listing service shall bear a UL label.
 - 3. Gas-fired equipment and system shall meet AGA Regulations and shall have AGA label.

4. HVAC and electrical equipment and systems with electrical components shall be UL Listed and meet UL Standards and requirements of the NEC.

1.13. CUTTING AND PATCHING

- A. Each trade shall include their required cutting and patching work unless shown as part of the General Construction work on the architectural drawings. Refer to General Conditions of the Contract for Construction for additional requirements. Cut and drill from both sides of walls and/or floors to eliminate splaying. Patch any cut or abandoned holes left by removals of equipment, fixtures, etc. Patch adjacent existing work disturbed by installation of new work including insulation, walls and wall covering, ceiling and floor covering, other finished surfaces. Patch openings and damaged areas equal to existing surface finish. Cut openings in prefabricated construction units in accordance with manufacturer's instructions.

1.14. PAINTING

- A. Include painting for patchwork with color to match adjacent surfaces. Where color cannot be adequately matched, paint entire surface. Provide one coat of primer and two finish coats or as called for in the HVAC Specifications. Refer to General Construction Specifications for additional information.

1.15. CONCEALMENT

- A. Conceal all contract work above ceilings and in walls, below slabs, and elsewhere throughout building. If concealment is impossible or impractical, notify Owner's Representative before starting that part of the work and install only after his review. In areas with no ceilings, install only after Owner's Representative reviews and comments on arrangement and appearance.

1.16. CHASES

- A. In Existing Buildings
 1. Drill holes for floor and/or roof slab openings.
 2. Multiple pipes smaller than 1 inch properly spaced and supported may pass through one 6-inch or smaller diameter opening.
 3. Seal voids in fire rated assemblies with a fire-stopping seal system to maintain the fire resistance of the assembly. Provide 18 gauge galvanized sleeves at fire rated assemblies. Extend sleeves 2 inches above floors.
 4. In wall openings, drill or cut holes to suit. Provide 18 gauge galvanized sleeves at shafts and fire rated assemblies. Provide firestopping seal between sleeves and wall in drywall construction. Provide firestopping similar to that for floor openings.

1.17. FLASHING, SEALING, FIRE-STOPPING

- A. See Section 15019, HVAC Firestopping.

1.18. SUPPORTS

- A. Provide required supports, beams, angles, hangers, rods, bases, braces, and other items to properly support contract work. Supports shall meet the approval of the Owner's Representative. Modify studs, add studs, add framing, or otherwise reinforce studs in metal stud walls and partitions as required to suit contract work. If necessary, in stud walls, provide special supports from floor to structure above. For precast panels/planks and metal decks, support HVAC/electrical work as determined by manufacturer and Owner's Representative. Provide heavy gauge steel mounting plates for mounting contract work. Mounting plates shall span two or more studs. Size, gauge, and strength of mounting plates shall be sufficient for equipment size, weight, and desired rigidity.

1.19. ACCESS PANELS

- A. Access panels shall be installed by Contractor where appropriate. Location and size shall be the responsibility of the Contractor. Bear cost of construction changes necessary due to improper information or failure to provide proper information in ample time. Access panels over 324 square inches shall have two cam locks. Contractor shall provide proper frame and door type for various wall or ceiling finishes. Access panels shall be equal to "Milcor" as manufactured by Inland Steel Products Co., Milwaukee, Wisconsin. Provide General Contractor with a set of architectural black and white prints with size and approximate locations of access panels shown.

1.20. HVAC EQUIPMENT CONNECTIONS

- A. Contractor is responsible for draining, filling, venting, chemically treating and restarting any systems which are affected by work shown on the Contract Documents unless specifically noted otherwise.
- B. Provide final hydronic, steam, drain, vent, and gas connections to all equipment as required by the equipment. Provide final connections, including domestic water piping, controls, and devices from equipment to outlets left by other trades. Provide equipment waste, drip, overflow and rail connections extended to floor drains.
- C. Provide for Owner-furnished and Contractor-furnished equipment all valves, piping, piping accessories, traps, pressure reducing valves, gauges, relief valves, vents, drains, insulation, sheet metal work, controls, dampers, as required.
- D. Refer to manufacturer drawings and specifications for requirements of kitchen equipment, laboratory equipment and special equipment. Verify connection requirements before bidding.
- E. It is the general intent that all electrical power wiring, motor starters and/or power disconnects be provided and installed by the Contractor. Some HVAC equipment is specified to have factory-installed integral starters and/or power disconnects and as such, are to be provided by the Contractor. Refer to the motor connection schedule for all requirements.

1.21. DELIVERY

- A. Accept materials delivered on site in manufacturer's packaging, labeled with manufacturer's identification and product information.

1.22. STORAGE AND PROTECTION OF MATERIALS

- A. Store materials on dry base, at least 6 inches above ground or floor. Store so as not to interfere with other work or obstruct access to buildings or facilities. Provide waterproof/windproof covering. Remove and provide special storage for items subject to moisture damage. Protect against theft or damage from any cause. Replace items stolen or damaged, at no cost to Owner.
- B. Maintain ambient conditions for each product as required by each manufacturer from time of delivery. Maintain appropriate ambient conditions for installation as recommended by each manufacturer for a minimum of 24 hours prior and 24 hours after installation.
- C. Refer to General Conditions of the Contract for Construction.

1.23. FREEZING AND WATER DAMAGE

- A. Take all necessary precautions with equipment, systems and building to prevent damage due to freezing and/or water damage. Repair or replace, at no charge in contract, any such damage to equipment, systems, and building. Perform first season's winterizing in presence of Owner's operating staff.

1.24. OWNER INSTRUCTIONS

- A. Before final acceptance of the work, furnish necessary skilled labor to operate all systems by seasons. Instruct designated person on proper operation, and care of systems/equipment. Repeat instructions, if necessary. Obtain written acknowledgement from person instructed prior to final payment. Contractor is fully responsible for system until final acceptance, even though operated by Owner's personnel, unless otherwise agreed in writing. List under clear plastic, operating, maintenance, and starting precautions procedures to be followed by Owner for operating systems and equipment.

1.25. MAINTENANCE MANUALS

- A. Prepare Instructions and Maintenance Portfolios. Include one copy of each of approved Shop Drawings, wiring diagrams, piping diagrams spare parts lists, as-built drawings and manufacturer's instructions. Include typewritten instructions, describing equipment, starting/operating procedures, emergency operating instructions, summer-winter changeover, freeze protection, precautions and recommended maintenance procedures. Include name, address, and telephone number of supplier manufacturer representative and service agency for all major equipment items in a three ring binder with name of project on the cover. Deliver to Owner's Representative before request for final acceptance.

1.26. RECORD DRAWINGS

- A. The Contractor shall obtain at his expense one set of construction Contract Drawings including non-reproducible black and white prints and one set of reproducible mylars for the purpose of recording record conditions.
- B. The Contractor shall perform all survey work required for the location and construction of the work and to record information necessary for completion of the record drawings. Record drawings shall show the actual location of the constructed facilities in the same manner as was shown on the bid drawings. All

elevations and dimensions shown on the drawings shall be verified or corrected so as to provide a complete and accurate record of the facilities as constructed.

- C. It shall be the responsibility of the Contractor to mark each sheet of the non-reproducible drawings in pencil and to record thereon in a legible manner, any and all approved field changes and conditions as they occur. A complete file of approved field sketches, diagrams, and other changes shall also be maintained. At completion of the work, each sheet of record prints, plus all approved field sketches and diagrams shall be used in preparation of the mylar reproducible record drawings.
- D. Completed reproducible mylar drawings shall be certified as reflecting record conditions and submitted to the engineer for approval.

1.27. ADDITIONAL ENGINEERING SERVICES

- A. In the event that the consultant is required to provide additional engineering services as a result of substitution of equivalent materials or equipment by the Contractor, or changes by the Contractor in dimension, weight, power requirements, etc., of the equipment and accessories furnished, or if the Consultant is required to examine and evaluate any changes proposed by the Contractor for the convenience of the Contractor, then the consultant's expenses in connection with such additional services shall be paid by the Contractor and may be deducted from any monies owed to the Contractor.

1.28. FINAL INSPECTION

- A. Upon completion of all punch list items, the Contractor shall provide a copy of the punch list back to the Architect/Engineer with each item noted as completed or the current status of the item. Upon receipt, the Architect/Engineer will schedule a final inspection.

1.29. ALL TRADES TEMPORARY HEAT

- A. Refer to the Standard General Conditions of the Contract for Construction and the Supplementary General Conditions.

1.30. HVAC MAINTENANCE OF SYSTEMS DURING TEMPORARY USE PERIODS

- A. Provide each air handling system with a set of prefilters in addition to the permanent filters. Furnish four sets of prefilters for each system for use when system is operated for temporary heating or cooling. During such use, change prefilters as often as directed by Owner's Representative. Provide necessary temporary throw away filters in all return openings to keep dust out of ductwork. Change as often as necessary. Remove all such temporary filters upon completion. Use supply units only. Do not operate return fans.
- B. Blank-off outside air intake opening during temporary heating period. Install first set of permanent filters and prefilters.
- C. Adjust dampers on supply system.
- D. Set all heating coil control valves for manual operation.
- E. Do not install any grilles or diffusers at room terminal ends of ducts until permission is given.

- F. Assume responsibility for systems and equipment at all times, even though used for temporary heat or ventilating. Repair or replace all dented, scratched or damaged parts of systems prior to final acceptance.
- G. Remove concrete, rust, paint spots, other blemishes, then clean.
- H. Just prior to final acceptance, remove used final filter. Deliver all unused sets of prefilters to the Owner and obtain written receipt. Properly lubricate system bearings before and during temporary use. Maintain thermostats, freeze stats, overload devices, and all other safety controls in operating condition.

1.31. CLEANING

- A. It is the Contractor's responsibility to keep clean all equipment and fixtures provided under this contract for the duration of the project. Each trade shall keep the premises free from an accumulation of waste material or rubbish caused by his operations. The facilities require an environment of extreme cleanliness, and it is the Contractor's responsibility to adhere to the strict regulations regarding procedures on the existing premises. After all tests are made and installations completed satisfactorily:
- B. Thoroughly clean entire installation, both exposed surfaces and interiors.
- C. Remove all debris caused by work.
- D. Remove tools, surplus, materials, when work is finally accepted.

1.32. SYSTEM START-UP AND TESTING

- A. All new heating and ventilating shall be started up and operated at normal operating temperature for a period of 24 hours to "bake off" the equipment. The associated ventilation system shall run on 100 percent outside air during the bake-off for an additional eight hours to purge the building. This work shall be completed prior to building occupancy or if the work is not completed in time for summer bake-off on a Saturday with the Contractor responsible for being on site during the entire purge and bake-off operation.
- B. Work which includes system bake-off, system start-up, system cut-over, or staff training shall not be done one week prior to and one week after the opening of the building/addition except upon written approval by the Owner.
- C. Start-up and testing of HVAC systems shall occur while the building is not occupied by Owner and only after notice to the Project Inspector is made at least 24 hours in advance. The Contractor shall be responsible for providing temporary filter media over all supply air registers and diffusers during the HVAC system start-up procedure. The Contractor shall provide airtight plastic covers over all supply and return air openings prior to the start of construction by any Contractor. The plastic shall be maintained airtight throughout the project construction and removed only with the approval of the Project Inspector.

END OF SECTION

SECTION 15019
HVAC FIRESTOPPING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Firestopping materials.
- B. Firestopping of all penetrations, openings, and interruptions to fire rated assemblies, whether indicated on drawings or not, including but not limited to piping, tubing, ductwork and similar utilities passing through or penetrating fire rated walls and floor assemblies.

1.02. REFERENCES

- A. ASTM International
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- B. National Fire Protection Association
 - 1. NFPA 70 - National Electrical Code.
- C. Underwriters Laboratories Inc.
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.
- D. Mechanical Code of New York State.

1.03. FIRE-STOP SYSTEM PERFORMANCE REQUIREMENTS

- A. General - For penetrations through fire-resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration fire-stop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire-resistance rating of construction penetrated.
 - 1. Fire-resistance-rated walls including fire walls, fire partitions, fire barriers and smoke barriers.
 - 2. Fire-resistance-rated horizontal assemblies including floors and ceiling membranes of roof/ceiling assemblies.

1.04. SUBMITTALS

- A. Product Data - For each type of product indicated.

1.05. QUALITY ASSURANCE

- A. Fire Testing - Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.
 - 1. Listing in the current-year classification or certification books of UL will be considered as constituting an acceptable test report.

1.06. ENVIRONMENTAL REQUIREMENTS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Hilti.
- B. Nelson Fire Stop Products.
- C. Specified Technology.
- D. 3M Fire Protection Products.
- E. Approved equals meeting UL requirements.

2.02. MATERIALS

- A. Sealant Firestopping
 - 1. Intumescent firestop sealant designed to expand when exposed to fire.
 - 2. Paintable.
 - 3. Fire Resistance - Up to four hours.
 - 4. Curing Time - 14 to 21 days.
 - 5. Elongation - 5 percent.
 - 6. Density - 1.5 g/cm³
 - 7. Product - FS-ONE Intumescent Firestop Sealant manufactured by Hilti USA.

8. Uses - Insulated and uninsulated metal pipes, with or without sleeve, jacketed cables, cable bundles, plastic pipes, sheet metal duct, and top of wall joints.
- B. Silicone Sealant Firestopping
1. Silicone-based firestop sealant that provides maximum movement in fire-rated joint applications and pipe penetrations.
 2. Not paintable.
 3. Fire Resistance - Up to four hours.
 4. Elongation - 25 percent
 5. Product - CP 601S Elastomeric Firestop Sealant manufactured by Hilti USA.
 6. Uses - Joints in walls, floor to floor or fire compartments.
- C. Safing Insulation
1. Mineral-wool type insulation.
 2. Thickness - 1 to 1-1/2 inches.
 3. Density - 4 to 8 pcf.
 4. Product - THERMAFIBER Safing Insulation.
- D. Sleeves - Provide sleeves as required by Section 1206.4 of the Mechanical Code.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify openings are ready to receive the work of this section.

3.02. PREPARATION

- A. Surface Cleaning - Clean out openings immediately before installing through-penetration fire-stop systems to comply with fire-stop system manufacturer's written instructions and with the following requirements
1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration fire-stop systems.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration fire-stop systems. Remove loose particles remaining from cleaning operation.

3. Remove laitance and form-release agents from concrete.

B. Priming - Prime substrates where recommended in writing by through-penetration fire-stop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.03. INSTALLATION

A. General - Install materials in manner described in UL Detail and in accordance with manufacturer's instructions, completely closing openings.

B. Installation

1. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.

2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.

3. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.

4. Fire Rated Surface

a. Seal opening at floor, wall, partition, and roof as follows

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

3) Pack void with backing material.

4) Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

b. Where piping, ductwork, cables, etc. penetrates fire rated surface, install firestopping product in accordance with manufacturer's instructions.

5. Non-Rated Surfaces

a. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows

1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.

2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.

3) Install type of firestopping material recommended by manufacturer.

- b. Install floor plates or ceiling plate where piping penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - c. Exterior wall openings below grade Assemble rubber links of mechanical seal to size of pipe and tighten in place, in accordance with manufacturer's instructions.
 - d. Interior partitions Seal pipe penetrations at mechanical rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.
- C. Identification - Identify through-penetration fire-stop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the fire-stop systems so that labels will be visible to anyone seeking to remove penetrating items or fire-stop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels
- 1. The words "Warning - Through-Penetration Fire-Stop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Date of installation.
 - 3. Through-penetration fire-stop system manufacturer's name.

3.04. CLEANING AND PROTECTION

- A. Clean off excess fill materials adjacent to openings as Work progresses by methods and with cleaning materials that are approved in writing by through-penetration fire-stop system manufacturers and that do not damage materials in which openings occur.
- B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration fire-stop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or deteriorated through-penetration fire-stop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 15060

PROCESS PIPING

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Furnish, install, and test aboveground process piping complete with all fittings, appurtenances and all other required accessories in accordance with the Contract Documents.

1.02. RELATED SECTIONS

- A. All Division 1 specifications
 B. Section 09900 – PAINTING
 C. Section 15100 - PROCESS VALVES

1.03. REFERENCES

- A. Ductile Iron Pipe

Handbook of Cast Iron Pipe - Cast Iron Pipe Research Association (CIPRA)	CIPRA Standard for Flanged Pipe With Threaded Flanges
ANSI A21.4/AWWA C104	Cement-Mortar Lining for Ductile Iron and Gray Iron Pipe and Fittings for Water
ANSI A21.10/AWWA C110	Ductile Iron and Gray Iron Fittings, 3-inch through 48-inch, for Water and Other Liquids
ANSI A21.15/AWWA C115	Flanged Ductile Iron and Gray Iron Pipe With Threaded Flanges
ANSI A21.50/AWWA C150	Thickness Design of Ductile Iron Pipes
ANSI A21.51/AWWA C151	Ductile Iron Pipe Centrifugally Cast in Metal Molds and Sand Lined Molds for Water and Other Liquids
ASTM A126	Gray Iron Castings for Valves, Flanges, and Pipe Fittings
ASTM A536	Ductile Iron Castings
ANSI/AWWA C606	Grooved and Shouldered Joints

- B. Plastic Pipe and Fittings

ANSI/AWWA C900	Poly (Vinyl Chloride) (PVC) Pressure Pipe 4-inch through 12-inch for Water
AWWA C901	Polyethylene (PE) Pressure Pipe and Tubing 1/2-inch through 3-inch for Water Service
AWWA C902	Polybutylene (PB) Pressure Pipe, Tubing and Fittings, 1/2-inch through 3-inch for Water
ASTM D1248	Polyethylene Plastics Molding and Extension Materials (High Density Type III Black Polyethylene Pipe)

ASTM D1784	Rigid Poly (Vinyl Chloride) (PVC) Compounds and Chlorinated Poly (Vinyl Chloride) (PVC) Plastic Pipe Schedule 80
ASTM D1785	Poly (Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80 and 120
ASTM D2241	Poly (Vinyl Chloride) (PVC) Pressure Rated Pipe (SDR Series)
ASTM D2464	Threaded Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2467	Socket-Type Poly (Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80
ASTM D2564	Solvents Cements for Poly (Vinyl Chloride) (PVC) Plastic Pipe and Fittings
ASTM D2581	Polybutylene (PB) Plastics Molding and Extrusions Materials
ASTM D2657 and D3261	Butt Heat Fusion and Polyethylene (PE) Plastic Fittings for Polyethylene (PE) Plastic Pipe and Tubing
ASTM D2672	Solvent Cement Joint Sockets or Belled PVC Pressure Pipe
ASTM D2774	Underground Installation of Thermoplastic Pressure Piping
ASTM D3139	Joints for Plastic Pressure Pipe Using Flexible Elastomeric Seals
ASTM D3350	Polyethylene Plastics Pipe and Fittings Materials
ASTM F477	Elastomeric Seals, (Gaskets) for Joining Plastic Pipe

1.04. SUBMITTALS

- A. Provide in accordance with Sections 01300, Submittals; 01640, Equipment-General; and as supplemented herein. Submittals shall include, but not be limited to, the following:
1. Shop Drawings
 - a. Shop drawings shall indicate conformance to applicable ASTM/AWWA codes, pipe material, sizes, class, dimensions, joint type, features and accessories.
 2. Layout Drawings - Show complete piping layout, including materials, sizes, classes, locations, dimensions, supports, adapters, couplings, expansion joints, and hanger details. Joints shall be provided at all locations require by the Contract Documents, including all locations shown on the Contract Drawings. Piping layout drawings shall be submitted separately from piping product shop drawings.

1.05. PROJECT RECORD DOCUMENTS

- A. Provide in accordance with Section 01700, Closeout and Record Documents, and as supplemented herein
1. Submit marked up record plans including record location of pipe connections, valves, cleanouts, bends, tees, manholes, and rim and invert elevations.
 2. Invert elevations shall be the measurement of the pipe invert at a point where the pipe enters or exits a structure.
 3. Identify and locate on record drawings during construction the discovery of exposed uncharted existing utilities and services.

1.06. FIELD MEASUREMENTS

- A. Prior to the start of construction, field verify measurements and elevations for existing conditions, piping, and equipment are as shown on the Contract Drawings. Notify Engineer of specific differences.

1.07. COORDINATION

- A. Coordinate the work with Owner where operation of existing structures and treatment facilities are affected.

PART 2 PRODUCTS

2.01. GENERAL

- A. All products included in this section shall conform to the requirements of the standard specifications referenced herein.
- B. Pipe material, pipe class and pipe sizes shall be furnished and installed as listed in the pipe schedule herein and/or as shown on the Drawings.

2.02. DUCTILE IRON

- A. Ductile iron pipe shall conform to AWWA C151/ANSI A21.51. Ductile iron pipe shall be rated for a minimum water pressure of 150 psi and be minimum Class 53.
- B. Ductile iron pipe and fittings shall be double cement lined and seal coated inside and out in accordance with ANSI 21.4/AWWA C104.
- C. Fittings shall conform to ANSI A21.10/AWWA C110.
- D. Joints - All joints shall be Type I.
 - 1. Type I - Fittings shall be furnished with flanged joint. The type of joint shall meet the following applicable requirements:
 - a. Flanges shall be screw-on type flanges and the face of the flange shall be machined after installation of the flange onto the pipe.
 - b. No raised surface is allowable on cast iron flanges.
 - c. Flanges shall be 125-lb. ASA flanges rated for a maximum working pressure of 150 psi.
 - d. The fittings shall be of standard lengths given under the ANSI Specification B16.1, unless otherwise noted.
 - e. The pipe lengths shall be fabricated to meet the requirements of the Contract Drawings.

2.03. PLASTIC

A. PVC

1. PVC pipe shall be ASTM D1785, Type 1, Grade 1 (PVC 1120) pressure pipe material conforming to ASTM D1784, Class Schedule 80.
2. Joint sockets for belled PVC pressure pipe to conform to ASTM D2672 and ASTM D2564 (solvent cements).
3. Socket type fittings for Schedule 80 PVC pipe to conform to ASTM D2467.

2.04. JOINTS IN PIPING

A. Unless otherwise noted, joints for piping shall conform to the following specifications.

1. Flanged Joints

- a. Shall be brought to exact alignment and all gaskets and bolts or studs inserted in their proper places.
- b. Bolts or studs shall be uniformly tightened around the joints.
- c. Where stud bolts are used, the bolts shall be uniformly centered in the connections and equal pressure applied to each nut on the stud.
- d. Gaskets shall be ring type, minimum 1/8-inch thick.
 - 1) Material shall be neoprene rubber for general liquid service and digester gas piping.
 - 2) Material shall be Viton for general air service.
- e. Flanges shall conform to AWWA Standard C115 (ANSI A21.15) with bolts provided in the size and number called for and in accordance with the American Standard with hexagonal nuts.
- f. For bolt sizes and lengths, the "Handbook of Cast Iron Pipe" should be consulted.
- g. Bolts and fasteners for exterior exposed or submerged flanged pipe fittings at process tanks shall be Type 316 stainless steel.
- h. Bolts and fasteners for flanged pipe fittings located inside structures or otherwise protected shall be standard A36 steel. Steel bolts shall be field primed and painted with the same coating system the adjacent piping receives.

2.05. LININGS AND COATINGS

A. Inside of Pipe (Ductile Iron Pipe Only)

1. Pipe and fittings for all process and water lines shall be double cement lined and seal coated

in accordance with ANSI 21.4/AWWA C104.

2. Air piping and fittings shall not be lined

B. Outside of Pipe

1. All interior ductile iron and steel pipe and fittings shall be factory primed and field coated per Section 09900, Painting.

2.06. IDENTIFICATION

A. Each pipe length and fitting shall be clearly marked with the following:

1. Manufacturer's name and trademark.
2. Nominal pipe size and class.
3. Material designation.

B. Contractor shall furnish and install pipe labels in accordance with Section 10426, Pipe Identification.

2.07. HANGERS AND SUPPORTS

- A. All piping shall be adequately supported and braced by means of adequate hangers, concrete piers, pipe supports, brackets, or otherwise as may be required by the location. Refer to Section 15140, Supports and Anchors.

2.08. COUPLINGS AND ADAPTERS

A. General

1. Where alternative couplings are not shown on the Contract Drawings, flanged coupling adapters shall be used to join process piping to all pump flanges.
2. Adapters shall be restrained to process piping by the use of stainless steel tie rods. Refer to the Contract Drawings for additional tie rod requirements.
3. Couplings and/or adapters shall be provided by the Contractor for the alignment of similar types of pipe or connecting dissimilar pipe materials as required in accordance with the details shown on the Contract Drawings.
4. All new to existing connections shall be restrained in accordance with the detail shown on the Contract Drawings.
5. Unions shall be provided adjacent to all pumps, tanks, valves and other pieces of equipment where soldered, cement welded, or screwed joints are utilized.
6. Type 316 stainless steel bolts shall be used on all pipe adapters.
7. Where couplings and adapters are to be used they shall be installed in complete accordance with the manufacturer's recommendations

- B. Flanged Coupling Adapters - Dresser Style 128W, Smith-Blair 913, or equal.
- C. Dismantling Joints - Romac Style DJ400, Smith-Blair 975, or equal.
- D. Mechanical Couplings - Dresser Style 38, Smith-Blair 411, or equal.
- E. Reducer Couplings
 - 1. Dresser Style 62, or equal.
 - 2. When joining ductile iron pipe to existing reinforced concrete pipe, Contractor shall field verify O.D. of RCP and coordinate with coupling manufacturer for exact sizing. Contractor shall clean, grind, and smooth RCP for proper sealing of gasket.

PART 3 EXECUTION

3.01. PIPING EXAMINATION

- A. Verify that structures are complete enough to receive pipe.
- B. All pipe or fittings which have been damaged in transit or which are obviously deformed or refinished in any way shall be rejected, marked and removed from the site of the work.
 - 1. Any pipe or fitting which the Engineer suspects is improper for the job shall be temporarily rejected, marked and set aside for subsequent investigation to determine its conformity with the specifications.
 - 2. All pipe fittings and specials shall be carefully inspected in the field before installation.
 - a. Cracked, broken, warped, out-of-round, damaged pipe joints including damaged pipe lining or coatings or specials, as determined by the Engineer, shall be culled out and not installed.
 - b. Such rejected pipe shall be clearly tagged in such manner as not to deface or damage it, and the pipe shall then be removed from the job site by the Contractor at his own expense.

3.02. PIPING INSTALLATION

- A. All piping shall be installed by skilled workmen and in accordance with the best standard practice for piping installation.
 - 1. Proper tools and appliances for the safe and convenient handling and installing of the pipe and fittings shall be used.
 - 2. Great care shall be taken to prevent any pipe coating from being damaged on the inside of the pipe and fittings.
 - a. All pieces shall be carefully examined for defects and no piece shall be installed which

is known to be defective.

3. If any defective pieces should be discovered after having been installed, it shall be removed and replaced with a sound one in a satisfactory manner by the Contractor and at his own expense.
 4. Pipe and fittings shall be thoroughly cleaned before they are installed and shall be kept clean until they are accepted in the complete work.
 5. All piping connections to equipment or tanks shall be provided with unions or coupling flanges located so that piping may be readily dismantled from the equipment or tank.
 6. At certain applications, Dresser or Victaulic couplings may also be used, subject to the Engineer's approval.
 7. All piping shall be installed in such a manner that it will be free to expand and contract without injury to itself or surrounding structures or equipment.
 8. All piping shall be erected to accurate lines and grades and shall be supported and braced against movement temporary or permanent.
- B. Where process piping assemblies connect to equipment, valves or tanks, such piping shall be rendered compatible with the approved equipment, valve or tank installed and any necessary modifications to the original piping shall be shown in scaled layout on appropriate shop drawings submitted to the Engineer.
- C. Piping connections to equipment shall be in accordance with the following:
1. Mating piping/equipment flanges shall be concentric to within a tolerance of 1/8 inch unbolted.
 2. Mating flange faces shall be parallel to within a tolerance of 1/2 the normal gasket thickness or 1/8 inch, whichever is less, unbolted.
 3. Flange face separation shall be no more than 1/8 inch beyond the normal gasket thickness or relaxed expansion joint length unbolted; nor less than the relaxed expansion joint length by more than 1/16 inch.
- D. Piping assemblies under 4-inch size shall be essentially supported on walls and ceilings, unless otherwise shown on the Contract Drawings, being kept clear of openings and positioned above "headroom" space.
1. Where practical, such piping shall be run in neat clusters, plumb and level along walls, and parallel to overhead beams.
- E. Install in accordance with the Contract Documents and the manufacturer's written instructions.
- F. Field verify all dimensions and elevations. Notify Engineer of specific differences.
- G. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for installation and testing.

- H. Surface preparation and field painting shall be in accordance with Division 9 specifications.
- I. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- J. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners.

3.03. TESTING AND STARTUP

- A. Requirements for testing of water distribution are described in Section 02674, Pressure Testing of Water Distribution Systems.
- B. Requirements for testing gravity pipe are described in Section 02735, Leakage Tests of Sewers.
- C. Requirements for testing force mains are described in Section 02741, Pressure Tests of Force Mains.
- D. All process piping shall be tested in accordance with the procedures outlined below as required in the pipe schedule.
 - 1. Where a section of pipeline has multiple uses, the pipe shall be tested at the highest pressure required.
 - a. Procedure A shall consist of a 15-minute test at 100 psi followed by a 3-hour test at 50 psi.
 - b. Procedure B shall consist of a 1-hour test at 150 psi followed by a 2-hour test at 100 psi.
 - c. Procedure C shall consist of a 30-minute test at 50 psi.
 - d. Procedure D shall consist of an exfiltration test; the pipe is filled with clear water to provide a head of at least 5 feet above the top of the pipe at the highest point of the pipeline under test, and then measuring the loss of water from the line by the amount which must be added to maintain the original level. In this test, the test period (for taking measurements) shall not be less than three hours.
 - e. Procedure E - Shall consist of a pressure test using air only.
 - 1) All piping shall be tested at a pressure of at least two times the normal working pressure of the pipe, but in no case less than 50 psi in any of section of pipe being tested for a period of not less than 60 minutes.
 - 2. When no test method for inside process pressure piping is specified in the pipe schedule, the following procedure shall be used.
 - a. All newly installed pipe or any valved section thereof shall be subjected to a hydrostatic pressure 50 percent in excess of the working pressure at the point of testing, but in no case less than 50 psi in any section of the pipe being tested, for a period of 2 hours.
 - b. A leakage test shall be conducted concurrently with the pressure test. The section tested shall be driptight with no signs of leakage.
 - 3. Any leaks or defective pipe disclosed by any leakage and pressure tests shall be repaired or

replaced and aforementioned tests repeated as often as necessary until conformance with the requirements.

4. All water for tests shall be furnished and disposed of by Contractor at his expense.
5. The source and quality of water which Contractor proposes to use in testing the lines shall be acceptable to Engineer.
6. All test water must be removed from the interior of all stainless steel pipe by draining, blowing, mopping, etc. Water must not be allowed to stand for long periods of time within stainless steel pipe.

(continued)

PROCESS PIPE SCHEDULE

Pipe No.	Identity	Predominant Size(s) (Inches)	Pipe Material	Schedule or Class	Joints	Test Procedure
1	Raw Influent	3	DIP, PVC	Class 53, Schedule 80	Flanged, NPT (at pump connection)	C

END OF SECTION

SECTION 15070

TESTING, ADJUSTING, AND BALANCING FOR HVAC

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Testing, adjustment, and balancing (TAB) of air systems.
- B. Measurement of final operating condition of HVAC systems.

1.02. REFERENCE STANDARDS

- A. AABC (NSTSB) - AABC National Standards for Total System Balance, 7th Edition; 2016.
- B. ASHRAE Std 111 - Measurement, Testing, Adjusting, and Balancing of Building HVAC Systems; 2008.
- C. NEBB (TAB) - Procedural Standards for Testing Adjusting and Balancing of Environmental Systems; 2015, Eighth Edition.
- D. SMACNA (TAB) - HVAC Systems Testing, Adjusting and Balancing; 2002.

1.03. SUBMITTALS

- A. TAB Plan - Submit a written plan indicating the testing, adjusting, and balancing standard to be followed and the specific approach for each system and component.
 - 1. Include at least the following in the plan:
 - a. List of all air flow, water flow, sound level, system capacity and efficiency measurements to be performed and a description of specific test procedures, parameters, formulas to be used.
 - b. Copy of field checkout sheets and logs to be used, listing each piece of equipment to be tested, adjusted and balanced with the data cells to be gathered for each.
 - c. Discussion of what notations and markings will be made on the duct and piping drawings during the process.
 - d. Final test report forms to be used.
 - e. Procedures for formal deficiency reports, including scope, frequency and distribution.
- B. Final Report - Indicate deficiencies in systems that would prevent proper testing, adjusting, and balancing of systems and equipment to achieve specified performance.
 - 1. Revise TAB plan to reflect actual procedures and submit as part of final report.

2. Submit draft copies of report for review prior to final acceptance of Project. Provide final copies for Engineer and for inclusion in operating and maintenance manuals.
3. Include actual instrument list, with manufacturer name, serial number, and date of calibration.
4. Form of Test Reports - Where the TAB standard being followed recommends a report format use that; otherwise, follow ASHRAE Std 111.
5. Units of Measure - Report data in both I-P (inch-pound) and SI (metric) units.

PART 2 EXECUTION

2.01. GENERAL REQUIREMENTS

- A. Perform total system balance in accordance with one of the following:
 1. AABC (NSTSB), AABC National Standards for Total System Balance.
 2. ASHRAE Std 111, Practices for Measurement, Testing, Adjusting and Balancing of Building Heating, Ventilation, Air-Conditioning, and Refrigeration Systems.
 3. NEBB Procedural Standards for Testing Adjusting Balancing of Environmental Systems.
 4. SMACNA (TAB).
- B. Begin work after completion of systems to be tested, adjusted, or balanced and complete work prior to Substantial Completion of the project.
- C. TAB Agency Qualifications - Company specializing in the testing, adjusting, and balancing of systems specified in this section.
- D. TAB Supervisor and Technician Qualifications - Certified by same organization as TAB agency.

2.02. EXAMINATION

- A. Verify that systems are complete and operable before commencing work. Ensure the following conditions:
 1. Systems are started and operating in a safe and normal condition.
 2. Final filters are clean and in place. If required, install temporary media in addition to final filters.
 3. Duct systems are clean of debris.
 4. Fans are rotating correctly.
 5. Fire and volume dampers are in place and open.

6. Air coil fins are cleaned and combed.
 7. Access doors are closed and duct end caps are in place.
 8. Air outlets are installed and connected.
 9. Duct system leakage is minimized.
- B. Submit field reports. Report defects and deficiencies that will or could prevent proper system balance.
 - C. Beginning of work means acceptance of existing conditions.
- 2.03. PREPARATION
- A. Hold a pre-balancing meeting at least one week prior to starting TAB work.
 - B. Provide instruments required for testing, adjusting, and balancing operations. Make instruments available to Engineer to facilitate spot checks during testing.
 - C. Provide additional balancing devices as required.
- 2.04. ADJUSTMENT TOLERANCES
- A. Air Handling Systems - Adjust to within ± 5 percent of design for supply systems and plus or minus 10 percent of design for return and exhaust systems.
 - B. Air Outlets and Inlets - Adjust total to within +10 percent and -5 percent of design to space. Adjust outlets and inlets in space to within ± 10 percent of design.
- 2.05. RECORDING AND ADJUSTING
- A. Ensure recorded data represents actual measured or observed conditions.
 - B. Permanently mark settings of valves, dampers, and other adjustment devices allowing settings to be restored. Set and lock memory stops.
 - C. After adjustment, take measurements to verify balance has not been disrupted or that such disruption has been rectified.
 - D. Leave systems in proper working order, replacing belt guards, closing access doors, closing doors to electrical switch boxes, and restoring thermostats to specified settings.
- 2.06. AIR SYSTEM PROCEDURE
- A. Adjust air handling and distribution systems to provide required or design supply, return, and exhaust air quantities at site altitude.
 - B. Make air quantity measurements in ducts by Pitot tube traverse of entire cross sectional area of duct.
 - C. Measure air quantities at air inlets and outlets.

- D. Adjust distribution system to obtain uniform space temperatures free from objectionable drafts and noise.
- E. Use volume control devices to regulate air quantities only to extend that adjustments do not create objectionable air motion or sound levels. Effect volume control by duct internal devices such as dampers and splitters.
- F. Vary total system air quantities by adjustment of fan speeds. Provide drive changes required. Vary branch air quantities by damper regulation.
- G. Measure static air pressure conditions on air supply units, including filter and coil pressure drops, and total pressure across the fan. Make allowances for 50 percent loading of filters.
- H. Adjust outside air automatic dampers, outside air, return air, and exhaust dampers for design conditions.
- I. Measure temperature conditions across outside air, return air, and exhaust dampers to check leakage.
- J. Where modulating dampers are provided, take measurements and balance at extreme conditions. Balance variable volume systems at maximum air flow rate, full cooling, and at minimum air flow rate, full heating.
- K. Measure building static pressure and adjust supply, return, and exhaust air systems to provide required relationship between each to maintain approximately 0.05 inches (12.5 Pa) positive static pressure near the building entries.

2.07. MINIMUM DATA TO BE REPORTED

- A. Electric Motors
 - 1. Manufacturer.
 - 2. Model/frame.
 - 3. HP/BHP.
 - 4. Phase, voltage, amperage; nameplate, actual, no load.
 - 5. RPM.
 - 6. Starter size, rating, heater elements.
 - 7. Sheave make/size/bore.
- B. Return Air/Outside Air
 - 1. Identification/location.
 - 2. Design air flow.

3. Actual air flow.
4. Design return air flow.
5. Actual return air flow.
6. Design outside air flow.
7. Actual outside air flow.
8. Return air temperature.
9. Outside air temperature.
10. Required mixed air temperature.
11. Actual mixed air temperature.
12. Design outside/return air ratio.
13. Actual outside/return air ratio.

C. Exhaust Fans

1. Location.
2. Manufacturer.
3. Model number.
4. Serial number.
5. Air flow, specified and actual.
6. Total static pressure (total external), specified and actual.
7. Inlet pressure.
8. Discharge pressure.
9. Sheave make/size/bore.
10. Number of belts/make/size.
11. Fan RPM.

END OF SECTION

SECTION 15076

IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Nameplates.
- B. Tags.
- C. Adhesive-backed duct markers.

1.02. REFERENCE STANDARDS

- A. ASME A13.1 - Scheme for the Identification of Piping Systems; 2015.
- B. ASTM D709 - Standard Specification for Laminated Thermosetting Materials; 2016.

PART 2 PRODUCTS

2.01. IDENTIFICATION APPLICATIONS

- A. Air Handling Units - Nameplates.
- B. Ductwork - Nameplates.
- C. Heat Transfer Equipment - Nameplates.
- D. Instrumentation - Tags.
- E. Major Control Components - Nameplates.
- F. Thermostats - Nameplates.

2.02. NAMEPLATES

- A. Manufacturers
 - 1. Advanced Graphic Engraving, LLC - www.advancedgraphicengraving.com.
 - 2. Kolbi Pipe Marker Co - www.kolbipipemarkers.com.
 - 3. Seton Identification Products, a Tricor Direct Company - www.seton.com.
 - 4. Substitutions - See Section 01600, Materials and Equipment.

- B. Letter Color - White.
- C. Letter Height - 1/4 inch (6 mm).
- D. Background Color - Black.
- E. Plastic - Conform to ASTM D709.

2.03. TAGS

- A. Manufacturers:
 - 1. Advanced Graphic Engraving - www.advancedgraphicengraving.com.
 - 2. Brady Corporation - www.bradycorp.com.
 - 3. Kolbi Pipe Marker Co - www.kolbipipemarkers.com.
 - 4. Seton Identification Products, a Tricor Company - www.seton.com.
 - 5. Substitutions - See Section 01600, Materials and Equipment.
- B. Plastic Tags - Laminated three-layer plastic with engraved black letters on light contrasting background color. Tag size minimum 1-1/2 inch (40 mm) diameter.
- C. Metal Tags - Brass with stamped letters; tag size minimum 1-1/2 inch (40 mm) diameter with smooth edges.

2.04. ADHESIVE-BACKED DUCT MARKERS

- A. Material - High gloss acrylic adhesive-backed vinyl film 0.0032 inch (0.76 mm); printed with UV and chemical resistant inks.
- B. Style - Individual Label.
- C. Color - Yellow/Black.

PART 3 EXECUTION

3.01. PREPARATION

- A. Degrease and clean surfaces to receive adhesive for identification materials.

3.02. INSTALLATION

- A. Install nameplates with corrosive-resistant mechanical fasteners, or adhesive. Apply with sufficient adhesive to ensure permanent adhesion and seal with clear lacquer.
- B. Install tags with corrosion-resistant chain.

- C. Install ductwork with plastic nameplates. Identify with air handling unit identification number and area served. Locate identification at air handling unit, at each side of penetration of structure or enclosure, and at each obstruction.

END OF SECTION

SECTION 15086
DUCT INSULATION

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Duct insulation.
- B. Insulation jackets.

1.02. RELATED REQUIREMENTS

- A. Section 15019 - HVAC FIRESTOPPING
- B. Section 15076 – IDENTIFICATION FOR HVAC PIPING AND EQUIPMENT
- C. Section 15810 – HVAC DUCTS AND CASINGS

1.03. REFERENCE STANDARDS

- A. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.
- B. ASTM C 518 - Standard Test Method for Steady-State Thermal Transmission Properties by Means of the Heat Flow Meter Apparatus; 2004.
- C. ASTM C 553 - Specification for Mineral Fiber Blanket Thermal Insulation for Commercial and Industrial Applications; 2008.
- D. ASTM C 612 - Standard Specification for Mineral Fiber Block and Board Thermal Insulation; 2009.
- E. ASTM C 1071 - Standard Specification for Fibrous Glass Duct Lining Insulation (Thermal and Sound Absorbing Material); 2005.
- F. ASTM E 84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2010.
- G. ASTM E 96/E 96M - Standard Test Methods for Water Vapor Transmission of Materials; 2005.
- H. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.04. SUBMITTALS

- A. Product Data - Manufacturer's catalog cuts sheets, specifications, and installation instructions for the following:
 - 1. Insulation materials.
 - 2. Jacket materials.

- B. Materials Schedule - Itemize insulation materials and thicknesses for each specified application in insulation material schedules in Part 3 of this section. Where optional materials are specified, indicate the option selected.

1.05. QUALITY ASSURANCE

- A. Applicator Qualifications - Company specializing in performing the type of work specified in this section, with minimum five years of experience.
- B. Regulatory Requirements - Insulation installed inside buildings, including duct lining materials, laminated jackets, mastics, sealants, and adhesives shall have a Fire Spread/Smoke Developed Rating of 25/50 or less based on ASTM E 84.

1.06. FIELD CONDITIONS

- A. Maintain ambient temperatures and conditions required by manufacturers of insulations, adhesives, mastics, and insulation cements.
- B. Maintain temperature before, during, and after installation for minimum period of 24 hours.

PART 2 PRODUCTS

2.01. FIBROUS GLASS INSULATION

- A. Composed principally of fibers manufactured from rock, slag, or glass, with or without binders, and asbestos free.
- B. Manufacturers
 - 1. Knauf Insulation.
 - 2. Johns Manville Corporation.
 - 3. Owens Corning Corporation.
- C. Type 'B' Insulation - ASTM C 612; Rigid Board.
 - 1. 'K' value - 0.26 at 75 degrees F, when tested in accordance with ASTM C 518.
 - 2. Maximum Service Temperature - 450 degrees F.
 - 3. Minimum Density - 3.0 pcf or 6.0 pcf as specified.
- D. Type 'C' Insulation - ASTM C 1071; Thermal and Acoustic Duct Liner Board Insulation.
 - 1. 'K' value - 0.27 at 75 degrees F, when tested in accordance with ASTM C 518.
 - 2. Maximum Service Temperature - 250 degrees F.

3. Minimum Density - 3.0 pcf.
4. Erosion, temperature, and fire resistant type; NFPA 90-A and 90-B.
5. Minimum Noise Reduction Coefficients:
 - a. 1/2-inch Thickness - 0.30.
 - b. 1-inch Thickness - 0.45.
 - c. 1-1/2-inch Thickness - 0.60.

2.02. INSERTS

A. High Density Jacketed Insulation Inserts for Hangers and Supports

1. For Use with Fibrous Glass Insulation - ASTM C 612 Fibrous Glass Board.
 - a. 'K' value - 0.26 at 75 degrees F, when tested in accordance with ASTM C518.
 - b. Minimum Density - 6.0 pcf.

2.03. JACKETS

A. Laminated Vapor Barrier Jackets - Factory applied by insulation manufacturer, conforming to ASTM C 1136.

1. Type I - Reinforced white kraft and aluminum foil laminate with kraft facing out.
2. Type II - Reinforced aluminum foil and kraft laminate with foil facing out.
3. Laminated vapor barrier jackets are not required for flexible elastomeric foam insulation.

B. Canvas Jackets - Fire retardant cotton duck, 6 oz/sq yd, complying with NFPA 701.

C. Aluminum Jacket - ASTM B 209 formed aluminum sheet, Type 1100, 3003, 3105, or 5005, Temper H14.

1. Thickness - 0.020-inch sheet.
2. Finish - Smooth.
3. Joining - Longitudinal slip joints and 2-inch laps.
4. Fastening Devices
 - a. Metal Jacket Bands - 1/2-inch wide; 0.020-inch thick Type 18-8 stainless steel.
 - b. Wing Seals - Type 18-8 stainless steel, 0.032-inch thick.
 - c. Sheet Metal Screws - Pan-head Type A hardened aluminum, or stainless steel.

2.04. ADHESIVES, MASTICS, AND SEALERS

- A. Lagging Adhesive (Canvas Jackets) - Childers' CP-50A, Epolux's Cadalag 336, Foster's 30-36.
- B. Vapor Seal Adhesive (Fibrous Glass Insulation) - Childers' CP-82, Epolux's Cadoprene 400, Foster's 85-75 or 85-20.
- C. Vapor Barrier Mastic/Joint Sealer (Fibrous Glass Insulation) - Childers' CP-30, Epolux's Cadalar 670, Foster's 95-44 or 30-35.
- D. Adhesive (Flexible Elastomeric Foam) - Armstrong's 520, Childers' CP-80, Epolux's Cadoprene 488, Foster's 82-40.

2.05. MISCELLANEOUS MATERIALS

- A. Insulation Fasteners
 - 1. Manufacturers
 - a. Duro-Dyne Corporation.
 - b. Erico Fastening Systems Inc.
 - c. Carlisle Hardcast Inc.
 - 2. Fastener Type - Galvanized steel, impact applied or welded with integral head, complete with self-locking insulation retaining washers.
- B. Pressure Sensitive Tape for Sealing Laminated Jackets
 - 1. Manufacturers
 - a. Alpha Associates.
 - b. Childers.
 - c. Morgan Adhesive.
 - 2. Tape Type - Same construction as jacket.
- C. Metal Corner Angles - Galvanized steel, 2 inch x 2 inch x 28 gage.
- D. Reinforcing Membrane
 - 1. Manufacturers
 - a. Alpha Associates Style 59.
 - b. Childers' Chil-Glas.
 - c. Foster's Mast-A-Fab.

PART 3 EXECUTION

3.01. PREPARATION

- A. Perform the following prior to starting insulation work:
 - 1. Install hangers, supports, and appurtenances in their permanent locations.
 - 2. Complete testing of ductwork and equipment.
 - 3. Clean and dry surfaces to be insulated.

3.02. INSTALLATION

- A. General
 - 1. Install the work of this section in accordance with manufacturer's printed installation instructions unless otherwise specified.
 - 2. All ductwork shall be thermally insulated in accordance with the New York State Energy Conservation Code and NAIMA National Insulation Standards.
 - 3. Continue insulation through walls, sleeves, hangers, and other duct penetrations.
 - 4. Insulate ducts prior to erection in place when ducts are required to be installed proximate to walls, ceilings, equipment or other ductwork which will not permit adequate space for installation of insulation after ducts are installed.
- B. Duct Liner Application
 - 1. Adhere insulation with adhesive for 90 percent coverage only where mechanical fasteners cannot be used due to space or size constraints.
 - 2. Secure insulation with mechanical liner fasteners. Refer to SMACNA HVAC Duct Construction Standards - Metal and Flexible for spacing.
 - 3. Seal and smooth joints. Seal and coat transverse joints.
 - 4. Seal liner surface penetrations with adhesive.
 - 5. Duct dimensions indicated are net inside dimensions required for air flow. Increase duct size to allow for insulation thickness.
- C. Fibrous Glass Board Insulation Application
 - 1. Secure insulation to ductwork with insulation fasteners spaced 3 inches in from all corners of ducts, with intermediate fasteners at maximum 16-inch centers in all directions.
 - 2. Butt edges of insulation and fill voids with similar insulation.

3. Seal longitudinal jacket laps continuously with vapor seal adhesive minimum 1-1/2 inch wide.
4. Lap circumferential joints with 4-inch wide jacket material and seal laps continuously with vapor barrier adhesive or 3-inch wide pressure-sensitive sealing tape.
5. Install metal corner angles over the jacketed insulated corners. Seal exposed ends of insulation with vapor barrier mastic.
6. Vapor seal breaks in vapor barrier jacketing, exposed surfaces of duct insulation fasteners, and metal corner angles with pressure-sensitive sealing tape or coat with vapor barrier mastic.
7. Field apply 6 oz canvas jacket over the vapor barrier jacketed insulation where indicated in the Schedule of Ductwork Insulation in this section.
 - a. Apply canvas jacket with lagging adhesive with a 2-inch lap on all seams.
 - b. Use outward clinching staples for additional securement of canvas to bottom of ducts in excess of 48-inch width.
 - c. Apply heavy coat of lagging adhesive to entire canvas surface.
8. Place trapeze hangers outside of jacketed insulated ducts.
 - a. Install high density insulation inserts, of thickness equal to insulation minimum of 4-inch width by the bottom dimensions of the duct at points of support.
 - b. Continuously jacket insulated ducts and filler pieces through supports.

3.03. SCHEDULE OF DUCTWORK INSULATION

A. 100 Percent Outside Air Ducts

1. Exposed Inside Building Envelope
 - a. Type 'B' Rigid Board.
 - 1) Minimum Thickness - 1-1/2 inch.
 - 2) Minimum R value - R-5.
 - 3) Jacket Type - Type I with canvas outer jacket in unclassified or non-corrosive, dry areas .
 - 4) Jacket Type – Aluminum jacket in all corrosive or wet/corrosive areas, unclassified or unclassified/wet areas, and hazardous or hazardous/wet areas.

B. Exhaust Ducts Within 10 Feet of Exterior Openings

1. Type C Thermal and Acoustic Duct Liner Board Insulation
 - a. Thickness – 1 inch.

END OF SECTION

SECTION 15100

PROCESS VALVES

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Furnish, install, and test process valves complete with operators and all other required accessories in accordance with the Contract Documents.

1.02. RELATED SECTIONS

- A. All Division 1 Specifications
- B. Section 15060 - PROCESS PIPING

1.03. REFERENCES

- A. ANSI/AWWA C500 – Metal-Seated Gate Valves for Water Supply Service
- B. ANSI/AWWA C504 – Rubber Seated Butterfly Valves 3 inches through 72 inches
- C. ANSI/AWWA C507 – Ball Valves 6 inches through 48 inches
- D. ANSI/AWWA C508 – Swing Check Valves for Waterworks Service 2 inches through 24 inches NPS
- E. ANSI/AWWA C509 – Resilient-Seated Gate Valves for Water Supply Service
- F. ANSI/AWWA C510 – Double Check Valve Backflow Prevention Assembly
- G. ANSI/AWWA C511 – Reduced Pressure Principle Backflow Prevention Assembly
- H. ANSI/AWWA C512 - Air-Release, Air/Vacuum and Combination Air Valves for Waterworks
- I. ANSI/AWWA C515 – Reduced-Wall Resilient Seated Gate Valves for Water Supply Service
- J. ANSI/AWWA C517 – Resilient-Seated Cast-Iron Eccentric Plug Valves
- K. ANSI/AWWA C520 – Knife Gate Valves 2 inches through 96 inches
- L. ANSI/AWWA C542 – Electric Motor Actuators for Valves and Slide Gates
- M. ANSI/AWWA C550 – Protective Interior Coatings for Valves and Hydrants
- N. ASTM A126 – Gray Iron Castings
- O. ASTM A48 – Gray Iron Castings for Valves, Flanges and Pipe Fittings

1.04. SUBMITTALS

- A. Provide in accordance with Sections 01300, Submittals; 01640, Equipment-General; and as supplemented herein. Submittals shall include, but not be limited to, the following:
 - 1. Shop Drawings
 - a. Shop drawings shall indicate types of valves, appurtenances proposed for the project including conformance to ANSI/AWWA codes and related details for field assembly, operations and maintenance. Contractor shall identify the service that the proposed equipment is intended for on the shop drawing.
 - 2. Shop Test Results - Submit test results, if shop testing is required.
 - 3. Operations and maintenance manuals.
 - 4. Valve Directory
 - a. Provide valve directory listing all valve numbers, the valve function, and location which corresponds to the valve tags.

PART 2 PRODUCTS

2.01. GENERAL

- A. The design working pressure shall be 200 psig for valves 12 inches NPS in diameter and smaller, and 150 psig for valves 16 inches NPS in diameter and larger.
- B. All valves shall be compatible with all the materials the valves shall be exposed to.
- C. All valves and deck hydrants shall have the manufacturer's name monogrammed or initialed by the manufacturer thereon and shall be identified by catalog numbers.
- D. Valve size, type of valve, joint type, class, lining, coatings shall be installed as listed herein or as shown on the Contract Drawings.
- E. Valves shall be of standard manufacturer and of highest quality, both as to material and workmanship, conforming to the latest edition of AWWA standards specified.
- F. All valves shall be provided with flanged or screwed ends as described herein or shown on the Contract Drawings.
- G. Valves 2 inches in nominal diameter and smaller shall be all brass or bronze, unless otherwise noted. Valves over 2 inches in nominal diameter shall be iron bodied, fully brass or bronze mounted, unless otherwise noted.
- H. All surface forming joints or bearing surfaces shall be machined to a perfect fit.
- I. All disc and seat rings shall be carefully and thoroughly secured in place with the iron castings machined where the rings are bare and the backs of the rings machined all over. After the rings have

been fastened securely in place, the front shall be machined all over to a perfectly true and smooth bearing surface.

- J. All valves with non-rising stems shall have valve position indicators.
- K. Valves shall open counterclockwise (left) unless otherwise specified.
- L. Ferrous metal valves shall be painted in accordance with Section 09900, Painting.
- M. All new motorized actuators on motorized valves shall be of the same manufacturer.
- N. All valves installed on glass-lined process piping shall be glass lined. Refer to Section 15060, Aboveground Process Piping.

2.02. PLUG VALVES

- A. Plug valves shall be non-lubricated, eccentric type and shall close drop-tight at the rated pressure of 150 psig.
- B. Port areas shall be of rectangular design and 100 percent of the standard pipe area.
- C. Valves shall be furnished with end connections shown on the Contract Drawings.
 - 1. Flanged valves shall be in accordance with the ANSI B16.1 Class 125/150lb standard.
 - 2. Mechanical joint ends shall be in accordance with the AWWA Standard C111.
- D. Valve bodies shall be constructed of cast iron in accordance with AWWA C517. All exposed nuts, bolt springs and washers shall be stainless steel.
- E. Valves shall be capable of providing drip-tight shut-off to the full rating with pressure on either side of the plug.
- F. Valves shall have welded-in-place nickel seats, except where rubber lining is required. Seats shall be raised 1/4-inch to prevent the plug from being in contact with the valve body when the plug is closed.
- G. The plug shall be cast iron with chloroprene resilient facing.
 - 1. The plug shall be capable of withstanding the full pressure rating of the valve in either direction without the use of structural ribs that extend beyond the profile of the plug.
 - 2. No bolt-on sections to the plug shall be acceptable.
 - 3. Internal components shall be chemically resistant to the liquid for which it is servicing.
- H. Body and bonnet bearings shall be fabricated from sintered oil impregnated 316 stainless steel.
- I. The plug shaft seal shall utilize a bonnet and gland with a packing ring bonnet.
 - 1. Bonnet shall be the same material as the body.

2. Gland shall be cast iron.
 3. Packing shall be NBE acrylonitrile-butadiene, V-type.
 4. For valves 4 inches and greater, the plug shaft seal shall be adjustable or completely replaceable without removing the operator, bonnet or plug from the valve.
 5. The plug shaft seal must be capable of being allowed to drain away from the valve without any liquid entering the operator.
- J. All valves 6 inches or larger shall be provided with gear actuators and handwheels. Inside valves smaller than 6 inches shall have lever operators.
1. Valves installed 6 feet above the floor or higher shall be provided with chainwheel operators.
 2. The diameter of the handwheels or chainwheels shall not exceed twice the diameter of the gear sector. Handwheels shall be ductile iron.
 3. Gears shall be made of bronze or be mounted on bronze bearings.
 4. Actuators shall be designed to produce the required torque with a maximum pull of 40 lbs. on the handwheel or chainwheel. The maximum input on operating nuts shall be 150 ft-lbs.
 5. All actuator components shall be designed to withstand a pull of 200 ft-lbs. for handwheel/chainwheel and 300 ft-lbs. for operating nuts without any damage.
 6. Power actuators shall be designed and manufactured in accordance with all applicable requirements of ANSI/AWWA C450.
 7. Submerged valves shall be capable of withstanding external water pressure 50 percent greater than exposed to.
- K. Unless otherwise specified, valves shall be installed so that when closed, the plug is at the upstream end of the valve.
- L. In horizontal piping with the plug shaft installed horizontally, the plug shall be in the upper part of the valve body when open.
- M. Plug valves shall be as manufactured by DeZurik, or equal.

2.03. CHECK VALVES

- A. The valves shall be designed, manufactured, tested and certified to American Water Works Association Standard ANSI/AWWA C508.
- B. The valves used in potable water service shall be certified to NSF/ANSI 61 Drinking Water System Components – Health Effects, and certified to be Lead-Free in accordance with NSF/ANSI 372.
- C. Manufacturer shall have a quality management system that is certified to ISO 9001 by an accredited, certifying body.

- D. The valves shall have flanges with drilling to ANSI B16.1, Class 125.
- E. The valve body shall be full flow equal to nominal pipe diameter at all points through the valve. The 4-inch (100mm) valve shall be capable of passing a 3-inch (75mm) solid. The seating surface shall be on a 45-degree angle to minimize disc travel. A threaded port with pipe plug shall be provided on the bottom of the valve to allow for field installation of a backflow actuator or oil cushion device without special tools or removing the valve from the line.
- F. The top access port shall be full size, allowing removal of the disc without removing the valve from the line. The access cover shall be domed in shape to provide flushing action over the disc for operating in lines containing high solids content. A threaded port with pipe plug shall be provided in the access cover to allow for field installation of a mechanical, disc position indicator.
- G. The disc shall be of one-piece construction, precision molded with an integral O-ring type sealing surface and reinforced with alloy steel. Non-slam closing characteristics shall be provided through a short 35-degree disc stroke and a disc accelerator to provide a cracking pressure of 0.3 psig.
- H. The disc accelerator shall be of one-piece construction and provide rapid closure of the valve in high head applications. The disc accelerator shall be enclosed within the valve and shall be field adjustable and replaceable without removal of the valve from the line. The disc accelerator shall be securely held in place captured between the cover and disc. It shall be formed with a large radius to allow smooth movement over the disc surface.
- I. The valve disc shall be cycle tested 1,000,000 times in accordance with ANSI/AWWA C508 and show no signs of wear, cracking, or distortion to the valve disc or seat and shall remain drop tight at both high and low pressures.
- J. The valve body and cover shall be constructed of ASTM A536 Grade 65-45-12 ductile iron.
- K. The disc shall be precision molded Buna-N (NBR), ASTM D2000-BG.
- L. The disc accelerator shall be Type 302 stainless steel.
- M. All check valves shall be SurgeBuster® Series as manufactured by Val-Matic Valve and Manufacturing Corp.

2.04. SOLENOID VALVES

- A. Solenoid valves shall be properly sized and rated for their intended use and shall be installed where indicated on the Contract Drawings and as required to facilitate proper process equipment operations.
- B. Each valve shall be of heavy-duty type capable of operating on continuous duty.
- C. Solenoid valves in hazardous areas shall be rated explosionproof and all others shall be waterproof.
- D. Valves shall be suitable for operation on 120 VAC, single phase, 60 Hertz.
- E. Engineer shall provide valve position when de-energized during shop drawing review.
- F. Metallic solenoid valves shall be Model WP 8210 (waterproof) or Model 8211 (explosion-proof) as

manufactured by Automatic Switch Company; Skinner; or equal, and shall be preceded with a bronze-bodied Monel metal element strainer equal to the Automatic Switch Company Bulletin 8600.

- G. Thermoplastic solenoid valves shall be Series "PS" pilot with Teflon pipe bellows as manufactured by Plast-O-Matic or equal. These valves shall be rated as both waterproof and explosion-proof. The valves shall be preceded by a PVC-bodied strainer as manufactured by Plast-O-Matic, Hayward, or equal. Manufacturer shall certify that the valve is chemically resistant to the solution the valve is servicing.

2.05. TAPPING SLEEVES AND VALVES

- A. Tapping sleeves and valves shall be provided where shown on the Contract Drawings.
- B. Tapping sleeves shall be compatible with the pipe encountered so that a watertight connection will be made.
- C. The sleeve shall be adequate to provide reinforcement of the pipe being tapped and protect this pipe against all strains resulting from either tapping the pipe or connecting to the pipe.
- D. Tapping valves used shall conform to the requirements for gate valves specified herein.
- E. Tapping sleeves and tapping valves for this project shall be Models H-615 and H-687, respectively, as manufactured by Mueller Company or equal.
- F. The tapping contractor shall have a minimum of five years' experience in performing taps.
- G. After the sleeve has been installed, but prior to making the tap, the sleeve shall be subjected to a hydrostatic test equal to the maximum line pressure. There shall be no observed leakage from the sleeve.

2.06. HANDWHEEL OPERATORS

- A. Valves specified with handwheel operators shall have the proper size handwheel to provide an effortless operation.
- B. Handwheels shall be made of bronze or cast iron and shall be properly secured to the valve stem to prevent displacement during use.

2.07. WRENCH OPERATORS

- A. Wrench for wrench-operated valves located above ground shall be of bronze or cast iron, and shall be of suitable size and length to facilitate an effortless operation. One wrench shall be provided for each valve on the project requiring wrench operation.

2.08. CHAIN AND WHEEL OPERATORS

- A. All valves located with center of shaft 6 feet or higher from the operating floor shall be equipped with chainwheel operators.
- B. The chainwheel operators shall have a straight or a beveled gear reducer-type operator depending on the type recommended by the manufacturer.

- C. The length of the operating chain shall extend to 4 feet 0 inches above the operating floor.
- D. Chain in wet or corrosive areas shall be stainless steel.

2.09. EXTENDED OPERATORS

- A. All submerged valves, valves located below walkways and as otherwise shown on the Drawings shall be provided with extended operators.
- B. Extended operators shall be cold rolled steel supported by bronze bushed, cast iron guide brackets at intervals not to exceed 10 feet.
- C. Extended operators shall be provided with position indicators and shall be of sufficient length to allow operation of valve from approximately 48 inches above the surface of the walkway or as shown in the Contract Drawings.
- D. Anchor bolts for guide brackets shall be stainless steel.
- E. Right angle extended operators of the same material shall be furnished where shown on the Contract Drawings. Each right angle extended operator shall be provided with a minimum of two bearing blocks.

2.10. VALVE TAGS AND DIRECTORY

- A. Provide valve tags for all valves. Tag/identification shall be coordinated with Engineer.
- B. Tags shall be made from a plastic laminate of heavy plastic with a brass eyelet in the corner and shall be engraved or printed with the valve number and fluid in the pipe.
- C. Tags shall be fastened to each valve with a brass chain.
- D. Tags to be made by Seton Name Plate Company, New Haven, CT; W.H. Brady Company; or equal.
- E. A final valve directory shall be provided listing all valve numbers, the valve function, and location which corresponds to the valve tags. The directory shall be typewritten and framed with a glass cover and delivered to the Owner after inspection and approval by the Engineer.

2.11. FABRICATION REQUIREMENTS

- A. Shop coat per manufacturer's standard finish system and color.
- B. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- C. Welds shall be continuous unless noted otherwise.
- D. Grind exposed joints flush and smooth with adjacent finish surface. Make exposed joints butt tight, flush, and hairline. Ease exposed edges to small uniform radius.

PART 3 EXECUTION

3.01. EQUIPMENT INSTALLATION

- A. Install in accordance with the Contract Documents and the manufacturer's written instructions.
- B. No modifications to equipment shall be made without the written consent of the manufacturer and approval of Engineer.
- C. Field verify all dimensions and elevations. Notify Engineer of specific differences.
- D. Verify that structures are complete and ready to receive work.
- E. All valves, deck hydrants and appurtenances shall be carefully inspected in the field before installation.
 - 1. Cracked, broken, warped, out-of-round, damaged joints, including damaged linings or coatings, or otherwise defective valves, hydrants and stops, as determined by the Engineer, shall be culled out and not installed.
 - 2. Rejected material shall be clearly tagged in such manner as not to deface or damage it, and the material shall then be removed from the job site by the Contractor at his own expense.
- F. For tapping sleeve and valve connections, the Contractor, prior to making any connections, shall verify the material and outside diameter of existing water main.
- G. Contractor shall have on the job site all the proper tools, gauges, pipe cutters, lubricants, etc., to properly install valves, deck hydrants, etc.
- H. Contractor shall verify all valve positions and locations before installation.
- I. Valves, backflow preventers and appurtenances shall be installed at the elevations and locations shown on the Contract Drawings.
- J. The Contractor shall furnish slings, straps, and/or approved devices to provide satisfactory support of the valves or hydrants when lifted. Transportation from storage areas to the work area shall be restricted to operations which can cause no damage to the coating or lining or castings.
- K. The valves or deck hydrants shall not be dropped from trucks onto the ground or into the trench.
- L. All valves shall be installed in accordance with the specifications for the pipe to which they are to be connected and as previously described for individual types of valves.
- M. Joints of valves shall be made up in accordance with the Contract Drawings and/or as described under the appropriate pipe joint descriptions found in other sections of these specifications.
- N. The valves shall be so located that they are accessible for operating purposes and shall bear no stresses due to loads from the adjacent pipe.
- O. All valves shall be inspected before installation, and they shall be cleaned and well lubricated before being installed in the line.

- P. Hydrants shall be set at locations specified on the Contract Drawings. Hydrants shall be set so that the barrel is truly vertical and shall be backfilled so that the barrel will remain vertical. They shall be placed with 3 cubic feet of crushed stone pocket to provide drainage for the hydrant.
- Q. Furnish all necessary materials (including lubricants, chemicals, etc.) and equipment (including measuring devices, etc.) for installation and testing.
- R. Surface preparation and field painting shall be in accordance with Division 9 specifications.
- S. All bolts, nuts, washers, and other fasteners shall be Type 316 stainless steel unless otherwise noted.
- T. Anchor rods (bolts) shall be Type 316 SS HILTI-style adhesive anchors.
- U. Backpaint aluminum in contact with painted or galvanized steel or concrete with 5 mils of Tnemec Series N69-Gray, Hi-Build Epoxoline or DuPont 25P Epoxy.
- V. Isolate dissimilar metals by backpainting or with dielectric using stainless steel fasteners

3.02. TESTING AND STARTUP

- A. Testing and startup shall be performed in accordance with Section 01660, Testing and Startup, and as specified herein unless otherwise noted.
- B. All testing shall be done in the presence of the Engineer and the equipment manufacturer or their approved representative.
- C. Valves and appurtenances installed in piping systems shall be pressure tested under the same conditions required for the adjacent piping. Refer to Section 15060, Aboveground Process Piping, for pipe testing requirements.

END OF SECTION

SECTION 15140
SUPPORTS AND ANCHORS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Furnish and install supports and anchors complete with all required accessories to provide complete support systems that can adequately support loads under all operating conditions in accordance with the Contract Documents.
- B. The locations of all required supports, anchors, and accessories are not shown on the Drawings.
- C. Where supports, anchors, and accessories are shown on the Drawings, they shall be considered to be the minimum allowable requirements. Provide additional supports, anchors, and accessories as required for complete support systems.

1.02. SECTION INCLUDES

- A. Piping and equipment hangers and supports.
- B. Equipment bases and supports.
- C. Inserts.
- D. Schedules.

1.03. RELATED SECTIONS

- A. Division 1 specifications
- B. Section 03001 - CONCRETE
- C. Division 5 specifications
- D. Section 09900 – PAINTING

1.04. REFERENCES

- A. ASME B31.1, Power Piping, latest edition
- B. ASME B31.3, Process Piping, latest edition
- C. ASME B31.9, Building Services Piping, latest edition
- D. ASTM E84 - 13a, Standard Test Method for Surface Burning Characteristics of Building Materials
- E. ASTM F708, Design and Installation of Rigid Pipe Hangers
- F. MSS SP-58 - Pipe Hangers and Supports - Materials, Design and Manufacturer

- G. MSS SP-69 - Pipe Hangers and Supports - Selection and Application
- H. MSS SP-89 - Pipe Hangers and Supports - Fabrication and Installation Practices
- I. NFPA 13: Standard for the Installation of Sprinkler Systems, latest edition
- J. NFPA 14: Standard for the Installation of Standpipe and Hose Systems, latest edition
- K. Seismic Considerations - Refer to State Building Codes

1.05. SUBMITTALS

- A. Product Data – Provide manufacturers' catalog data including materials and load capacity.
- B. Design Data - Indicate load carrying capacity of trapeze, unistrut, multiple pipe, and riser support hangers.
- C. Manufacturer's Installation Instructions - Indicate special procedures and assembly of components.

1.06. REGULATORY REQUIREMENTS

- A. Conform to National Standard Plumbing Code – Chapter 8 for support of plumbing piping.
- B. Supports for Sprinkler Piping - In conformance with NFPA 13.
- C. Supports for Standpipes - In conformance with NFPA 14.

PART 2 PRODUCTS

2.01. GENERAL

- A. All hangers and supports shall be manufactured or fabricated from materials suitable for the particular area in which they are installed.
 - 1. The Contractor shall install hanger supports that are similar in material construction regardless of piping or conduit application within a given area.
 - 2. Pipe hangers and supports for process pipe, conduit, heating and ventilating piping and plumbing piping shall be constructed of similar materials, (e.g., all hangers and supports located in an interior wet location shall be manufactured from Type 316 stainless steel or polyvinyl chloride (PVC)-coated galvanized steel).
 - 3. Where applicable, fasteners, brackets and supports shall be fabricated in accordance with Section 05500, Miscellaneous Fabrications, and as specified herein.

2.02. SEISMIC RESTRAINTS

- A. Provide seismic restraint for all piping, ductwork, equipment, and systems in accordance with all

applicable Building Codes.

2.03. MATERIALS

- A. Pipe support and hanger material in contact with pipes shall be compatible with the piping material so that neither shall have a deteriorating action on the other.
- B. All hangers and supports shall be manufactured or fabricated from materials suitable for the particular area in which they are installed. Reference the Contract Documents for area classifications and the Hanger and Support Application Schedule herein.
- C. Where applicable, fasteners, brackets and supports shall be fabricated in accordance with Section 05500, Miscellaneous Fabrications, and as specified herein.
- D. Anchors for supports shall be fabricated in accordance with Section 05505, Concrete and Masonry Anchors.
- E. Stainless Steel - For the purpose of this section, all stainless steel shall be Type 316.
- F. PVC-Coated Materials - PVC-coated hangers and supports shall be installed where applicable for chemical and corrosion-resistant applications as required in the specified areas, or as specifically called out in other sections of these specifications. PVC coating process shall be as follows:
 - 1. Piping systems scheduled as PVC-coated shall have stainless steel support rods, stainless steel mounting hardware, stainless steel fasteners, and stainless steel concrete inserts. All non-stainless steel parts of the hangers and supports shall be PVC coated.
 - 2. Hanger or support shall be hot dipped galvanized including the threads.
 - 3. The zinc surface shall be treated with chromic acid prior to coating to enhance the bond between metal and plastic.
 - 4. All surfaces shall be coated with an epoxy acrylic primer of approximately 0.0005-inch thickness.
 - 5. The coating shall be applied by the liquid plastisol method.
 - 6. The plastisol shall be compounded of pure materials and shall be free of any fillers or secondary plasticizers.
 - 7. A PVC coating shall be bonded to the galvanized outer surface of the product. The bond between the PVC coating and the product surface shall be greater than the tensile strength of the plastic. The thickness of the PVC coating shall be a minimum of 0.040-inch (40 mils).
 - 8. Coating system shall be OCAL-40 as provided by Occidental Coating Company, Van Nuys, CA; Plasti-Bond Red as provided by Robroy Industries, Verona, PA; or equal.
- G. Steel and steel alloy hangers and supports shall conform to ASME B31.1, ASME B31.3, ANSI B31.10, and MSS Standard Practice SP-58.
- H. Fiberglass Reinforced Plastic (FRP) Hangers and Supports

1. FRP Systems - Use StrutTech, Aickinstrut, or equal.
2. All vinylester (Series VF) and polyester fiberglass (Series PF) shall be Class 1 ASTM E84, and Polyurethane V-O shall be UL94V PVC (Capping strip) 5V and V-O UL94.
3. All fiberglass channels shall be vinylester or polyester resin.
4. All pipe clamps shall be manufactured of thermoplastic polyurethane, polyester or thermoset vinylester fiberglass, compatible with pipe size to be supported.
5. All fasteners including channel nuts, bolts, nuts, washers, couplers shall be glass filled polyurethane resin.
6. All thread rods shall be vinylester fiberglass.
7. Verify that the materials of the FRP support system meet the required chemical resistance for the chemical being transported.

2.04. MANUFACTURERS

- A. Anvil International
- B. Carpenter & Patterson
- C. Unistrut Corporation
- D. Cooper Industries - B-Line Systems
- E. Globe Division of United States Gypsum
- F. Robroy Industries
- G. OCAL
- H. Or equal

2.05. HANGER AND SUPPORT SCHEDULES

- A. The following schedules are provided to identify the type of hangers and supports acceptable under this Contract. Provide the type of hangers and supports in these schedules, however, the acceptable materials of construction shall be provided as identified in the "Application Schedule" for the various systems and the intended location of the hanger or support. Several pipe supports are not specifically labeled on the Drawings for clarity.

Pipe Hanger and Support Schedule – Inside Process Piping

Type	Pipe System	Designation
A	All materials, non-insulated	Clevis hanger
A	All materials, insulated	Clevis hanger with protection shields
B	Ductile iron, steel	Pipe stanchion saddle, pipe support and floor plate with stainless steel yoke.
C	Ductile iron, PVC	Split pipe clamp with base flange
D	PVC and steel	PVC-coated clamp
E	Ductile iron, steel	Pipe support in trench
F	Ductile iron, steel	Concrete base fitting support
G	Ductile iron, steel	Concrete pipe support
H	Ductile iron, steel	Welded steel bracket
I	PVC, hose	Pipe channel support
J	Ductile iron, steel PVC	Channel framing
K	Ductile iron, steel	Steel pipe floor support
L	Ductile iron, steel, PVC	Concrete pipe support in trench
M	Ductile iron, steel, PVC	Steel angle pipe support

- B. Components of the alphabetical pipe support “Types” are further defined below. The numerical “Type” listed is based on nomenclature from MSS SP-58. Support materials from the manufacturers shall correspond to the MSS SP-58 type.
- C. Refer to the support details on the Drawings for further requirements.
- D. Process Piping
1. U-Bolts - Type 24.
 2. Clevis Hangers - Type 1. Use Type 39 or 40 protection shields for insulated pipe.
 3. Yoke Type Pipe Clamp - Type 2. Use for pipe with up to 4 inch insulation.
 4. Pipe Clamps - Type 3, 4 and 12. Do not use for insulated pipe.
 5. Riser Clamps - Type 8 and 42. Do not use for insulated pipe.
 6. Straps - Type 26.
 7. Pipe Rollers and Roller Supports - Type 41 and 43. Use Type 39 or 40 protection shields for insulated pipe.
 8. Trapezes - Type 59. Use Type 39 or 40 protective shields for insulated pipe. To be used only if all of the pipes to be supported are at the same bottom elevation.

9. Roller Hanger - Type 44, Use Type 39 or 40 protective shields for insulated pipe.
 10. Stanchions
 - a. Pipe Saddle - Type 37. Use Type 39 or 40 protective shields for insulated pipe.
 - b. Adjustable Pipe Saddle with U-bolt, Type 38. Use Type 39 or 40 protective shields for insulated pipe.
 11. Wall Brackets
 - a. For 4-inch diameter and larger piping, use only where indicated on Drawings.
 - b. Light duty, Type 31.
 - c. Medium duty, Type 32.
 - d. Heavy duty, Type 33.
 12. Structural Attachments
 - a. Welded Beam Attachment - Type 22.
 - b. Plate Lug - Type 57.
 - c. Concrete Inserts and Attachments - Anvil Figure 47, 49, and 52, or equal.
 13. Strut Support Systems - Use Unistrut Corporation, B-Line Systems, Globe Division of United States Gypsum, or equal.
 - a. System shall permit rigid metal construction without welding or drilling.
 - b. All members shall be fully adjustable, demountable and reusable.
 - c. One manufacturer shall furnish system complete with all nuts, bolts, couplers, channels and all other required fittings and mechanical accessories.
 - d. Channels and accessories shall be galvanized steel with 20 mil PVC coating, all of the same color.
 - e. All mounting hardware, fasteners and concrete inserts shall be Type 316 stainless steel.
 - f. Pipe clamps shall be PVC-coated galvanized straps with stainless steel rods, nuts, and flat washers.
 - g. Verify that the load carrying capacity of the strut system is adequate for weight of pipes and contents and span utilized.
- E. Hanger rods shall be machine threaded and based on root diameter. When hanger rods are over 18 inches in length, lateral bracing shall be provided every fourth hanger. The minimum rod diameter shall be as follows:

Pipe Diameter (Inches)	Minimum Rod Size (Inches)
2 and smaller	3/8
2-1/2 to 3-1/2	1/2
4 and 5	5/8
6 and 8	3/4
10 and 12	7/8
14 to 18	1
20 and 24	1-1/4

PART 3 EXECUTION

3.01. GENERAL

- A. All piping to be supported from floors, concrete slabs, ceilings or walls shall have supports and parts required for the installation of the piping systems which conform to the applicable requirements of ASME B31.1 and ASME B31.3 to the requirements of Chapter 1, Section 6 of the ANSI Code for Pressure Piping (B31.1), except as modified and supplemented by the requirements set forth in these Specifications.
- B. All piping shall be rigidly supported from the building structure by approved hangers, inserts, or supports, with adequate provisions for expansion and contraction. No piping shall be supported from other piping or from metal stairs, ladders, and walkways unless specifically directed by Engineer.
- C. In addition to the hangers and supports spaced as specified above, Contractor shall furnish and install additional hangers and supports at all valves, fittings, and pipe line equipment. Holding devices for valves and other pipe line appurtenances shall be designed and constructed to hold each unit securely.
- D. All vertical pipes shall be supported at each floor and/or at intervals of not more than 10 feet by approved pipe collars, clamps, brackets, or wall rests, and at all points necessary to ensure rigid construction.
- E. Spacing of supports for PVC pipe and provision for expansion shall be determined by operating temperature, size of pipe, and other conditions. It shall be such as to prevent subsequent visible sagging of the pipe between supports due to plastic deformation.
- F. In general, adjustable saddle supports shall be used when the height of the centerline of the pipe is 0 to 6 feet above the floor and hangers or brackets shall be used when the height of the centerline of pipe is greater than 6 feet.
- G. Install building attachments within concrete slabs or attach to structural steel. Space attachments within maximum piping span length indicated in MSS SP-69. Install additional attachments at concentrated loads, including valves, flanges, guides, strainers, and expansion joints, and at changes in direction of piping. Install concrete inserts before concrete is placed; fasten inserts to forms and install reinforcing bars through openings at top of inserts.

- H. Install hangers and supports complete with necessary inserts, bolts, rods, nuts, washers, and other accessories. Non-adhesive-type anchors are only allowed in applications in which the support is suspended from the ceiling and shall comply with Section 05505, Concrete and Masonry Anchors. All other applications shall be provided with adhesive anchors.
- I. Install hangers and supports to allow controlled thermal and seismic movement of piping systems, to permit freedom of movement between pipe anchors, and to facilitate action of expansion joints, expansion loops, expansion bends, and similar units.
- J. Load Distribution - Install hangers and supports so that piping live and dead loads and stresses from movement will not be transmitted to connected equipment.
- K. The hangers and supports shall be designed to resist or to allow controlled movement caused by operation of equipment.
- L. Pipe Slopes - Install hangers and supports to provide indicated pipe slopes and so maximum pipe deflections allowed by ASME B31.9, "Building Services Piping," is not exceeded.

3.02. SUPPORT INTERVALS

- A. At a minimum, additional supports or anchors will be required at:
 - 1. All bends on pump discharge line to prevent vertical or horizontal movement resulting from pressure thrusts.
 - 2. Each side of all couplings in the horizontal plane to eliminate vertical force on couplings.
 - 3. All branch connections to eliminate vertical and horizontal movement.
 - 4. Both side of expansion joints to prevent horizontal movement.
 - 5. All pipe joints subject to torque along centerline of pipe. Piping shall be supported so that pumps and other equipment may be removed without providing additional pipe support.
 - 6. Where depicted on the Drawings, pipe supports shall be of the type indicated.
- B. Flanged Ductile Iron Pipe - Supports and hangers for pipe 1-1/4 inches and larger, support spacing shall be 10 feet maximum.
 - 1. Additional supports and hangers will be required for grooved end ductile iron pipe and fittings at the Contractor's expense.
- C. Plastic Pipe - Supports and hangers and/or braces for plastic piping shall be used at all bends and support spacing shall be 4 feet maximum horizontally and vertically, except non-metallic electrical conduit support spacing shall be 3 feet maximum.
 - 1. Supports and hangers for plastic piping shall include saddles and bands to distribute load and thus avoid localized deformation of the pipe.
 - 2. All necessary inserts or appurtenances shall be furnished and installed in the concrete or structures for adequately securing these supports to the structure.

- D. Steel and Wrought Iron Pipe - Supports and hangers for steel and wrought iron pipe less than 1-1/4 inches, support spacing shall be 8 feet maximum; 1-1/4 inches and larger, support spacing shall be 10 feet maximum.
- E. Copper Pipe - Copper pipe 1/2-inch to 1-inch, support spacing shall be 6 feet maximum; 1-1/4-inch and over, support spacing shall be 10 feet maximum.
- F. Cast Iron Pipe - Cast iron soil pipe shall be supported at each length, close to bell.

3.03. INSERTS

- A. Provide inserts for suspending hangers from concrete slabs and sides of concrete beams.

3.04. HANGER AND SUPPORT APPLICATION SCHEDULE

- A. The materials of construction for all hangers and supports, applicable to inside process piping, fire protection, plumbing and HVAC systems, used on the project, shall be in accordance with the Hanger and Support Application Schedule. Refer to the Drawings for the classification for each room.

Area	Acceptable Materials
Exterior	
<ul style="list-style-type: none"> • Exposed to outdoor conditions • Inside tanks • Submerged locations unless otherwise specified 	Type 316 stainless steel
Interior	
Corrosive or Wet/Corrosive Areas (either Unclassified or Hazardous)	
<ul style="list-style-type: none"> • Interior sodium hypochlorite storage and feed areas 	FRP
Unclassified, Unclassified/Wet Areas	
<ul style="list-style-type: none"> • Pump rooms • Piping galleries • Below-grade vaults, manholes, and handholes • Polymer storage and feed areas 	Type 316 stainless steel
Hazardous, Hazardous/Wet Areas	
<ul style="list-style-type: none"> • NEC Class I, Division 1 or 2, Groups C and D 	Type 316 stainless steel

END OF SECTION

SECTION 15170

MOTORS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. All electric motors supplied under these Contract Documents shall conform to this specification as minimum requirements.
- B. All electric motors shall conform to ANSI Standards for Rotating Electrical Machinery (Designation C50) and to NEMA Standards MG-1 for Motors and Generators (NEMA Standard Publication latest revision) and to NEC, Article 430.
- C. The rating of the motors offered shall in no case be less than the horsepower required in the Contract Documents.
- D. Motors shall operate without an undue noise or vibration and shall show no signs of electrical unbalance.
- E. Motor efficiency shall be a prime consideration in selection of all motors. Unless otherwise specified in the individual equipment specifications, motors shall meet the requirements of Article 1.08.
- F. Owner shall receive all rebates from the utility as applicable. Contractor shall provide paid invoices for all motors for which rebates are available. Add specific rebate information.)

1.02. RELATED SECTIONS

- A. Drawings and General Provisions, including General and Supplementary Conditions and other Division 1 specifications, apply to this section.
- B. Section 09900 - PAINTING
- C. All sections where motors are specified or required.

1.03. SUBMITTALS

- A. Shop Drawings of Electric Motors - Submit in accordance with Sections 01300, Submittals, and 01640, Equipment-General.
- B. Include with submittals:
 - 1. Electric characteristics.
 - 2. Design characteristics.
 - 3. Mechanical construction.
 - 4. Manufacturer's name.

5. Manufacturer's type.
 6. Pertinent specifications for the use intended.
 7. Name of the equipment to be driven.
 8. Motor storage requirements.
- C. Tabulate the following information in one location on each electric motor shop drawing submittal:
1. Motor manufacturer.
 2. Model.
 3. Frame number.
 4. Type of enclosure.
 5. Volts.
 6. Hertz.
 7. Phase.
 8. NEMA design.
 9. Code letter.
 10. Locked rotor amps.
 11. Locked rotor torque.
 12. Nameplate horsepower.
 13. Motor rpm, full load nameplate.
 14. Insulation class.
 15. Service factor.
 16. Maximum ambient temperature.
 17. Maximum temperature rise.
 18. Shop painting.
 19. Nominal efficiency.
 20. Guaranteed minimum efficiency at 50, 75 and 100 percent full load.
 21. Minimum power factor at 50, 75 and 100 percent load.

22. Resistance temperature device information (if applicable).

1.04. INSULATION

- A. Minimum NEMA Class B insulation unless otherwise noted in the individual equipment specifications.
- B. Provide Class F insulation if required by the manufacturer to meet specified energy efficiency.
- C. Use Class F or H insulation where ambient temperatures exceed 104 degrees F (40 degrees C) as shown on the Contract Drawings or elsewhere in the specifications.
- D. Where motors are to be used with variable frequency drives (VFDs), insulation systems shall be “inverter grade” with Class F thermostats. Insulation system shall meet NEMA MG-1, Part 31 standards.

1.05. RATINGS AND DESIGN

- A. Furnish with adequate ratings to accelerate and drive connected equipment under all normal operating conditions without exceeding nameplate ratings.
- B. Furnish with service factors in accordance with NEMA standards as follows unless otherwise noted in individual equipment specifications.

Type of Machine	Minimum Service Factor (SF)
Mill and chemical duty	1.15
Open drip-proof	1.15
Submersible	1.15
Inverter duty	1.0
All others	1.0

- C. Motors shall operate successfully under running conditions at rated load and frequency with a voltage variation up to 10 percent; at rated load and voltage with a frequency variation up to 5 percent; and at rated load with a combined variation in voltage and frequency not more than 10 percent above or below the rated voltage and frequency provided that the frequency variation does not exceed 5 percent.
- D. Assume voltage unbalance to be 1 percent. Altitude is less than 3,300 feet.
- E. Assume ambient temperatures to be 40 degrees C for motors in air and 25 degrees C for submersible motors.

F. Motor winding temperature rise shall be as follows:

	Class of Insulation		
	B	F	H
Open, drip-proof motors	80°C	105°C	125°C
Totally enclosed fan-cooled motors	80°C	105°C	125°C
Totally enclosed non-ventilated motors	85°C	110°C	135°C
Explosionproof motors	80°C	105°C	125°C
All other motors with 1.15 SF or higher	90°C	115°C	--

G. Use the applicable paragraphs of NEMA MG1 12.42 in making design selections.

H. Unless otherwise specified, all three phase motors shall be constant speed, squirrelcage induction type.

1. The Contractor shall provide multi speed (multiple windings or consequent poles - single winding, wound rotor, etc.) where required as specified in individual equipment specifications.

I. Motor Voltages

1. Motors of 1/2 HP and Larger - Squirrel cage induction type designed for 3phase, 60 cycle, 230/460 volt operation unless otherwise specified.
2. Motors Smaller Than 1/2 HP - Capacitor type designed for single phase, 60 cycle, 120 volt operation unless otherwise specified.
3. Motors indicated on the Contract Drawings and/or specified in the specifications as 208 volt shall be specially wound for voltage indicated and/or specified.
4. Dual-rated motors (i.e., 208/230 volts) are not acceptable for operation on 208 volts.

J. Motors intended for inverter duty (those controlled through variable speed drives), shall be specifically manufactured for inverter duty and shall be rated to meet or exceed the requirements in MG-1, Part 31. Motor rated "suitable for use with VFDs" or similar wording are acceptable.

K. Hazardous area motors shall be certified to meet UL requirements for operation over the motors entire speed range.

L. Unless otherwise specified, all single-phase motors shall be NEMA design letter M or N, designed to withstand full voltage starting in accordance with MG12.32.

1. Motors shall comply with NEMA Standards for Definite Purpose Motors (paragraphs 18.001 18.717).

M. In general, capacitor start induction run or split phase-type motors shall be used unless otherwise approved by the Engineer.

- N. Shaded pole motors larger than 1/8 HP will not be allowed.
- O. Thermal overload protectors and any auxiliary components necessary to provide required starting characteristics including capacitors, resistors and automatic switching devices shall be furnished and mounted integrally unless motor starters with overload protection are provided.

1.06. MECHANICAL CONSTRUCTION

- A. Unless otherwise specified, electric motors shall be of the following types of construction according to the degree of mechanical protection:
 - 1. Totally Enclosed, Explosionproof Motors - When located in areas designated as hazardous locations (explosionproof) (NEC locations Class I, Divisions 1 or 2).
 - a. See the Contract Drawings for other hazardous area classifications.
 - 2. Totally Enclosed, Fan Cooled (TEFC) Motors - When located outdoors or indoors in wet areas such as washdown areas or elsewhere if specified.
 - a. Winding (condensation) heaters shall be provided for all motors 7-1/2 HP and larger when specified.
 - 3. Mill and Chemical Duty or Severe Duty - Suitable for use in corrosive areas unless otherwise specified in individual equipment specifications.
 - 4. Submersible Motors - For submerged application.
 - a. Provide motor winding thermal protection in motors 1 HP and larger.
 - 5. In all other cases, they shall be open drip-proof.
- B. Encapsulated Windings - Where specified, an additional "dip and bake" will not be acceptable. Encapsulation shall be Contour Mold Everseal by U.S. Motors; Costum Polyseal by General Electric; or equal.
- C. Bearings
 - 1. Unless otherwise specified or required, motors rated above 2 HP shall have the bearings of the grease lubricated, anti friction ball type with conveniently located grease fittings.
 - 2. Provide a means of preventing bearings from becoming overgreased (such as double shields on bearings or pressure sensitive relief fittings).
 - 3. Unless otherwise specified, bearings shall be rated at a minimum B-10 life of 150,000 hours for direct-coupled motors or 50,000 hours for belted motors.
 - 4. Submersible motors shall have bearings rated of an L 10 or B 10 life of minimum of 17,500 hours.
- D. Vertical shaft construction, the motors shall have adequate thrust bearings to carry all motor loads and any other operating equipment loads.

1. Grease slingers to be provided for non-submersible motors.
 2. For motors used with VFDs, provide conductive micro-fiber shaft ground rungs (SGRs) by AEGIS on the drive end of the motor and grounded through the motor frame. Provide insulated bearing on non-drive end. Spring-loaded contact brushes are not acceptable.
- E. Horizontal Shaft Construction - Coupled to fluid pumps, the motors shall either have adequate thrust bearings or they shall have the couplings end play and rotor float coordinated to prevent damage to rotor bearings.
1. For motors used with VFDs, provide conductive micro-fiber SGRs by AEGIS on the drive end of the motor and grounded through the motor frame. Provide insulated bearing on non-drive end. Spring-loaded contact brushes are not acceptable.
- F. Rotors
1. Statically and dynamically balanced.
 2. Have secondary bars of heavy copper silver brazed to one piece end rings or they shall have rotor windings of one piece cast aluminum.
 3. Where applicable, construct with integral fans.
- G. Inverter duty motors shall have enhanced rotor and stator designs.
- H. Non reversing ratchets shall be provided where specified in the individual equipment specifications.
- I. Nameplates - Stainless steel furnished with all motors, with markings in accordance with NEMA MG1, latest revision, MG1 10.38.
- J. Terminal Boxes
1. Sized in accordance with NEC, Article 430-12 and of sufficient size to accommodate conduits and conductor sizes as shown on Contract Drawings.
 2. Furnish rubber gasketed terminal boxes with splash proof and totally enclosed motors.
 3. Horizontal Motors - Locate on the left hand side, when viewing the motor from the drive shaft ends and design such that conduit entrance can be made from above, below, or either side of the terminal box.
 4. Include grounding lug in terminal box.
 5. Oversize terminal boxes in the following applications:
 - a. Motors 7-1/2 HP and larger operating at 208 or 230 volts.
 - b. Motors 20 HP and larger operating at 460 volts.
- K. Motors used with belt drives shall have grease slingers on the sheave end and sliding bases to

provide for belt take-up.

- L. Cast iron construction for all motors, when available for the application.

1.07. MOTOR POWER FACTORS

- A. Provide when called for on the Contract Drawings.
- B. Provide for all three phase motors, 7 1/2 HP or larger, 1200, 1800, and 3600 rpm (nominal), 60 Hertz, constant single speed (not VFD controlled), squirrel cage induction type, which do not have a minimum power factor of 85 percent. Motors which cannot meet this criteria shall have power factor correction capacitors, switched integrally with the motors (unless otherwise required by either the motor or starter manufacturer), which will bring the power factor up to a minimum of 90 percent.
- C. Furnish and install, at no additional cost to the Owner, the capacitors and provide all necessary wiring to connect them to the motor terminals or motor controller terminals.
 - 1. Properly size fused switch or circuit breaker to serve as a disconnect for the capacitor.
- D. Capacitor and Disconnect Enclosure
 - 1. Indoors Mounting (Non-Hazardous) - NEMA 12 wall mounted.
 - 2. Indoor Wet Areas - NEMA 4 wall mounted.
 - 3. Outdoors Mounting - NEMA 4 wall, pad, or mounting stand mounted.
 - 4. Explosionproof Areas - NEMA 7 wall mounted (DS only)*.
 - 5. Corrosive Areas - NEMA 4X wall mounted*.
 - *Locate capacitor outside the hazardous or corrosive area.
- E. Size capacitors so they do not increase the self excitation voltage above the motor nameplate rating.
- F. Do not use capacitors on motors controlled by VFDs.
- G. When used with solid-state starters, energize only after bypass or full speed bypass contactor is energized. Verify with starter manufacturer their connection requirements and follow them.

1.08. MOTOR EFFICIENCY

- A. All single speed, three phase, squirrel cage induction-type motors 1 HP or larger, 60 Hertz, shall have nominal efficiencies in accordance with Table 15170-1, unless specifically otherwise specified in the respective equipment section.
 - 1. Determine efficiencies by using IEEE Test Procedure 112, Test Method B using segregated losses. Motors shall be listed by their manufacturers and be nameplated with words such as "High Efficiency," "Premium Efficient," and "Energy Saver."
 - 2. List guaranteed minimum efficiencies on motor nameplate. Adhere to the latest nominal

efficiencies eligible for a rebate published by the local utility where rebates are available. Those efficiencies may be higher than those listed in Table 15170-1.

3. Where rebates are available, submit to the Owner paid invoices for each specific motor supplied for which a rebate is being sought.
4. If a motor submitted does not meet the minimum efficiency, the Contractor shall be required to credit the Owner with the utilities rebate plus the cost of operating the motor for 20 years for the duty hours applicable to the motor, but no less than 2,190 hours per year, at the reduced efficiency with an estimated utility cost increase of 50 percent every 5 years.

1.09. FIELD TESTING

- A. All three phase electric motors 1/2 HP and larger and all single phase electric motors 1 HP and larger shall be field tested by the Contractor at as near operating conditions as possible. Complete and submit all of the information required by the attached "Motor Test Record" for all motors to be tested per the above. Submit record prior to the issuance of the "Substantial Completion Certificate." See Section 01700. Contractor, for the purposes of this item, is the one furnishing and/or installing the final motor-driven unit.
- B. All testing shall be witnessed by the Engineer.
- C. Submit completed forms in quadruplicate (one set to be submitted at the time when substantial completion is requested, and one set to be placed in each of the submitted O&M manuals).

1.10. MOTOR SHOP TESTS

- A. Perform motor shop tests in accordance with the IEEE Code for polyphase induction machines. Use NEMA report of test forms and submit results to the Engineer, in five copies, for his approval.
- B. Test each motor and submit report for power factor and efficiency at 50, 75, and 100 percent of its rated horsepower; for insulation resistance and dielectric strength; for heating; and for compliance with all specific performance requirements.
- C. For motors less than 50 HP, provide guaranteed performance data based on previous testing of the motor design. For motors of 50 HP or larger, make complete tests of each motor and furnish certified test data sheets.

1.11. VERTICAL HOLLOW SHAFT MOTORS

- A. Where specified, design vertical hollow shaft motors to carry the motors, pumps, and associated equipment's full thrust. Equip motors with oil lubricated spherical roller thrust bearings and lower grease lubricated radial guide bearings. Provide motors with visual oil level indicators and sufficient oil to fill the motor.
- B. Vertical Adjustment - By means of a lockable nut at the top of the shaft.
- C. Non-Reversing Ratchets - Provide where specified in the individual equipment specifications and where suitable for continuous operation at any speed between 50 and 100 percent of rated speed.

1.12. TWO-SPEED MOTORS

- A. Motors 1/2 HP and Larger Specified as Two Speed Motors - Two windings unless otherwise noted. Motors less than 1/2 HP will be permitted with single windings. Speeds of the motors shall be as specified. Two speed motors shall be tested at the higher speed.

1.13. PAINTING

- A. All motors shall have a manufacturer's standard shop rust-resisting priming coat. Finish coat, either shop or field applied, shall be in accordance with Section 09900, Painting.

1.14. HAZARDOUS OR EXPLOSIONPROOF AREAS

- A. All areas noted as hazardous or explosionproof (as defined in the latest edition of the National Electrical Code) shall have all work done in accordance with the requirements of the National Electrical Code (NEC) for that particular "class" and "division" and all equipment enclosures (for motors, starters, switches, capacitors, etc.), fittings, conduits and appurtenances shall be of a type approved for the area.
- B. Unless otherwise shown, all hazardous or explosionproof areas shall be Class I, Division 1 (Groups C and D); locations and all equipment enclosures, fittings, conduits and appurtenances shall be NEMA Type 7 and approved for use in Class I, Division 1, Groups C and D atmospheres.
- C. All wiring in these areas shall be done in accordance with the applicable NEC provisions.

1.15. STORAGE

- A. Motors shall only be stored in clean, dry, indoor, climate-controlled spaces (heated, dehumidified, and air conditioned). No outdoor storage will be allowed.
- B. Motors with space heaters (condensation heaters) shall have the heaters continuously energized while the motor is either in storage or in place but not operational.
- C. Motors in storage awaiting installation shall be rotated periodically as recommended by the manufacturer as published in literature included in the initial shop drawing submittal. In the absence of published manufacturer's literature, the Owner/Engineer shall provide storage requirements.

(continued)

TABLE 15170-1

NOMINAL FULL LOAD EFFICIENCIES FOR NEMA DESIGN A AND B
 “NEMA PREMIUM™” INDUCTION MOTORS RATED 600 VOLTS OR LESS (RANDOM WOUND)

HP	OPEN DRIP-PROOF*				TOTALLY ENCLOSED FAN-COOLED*			
	900	1200	1800	3600	900	1200	1800	3600
1	75.5	82.5	85.5	77.0	75.5	82.5	85.5	77.0
1.5	77.0	86.5	86.5	84.0	78.5	87.5	86.5	84.0
2	86.5	87.5	86.5	85.5	84.0	88.5	86.5	85.5
3	87.5	88.5	89.5	85.5	85.5	89.5	89.5	86.5
5	88.5	89.5	89.5	86.5	86.5	89.5	89.5	88.5
7.5	89.5	90.2	91.0	88.5	86.5	91.0	91.7	89.5
10	90.2	91.7	91.7	89.5	89.5	91.0	91.7	90.2
15	90.2	91.7	93.0	90.2	89.5	91.7	92.4	91.0
20	91.0	92.4	93.0	91.0	90.2	91.7	93.0	91.0
25	91.0	93.0	93.6	91.7	90.2	93.0	93.6	91.7
30	91.7	93.6	94.1	91.7	91.7	93.0	93.6	91.7
40	91.7	94.1	94.1	92.4	91.7	94.1	94.1	92.4
50	92.4	94.1	94.5	93.0	92.4	94.1	94.5	93.0
60	93.0	94.5	95.0	93.6	92.4	94.5	95.0	93.6
75	94.1	94.5	95.0	93.6	93.6	94.5	95.4	93.6
100	94.1	95.0	95.4	93.6	93.6	95.0	95.4	94.1
125	94.1	95.0	95.4	94.1	94.1	95.0	95.4	95.0
150	94.1	95.4	95.8	94.1	94.1	95.8	95.8	95.0
200	94.1	95.4	95.8	95.0	94.5	95.8	96.2	95.4
250	95.0	95.8	95.8	95.0	95.0	95.8	96.2	95.8
300	--	95.8	95.8	95.4	--	95.8	96.2	95.8
350	--	95.8	95.8	95.4	--	95.8	96.2	95.8
400	--	--	95.8	95.8	--	--	96.2	95.8
450	--	--	96.2	96.2	--	--	92.2	95.8
500	--	--	96.2	96.2	--	--	96.2	95.8

*Nominal speed; for two-speed motors, the efficiency applies to the highest speed.

The above nominal full load efficiencies became effective June 1, 2016 per CFR 431.25 Energy Conservation Standards and Effective Dates.

For fire pump motors, submersible motors, other motor horsepower, speeds, and for Design C and D motors, the efficiencies shall be in accordance with the applicable equipment specification sections.

MOTOR TEST REPORT

Equipment Description _____ Equipment No. _____ Equipment Loc. _____ Drawing Nos. and Rev. _____
 _____ MCC/Panel No. _____ Section/CKT. No. _____ Control CKT. No. _____

NAMEPLATE DATA

Motor Mfr. _____ HP _____ Rpm _____ S.F. _____ Volts _____ Phase _____ F.L.
 Amp _____ KVA Code _____ O^o Rise _____ Serial No. _____ Other _____

Locked Rotor KVA _____ Efficiency _____

Prestart Checks Date _____

Lubrication Checked (Motor and Driven Equipment) Motor Rotates Freely _____
 Overload Heater Size/Setting _____ (located at starter) _____ Control Circuit Tested _____
 Breaker Size (Frame Size/Trip Element Rating) _____ Motor Insulation Resistance (Megger) _____
 Test Volts _____ (500V for up to 250V motors and 1000V for up to 600V motors) Test Duration - 1 minute

Phase A to Gnd _____ Phase B to Gnd _____ Phase C to Gnd _____ Phase A to B _____ Phase B to C _____
 _____ Phase C to A _____

UNCOUPLED DATA

(Provide this only when motor is shipped, uncoupled.
 Do not uncouple motor from drive to test.)

Bus Voltage _____ Inrush Current _____ Amps _____ Sec Run in Time _____ Average Running Current _____ A _____
 _____ B _____ C Rotation * _____ Rpm _____
 Performed by _____ Date _____
 Approved by _____ Date _____ Test Engineer

COUPLED DATA

Bus Voltage _____ Inrush Current _____ Amps _____ Sec Run in Time _____ Average Running Current _____ A _____
 _____ B _____ C Rotation * _____ Rpm _____ System Lineup/Conditions _____
 Test Equipment Control Nos. _____ Remarks: _____
 Performed by _____ Date _____
 Approved by _____ Date _____ Test Engineer

*As viewed from motor outboard end. EQUIPMENT NO. _____

END OF SECTION

SECTION 15722

CENTRIFUGAL HVAC FANS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Wall-mounted exhaust fans.

1.02. RELATED SECTIONS

- A. Section 15810 – HVAC DUCTS AND CASINGS

1.03. REFERENCES

- A. AMCA 99 - Standards Handbook; Air Movement and Control Association International, Inc.; 2003.
- B. AMCA 210 - Laboratory Methods of Testing Fans for Aerodynamic Performance Rating; Air Movement and Control Association International, Inc.; 1999 (ANSI/AMCA 210, same as ANSI/ASHRAE 51).
- C. AMCA 301 - Methods for Calculating Fan Sound Ratings from Laboratory Test Data; Air Movement and Control Association International, Inc.; 1990.
- D. NEMA MG 1 - Motors and Generators; National Electrical Manufacturers Association; 2003.
- E. NFPA 96 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations; National Fire Protection Association; 2004.
- F. UL 705 - Power Ventilators; Underwriters Laboratories Inc.; 2004.

1.04. SUBMITTALS

- A. Product Data - Manufacturer's catalog sheets, standard schematic drawings, specifications, and installation instructions for each size unit and curb.
 - 1. Provide fan curves with specified operating point clearly plotted.
- B. Contract Closeout Submittals
 - 1. Operation and Maintenance Data - Deliver two copies covering the installed products to the Owner's Representative.

1.05. QUALITY ASSURANCE

- A. Regulatory Requirements
 - 1. Fans shall be licensed to bear the AMCA seal.
 - 2. All electrical components shall be UL listed.

PART 2 PRODUCTS

2.01. WALL-MOUNTED EXHAUST FANS

- A. Manufacturers
 - 1. Greenheck
 - 2. Loren Cook Company
 - 3. Hartzell Fan Corporation.
- B. General - Powered wall exhausters shall be of the electric motor centrifugal fan type, V-belt or direct drive as scheduled on drawings. Fans shall be enclosed in a storm proof aluminum housing, properly braced and stiffened to form a rigid unit.
- C. Housing - Fabricate from spun aluminum with bolted and welded construction utilizing corrosion-resistant fasteners. Top cap shall be of two piece construction with stainless steel quick release latches to permit access to motor compartment. Wall flange shall be constructed of spun aluminum and have pre-punched key slot holes and a mounting template with wall opening location. Provide structural reinforcing members to support fan wheel, motor and bearings, and vibration eliminating devices to prevent transmission of vibration to housing.
- D. Fan Assembly
 - 1. Fan Wheel - Non-overloading, backward inclined, spark-resistant centrifugal type, fabricated from aluminum balanced at the factory in accordance with AMCA Standard 204-96.
 - 2. Drive Assembly - Direct or Belt drive as indicated on Drawings.
 - a. Direct Drive - Electric motor direct drive.
 - b. Belt Drive - Electric motor driven V belt drive, with cast iron or steel pulleys, sized for 150 percent of rated horsepower at maximum speed. Provide motor pulley of the variable pitch type, factory set at the design fan RPM at mid-position.
 - 3. Bearings - Heavy duty re-greaseable ball type in a cast iron pillow block housing designed specifically for air handling equipment and selected for a minimum L50 life in excess of 200,000 hours at maximum cataloged operating speed.
 - 4. Motor - Heavy duty type with permanently lubricated sealed ball bearings and furnished at the specified voltage, phase, and enclosure. Factory installed wiring shall be in a flexible metal conduit or integral conduit chase.
- E. Damper - Automatic self-closing back draft type, with spring actuated return. Fabricate frame and blades from aluminum, with bearings of bronze or nylon. Damper blades shall be coupled together with tie rods at each end and shall have felted edges.
- F. Nameplate - Engraved aluminum indicating manufacturer's model number, serial number, and equipment name to match unit tag as identified on drawings.

G. Accessories

1. Disconnect Switch - Factory installed and wired non-fused disconnect switch, located under fan housing.
2. Bird Screen - Aluminum wire mesh bird screen on discharge openings.
3. Damper - Provide 120 volt automatic air damper in lieu of gravity damper were indicated on drawings. Include line voltage motor drive, power open, spring return.
4. Speed Control - On direct drive models, provide factory installed and wired solid state variable speed controller.

PART 3 EXECUTION

3.01. INSTALLATION

A. General

1. Install fans and accessories in complete accordance with manufacturer's printed installation instructions and the requirements of the Contract Documents.
2. Provide sheaves required for final air balance.
3. Provide backdraft dampers on inlet to roof and wall exhausters.
4. Provide backdraft dampers on outlet from cabinet and ceiling exhausters fans and as indicated.
 - a. Provide 120 volt automatic air dampers in lieu of gravity damper were indicated on Drawings. Include line voltage motor drive, power open, spring return.

B. In-line and Duct Fans

1. Install fans with vibration isolation.
2. Install flexible connections specified in Section 15053, Expansion Fittings And Flexible Connections, between fan and ductwork. Ensure metal bands of connectors are parallel with minimum 1-inch flex between ductwork and fan while running.
3. Provide inlet air screens on fans not indicated to have an inlet duct connection. If fan has inlet bearing, mount screen inside bearing.

END OF SECTION

SECTION 15762

UNIT HEATERS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Unit heaters.
- B. Room thermostats.

1.02. SUBMITTALS

- A. Product Data - Provide manufacturer's literature and data indicating rated capacities, weights, accessories, electrical nameplate data, and wiring diagrams.

PART 2 PRODUCTS

2.01. ELECTRIC UNIT HEATERS

- A. Manufacturers
 - 1. INDEECO (Industrial Engineering and Equipment Company) - www.indeeco.com.
 - 2. Marley Engineered Products - www.marleymep.com.
 - 3. Trane Inc - www.trane.com.
- B. Assembly - UL listed and labelled assembly with terminal box and cover, and built-in controls.
- C. Electric Resistance Heating Coil - Nickel-chromium heating wire, free from expansion noise and 60-Hz hum, embedded in magnesium oxide refractory and sealed in corrosion-resistant metallic sheath. Terminate elements in stainless-steel, machine-staked terminals secured with stainless-steel hardware, and limit controls for high-temperature protection. Provide integral circuit breaker for overcurrent protection.
- D. Cabinet - 0.0478 inch (1.2 mm) steel with easily removed front panel with integral air outlet and inlet grilles.
- E. Element Hangers - Quiet operating, ball bearing cradle type providing unrestricted longitudinal movement, on enclosure brackets.
- F. Fan - Direct drive propeller type, statically and dynamically balanced, with fan guard.
- G. Motor - Permanently lubricated, sleeve bearings for horizontal models, ball bearings for vertical models.
- H. Electrical Characteristics
 - 1. Disconnect Switch - Factory mount disconnect switch.

2.04. ROOM THERMOSTATS

A. Manufacturers

1. Honeywell - www.honeywell.com.
2. Siemens Building Technologies, Inc. - www.sbt.siemens.com.

B. Room Thermostat - Electric solid-state microcomputer-based room thermostat with remote sensor.

1. Thermostat Display
 - a. Actual room temperature.
 - b. Programmed temperature.

PART 3 EXECUTION

3.01. INSTALLATION

- A. Install in accordance with NFPA 90A.
- B. Install the work of this section in accordance with manufacturer's printed installation instructions.
- C. Install equipment exposed to finished areas after walls and ceiling are finished and painted. Do not damage equipment or finishes.
- D. Hang unit heaters from building structure, with pipe hangers anchored to building, not from piping.

END OF SECTION

SECTION 15810

HVAC DUCTS AND CASINGS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Metal ductwork.

1.02. RELATED REQUIREMENTS

- A. Section 15086 - DUCT INSULATION: External insulation and duct liner.
- B. Section 15850 - AIR OUTLETS AND INLETS

1.03. REFERENCE STANDARDS

- A. ASHRAE (FUND) - ASHRAE Handbook - Fundamentals; 2013.
- B. ASTM A36/A36M - Standard Specification for Carbon Structural Steel; 2014.
- C. ASTM A653/A653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2015.
- D. ASTM A666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2015.
- E. ASTM B209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2014.
- F. ASTM B209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate (Metric); 2014.
- G. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials; 2016.
- H. ICC-ES AC01 - Acceptance Criteria for Expansion Anchors in Masonry Elements; 2015.
- I. ICC-ES AC106 - Acceptance Criteria for Predrilled Fasteners (Screw Anchors) in Masonry Elements; 2012.
- J. ICC-ES AC193 - Acceptance Criteria for Mechanical Anchors in Concrete Elements; 2015.
- K. ICC-ES AC308 - Acceptance Criteria for Post-Installed Adhesive Anchors in Concrete Elements; 2015.
- L. NFPA 90A - Standard for the Installation of Air-Conditioning and Ventilating Systems; 2015.
- M. SMACNA (DCS) - HVAC Duct Construction Standards Metal and Flexible; 2005 (Rev. 2009).

1.04. SUBMITTALS

- A. Product Data - Provide data for duct materials.

PART 2 PRODUCTS

2.01. DUCT ASSEMBLIES

- A. Regulatory Requirements - Construct ductwork to NFPA 90A Standards.
- B. Ducts
 - 1. Galvanized Steel – For use with unclassified or non-corrosive locations, and other dry areas.
 - 2. Aluminum – For use with corrosive areas, hazardous areas, and wet areas.
- C. General Exhaust - 1/2-inch w.g. (125 Pa) pressure class
- D. Outside Air Intake - 1/2-inch w.g. (125 Pa) pressure class

2.02. MATERIALS

- A. Galvanized Steel for Ducts - Hot-dipped galvanized steel sheet, ASTM A653/A653M FS Type B, with G60/Z180 coating.
- B. Aluminum for Ducts - ASTM B209 (ASTM B209M); aluminum sheet, alloy 3003-H14. Aluminum Connectors and Bar Stock - Alloy 6061-T651 or of equivalent strength.
- C. Stainless Steel for Ducts - ASTM A666, Type 304.
- D. Joint Sealers and Sealants - Non-hardening, water resistant, mildew and mold resistant.
 - 1. Type - Heavy mastic or liquid used alone or with tape, suitable for joint configuration and compatible with substrates, and recommended by manufacturer for pressure class of ducts.
 - 2. VOC Content - Not more than 250 g/L, excluding water.
 - 3. Surface Burning Characteristics - Flame spread index of zero and smoke developed index of zero, when tested in accordance with ASTM E84.
- E. Hanger Rod - ASTM A36/A36M; steel, galvanized; threaded both ends, threaded one end, or continuously threaded, or same material as duct.
- F. Hanger Fasteners - Attach hangers to structure using appropriate fasteners, as follows:
 - 1. Concrete Wedge Expansion Anchors - Complying with ICC-ES AC193.
 - 2. Masonry Wedge Expansion Anchors - Complying with ICC-ES AC01.

3. Concrete Screw Type Anchors - Complying with ICC-ES AC193.
4. Masonry Screw Type Anchors - Complying with ICC-ES AC106.
5. Concrete Adhesive Type Anchors - Complying with ICC-ES AC308.

2.03. DUCTWORK FABRICATION

- A. Fabricate and support in accordance with SMACNA (DCS) and as indicated.
- B. Provide duct material, gages, reinforcing, and sealing for operating pressures indicated.
- C. Increase duct sizes gradually, not exceeding 15 degrees divergence wherever possible; maximum 30 degrees divergence upstream of equipment and 45 degrees convergence downstream.
- D. Fabricate continuously welded round and oval duct fittings in accordance with SMACNA (DCS).

PART 3 EXECUTION

3.01. INSTALLATION

- A. Install, support, and seal ducts in accordance with SMACNA (DCS).
- B. Install in accordance with manufacturer's instructions.
- C. During construction provide temporary closures of metal or taped polyethylene on open ductwork to prevent construction dust from entering ductwork system.
- D. Duct sizes indicated are inside clear dimensions. For lined ducts, maintain sizes inside lining.
- E. Provide openings in ductwork where required to accommodate thermometers and controllers. Provide pilot tube openings where required for testing of systems, complete with metal can with spring device or screw to ensure against air leakage. Where openings are provided in insulated ductwork, install insulation material inside a metal ring.
- F. Locate ducts with sufficient space around equipment to allow normal operating and maintenance activities.

END OF SECTION

SECTION 15850

AIR OUTLETS AND INLETS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Louvers.
- B. Dampers.

1.02. RELATED REQUIREMENTS

- A. Section 15810 – HVAC DUCTS AND CASINGS

1.03. REFERENCE STANDARDS

- A. AMCA 500-L - Laboratory Methods of Testing Louvers for Rating; Air Movement and Control Association International, Inc.; 2007.
- B. ASHRAE Std 70 - Method of Testing for Rating the Performance of Air Outlets and Inlets; American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc.; 2006.
- C. SMACNA (DCS) - HVAC Duct Construction Standards - Metal and Flexible; Sheet Metal and Air Conditioning Contractors' National Association; 2005.

1.04. SUBMITTALS

- A. Product Data - Catalog sheets, diagrams, standard schematic drawings, and installation instructions for each manufactured product.
- B. Color Selection - Submit manufacturer's color selection chart to Architect for louver color selection.

1.05. QUALITY ASSURANCE

- A. Regulatory Requirements - Unless otherwise shown or specified comply with the applicable requirements of the following:
 - 1. SMACNA - Gages of material, fabrication, sealing, and installation shall be in accordance with the SMACNA Manuals.
 - a. HVAC Duct Construction Standards.
 - b. Round Industrial Duct Construction Standard.
 - c. Rectangular Industrial Duct Construction Standard.
 - 2. NFPA - Standards No. 90A, 90B, 91, 96, and 101.
 - 3. UL - Standards No. UL181, UL555, and UL555S.

4. Test and rate air outlet and inlet performance in accordance with ASHRAE Std 70.
5. Test and rate louver performance in accordance with AMCA 500-L.

1.06. MAINTENANCE

A. Special Tools

1. One bar deflection key for every five supply grilles or diffusers.
2. Two keys or socket wrenches for each type of damper adjustment screw or device on manual damper regulators.
3. One tool for each type and size security fastener.

PART 2 PRODUCTS (SEE HVAC SCHEDULES FOR PRODUCTS)

2.01. LOUVERS

A. Manufacturers

1. Greenheck.
2. Louvers and Dampers/Mestek Inc..
3. Ruskin.

B. Type - Stationary type louver with welded construction and drainable blades mounted in a 2-inch louver frame. Each stationary blade shall incorporate an integral downspout so water drains to blade end, then down the downspouts and out at the louver sill.

C. Blades - Position blades at 45-degree angle at 4 inch on centers.

D. Material - 6063T5 extruded aluminum 0.081 inch nominal thickness.

E. Bird Screen - 3/4-inch x 3/4-inch framed, removable, rear-mounted aluminum bird screen. Provide insect screen in lieu of bird screen where indicated on drawings.

F. Finish - Louver shall be supplied with a baked enamel finish, color to be selected by Architect.

2.04. DAMPERS

A. Manufacturers - Damper shall be of same manufacturer as louver.

B. Damper shall be same size as corresponding louver and be suitable for mounting directly to the louver or a flanged wall sleeve.

C. Type - Insulated airfoil opposed blade low leakage control damper. Maximum leakage rate 6 cfm/sq ft at 4 in wg.

- D. Frame - 5-inch x 1-inch 16 gage galvanized steel hat channel with reinforced corners and welded joints.
- E. Blades - Airfoil-shaped, galvanized steel double skin construction equivalent to 14 gage with integral 1/2-inch polystyrene. Mounted on 1/2-inch diameter plated steel axles with synthetic sleeve type bearings.
- F. Linkage - Side linkage out of airstream concealed in frame. Weld actuator bracket to frame.
- G. Seals - Extruded silicone rubber blade seals. Flexible metal compression type jamb seals.
- H. Actuator
 - 1. Positive positioning, (see plans- when no voltage is specified for actuator coordinate voltage with equipment voltage) 120 volt actuator with spring return, furnished and sized for each louver by damper manufacturer.
 - 2. Mounting - Inside airstream.
 - 3. Actuator shall fail closed upon loss of electric power.

PART 3 EXECUTION

3.01. INSTALLATION

- A. Unless otherwise specified, install the work of this section in accordance with manufacturer's printed installation instructions and the appropriate SMACNA Manual.
- B. Coordinate location of outlets and inlets with other trades. Make necessary minor adjustments in position to conform with architectural features, symmetry, sprinkler/smoke heads, and lighting arrangement.
 - 1. Arrange and locate duct taps to accommodate proper placement of outlets and inlets.

END OF SECTION

SECTION 16051

MINOR ELECTRICAL DEMOLITION

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Electrical demolition.

PART 2 PRODUCTS

2.01. MATERIALS AND EQUIPMENT

- A. Materials and equipment for patching and extending work. As specified in individual sections.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify field measurements and circuiting arrangements are as indicated.
- B. Verify that abandoned wiring and equipment serve only abandoned facilities.
- C. Demolition drawings are based on casual field observation and existing record documents.
- D. Report discrepancies to Engineer before disturbing existing installation.
- E. Beginning of demolition means installer accepts existing conditions.

3.02. PREPARATION

- A. Disconnect electrical systems in walls, floors, and ceilings to be removed.
- B. Coordinate utility service outages with utility company and the Owner.
- C. Provide temporary wiring and connections to maintain existing systems in service during construction. When work must be performed on energized equipment or circuits, use personnel experienced in such operations.
- D. Existing Electrical Service - Maintain existing system in service at all times. Minimize outage duration to maximum extent possible. Contractor to provide temporary power as required.
 - 1. Obtain permission from Owner at least 48 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

- E. Existing Telephone System - Maintain existing system in service at all times throughout project duration. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Notify Owner at least 48 hours before partially or completely disabling system.
 - 2. Notify telephone utility company at least 24 hours before partially or completely disabling system.
 - 3. Make temporary connections to maintain service in areas adjacent to work area.
- F. Existing Security System - Maintain existing system in service at all times throughout project duration. Disable system only to make switchovers and connections. Minimize outage duration.
 - 1. Obtain permission from Owner at least 24 hours before partially or completely disabling system.
 - 2. Make temporary connections to maintain service in areas adjacent to work area.

3.03. DEMOLITION AND EXTENSION OF EXISTING ELECTRICAL WORK

- A. Perform work for removal and disposal of equipment and materials containing toxic substances regulated under the Federal Toxic Substances Control Act (TSCA) in accordance with applicable federal, state, and local regulations. Applicable equipment and materials include, but are not limited to:
 - 1. PCB-containing electrical equipment, including transformers, capacitors, and switches.
 - 2. PCB- and DEHP-containing lighting ballasts.
 - 3. Mercury-containing lamps and tubes, including fluorescent lamps, high intensity discharge (HID), arc lamps, ultraviolet, high pressure sodium, mercury vapor, ignitron tubes, neon, and incandescent.
 - 4. Contractor to closely coordinate any required hazardous material removal with the owner.
- B. Remove, relocate, and extend existing installations to accommodate new construction.
- C. Remove abandoned wiring to source of supply.
- D. Remove exposed abandoned conduit, including abandoned conduit above accessible ceiling finishes. Cut conduit flush with walls and floors, and patch surfaces.
- E. Disconnect abandoned outlets and remove devices. Remove abandoned outlets if conduit servicing them is abandoned and removed. Provide blank cover for abandoned outlets that are not removed.
- F. Disconnect and remove abandoned panelboards and distribution equipment.
- G. Disconnect and remove electrical devices and equipment serving utilization equipment that has been removed.

- H. Disconnect and remove abandoned luminaires. Remove brackets, stems, hangers, and other accessories.
- I. Repair adjacent construction and finishes damaged during demolition and extension work.
- J. Maintain access to existing electrical installations that remain active. Modify installation or provide access panel as appropriate.
- K. Extend existing installations using materials and methods compatible with existing electrical installations, or as specified. All requirements to be per NEC.
- L. The Owner shall have the right to maintain ownership of all material and equipment scheduled to be removed from the site throughout the project duration. Contractor to coordinate with the Owner and all material/equipment that the Owner wishes to maintain ownership of shall be moved to a location on the site as designated by the Owner. All material the Owner does not wish to maintain ownership of shall become the property of the contractor and the Contractor assumes responsibility to remove from the site.

3.04. CLEANING AND REPAIR

- A. Clean existing materials and equipment that remain or that are to be reused.
- B. Panelboards - Clean exposed surfaces, panel interior, and check tightness of electrical connections. Replace damaged circuit breakers and provide closure plates for vacant positions. Provide typed circuit directory showing revised circuiting arrangement.
- C. Luminaires - Remove existing luminaires for cleaning. Use mild detergent to clean all exterior and interior surfaces; rinse with clean water and wipe dry. Replace lamps, ballasts and broken electrical parts as necessary.

END OF SECTION

SECTION 16055

BASIC ELECTRICAL REQUIREMENTS

PART 1 GENERAL

1.01. DESCRIPTION OF WORK

- A. Provide all labor, items, articles, materials, operations, methods or equipment listed, mentioned, indicated or scheduled on the drawings and specified herein, and required to complete the electrical work. Contract Drawings and specifications are complementary and must be so construed to determine the full scope of work.
- B. Drawings
 - 1. Contract Drawings are, in part, diagrammatic and are intended to convey the scope of the work and indicate the general arrangement of the equipment. Follow these Drawings in laying out the work. Consult all Drawings to become familiar with all conditions affecting the work and to verify spaces in which the work will be installed.
 - 2. Reasonable changes required by job conditions (including offsetting of conduits around beams, etc.) shall be made, after obtaining the Engineer's approval, at no additional cost to the Owner.
- C. Definitions - The term "provide" shall have the same meaning as "furnish and install." All materials so implied either on the drawings or in these specifications shall be furnished and installed unless specifically noted otherwise.
- D. Where Contract Drawings call out a classified area all equipment, devices, and wiring methods to be suitable for this area per National Electrical Code (NEC). Refer to Contract Drawings for classified area locations and specifications for additional information.

1.02. QUALITY ASSURANCE

- A. All work specified in Division 16 shall be performed by approved workmen qualified by satisfactory experience in the particular work.

1.03. STANDARDS

- A. The following standards shall govern and shall constitute minimum requirements as approved. If the requirements of this specification exceed those of the standards mentioned, this specification shall govern.
 - 1. Local building codes.
 - 2. Underwriters Laboratories Inc., (UL) approved or listed - All materials shall be UL approved or third-party certified.
 - 3. Local Electric Utility - Standards in effect on bidding date.
 - 4. Local Telephone Utility - Standards in effect on bidding date for service entrance.

5. National Electrical Manufacturer's Association, NEMA - Equipment enclosures, mountings and connections.
6. America National Standards Institute, ANSI - Where mentioned herein.
7. American Institute of Electronic and Electrical Engineers, IEEE - Power equipment.
8. National Electrical Safety Code, NESC - Outdoor and overhead work for temporary service.
9. Occupational Safety and Health Act, OSHA - Requirements for safety and health of employees.
10. National Fire Prevention Association, NFPA
 - a. No. 70, National Electric Code, NEC.
 - b. No. 101, Life Safety Code.

1.04. SUBMITTALS

- A. Submittals - Obtain approval before procurement, fabrication, or delivery of items to the job site. Partial submittals will not be acceptable and will be returned without review. Submittals shall include the manufacturer's name, trade name, place of manufacture, catalog number or model, nameplate data, size, layout dimensions, capacity, project specification and paragraph reference, applicable federal, military, industry, and technical society publication references, and other information necessary to establish contract compliance of each item to be furnished. Furnish a minimum of three copies of shop drawings for each device/piece of equipment specified or called for.
- B. Shop Drawings - In addition to the requirements specified elsewhere, shop drawings shall meet the following requirements. Drawings shall be a minimum of 8.5 inches by 11 inches in size, except as specified otherwise. Drawings shall include complete ratings information, wiring diagrams, and installation details of equipment indicating proposed location, layout/arrangement, control panels, accessories, piping, ductwork, and other items that must be shown to assure a coordinated installation. Wiring diagrams shall identify circuit terminals and indicate the internal wiring for each item of equipment and the interconnection between each item of equipment. Drawings shall indicate adequate clearance for operation, maintenance, and replacement of operating equipment devices. If equipment is disapproved, revise drawings to show acceptable equipment and resubmit.
- C. Manufacturer's Data - Submittals for each manufactured items shall be current manufacturer's descriptive literature of cataloged products, equipment drawings, diagrams, performance and characteristic curves, and catalog cuts.
- D. Publication Compliance - Where equipment or materials are specified to conform to industry and technical society publications or organizations such as ANSI, ASTM, and UL, submit proof of such compliance. The label or listing by the specified organization will be acceptable evidence of compliance. In each of the publications referred to herein, consider the advisory provisions to be mandatory, as though the word "shall" had been substituted for "should" wherever it appears. In lieu of the label or listing, submit a certificate from an approved independent testing organization, adequately equipped and competent to perform such services, stating that the item has been tested in accordance with the specified organization's test methods and that the item conforms to the specified organization's publications.

- E. Submittals required - Supply shop drawing submittal information on the equipment as noted in each individual section.
- F. Submit temporary power plan to Engineer for approval prior to electrical outages or power disruptions.

1.05. RECEIPTS FOR LOOSE EQUIPMENT

- A. Provide one receipt for all equipment as follows, to be signed by the Owner and delivered to the Engineer prior to request for final payment:
 - 1. Spare fuses.
 - 2. Keys for panelboards and all other key operated equipment.
 - 3. Circuit breaker handle locks.
 - 4. As built drawings.
 - 5. Instruction manuals, shop drawings, wire diagrams, etc.

1.06. OPERATING INSTRUCTIONS

- A. Provide approved shop drawings, wiring diagrams, instruction manuals, operating instructions, service manuals, and signed instruction receipts bound in common folder; submit to Engineer for approval and delivery to Owner prior to request for final acceptance and payment.
- B. Provide instruction on the operation and maintenance of all equipment installed in this Contract for personnel designated by the Owner. A minimum of two personnel instruction periods by qualified instructors shall be provided on normal operating procedures, minor adjustments and changes, preventive maintenance, and safety precautions. Obtain signed receipt that Owner's representative has been so instructed and can satisfactorily operate the equipment.

1.07. AS-BUILT DRAWINGS

- A. Electrical Contractor shall record locations of all conduit runs that are 2 inches and larger with number and size of conductors as they are installed. This shall be done for all systems. Underground conduit plans shall include elevations and conduit and pull box locations shall be dimensioned. As-built drawings shall include all field and addendum changes.
- B. As-built drawings shall be prepared for all interior communication and signaling systems and for any other interior system if installation varies from arrangement shown on the Contract Drawings.
- C. All circuit numbers/positions shall be correctly recorded on the drawings as they were installed. In addition all panelboard schedules shall be computer generated and attached to the inside cover of each field installed panelboard.
- D. At completion of the job before final payment will be certified, the Electrical Contractor shall submit four prints to the Engineer who will in turn transmit three copies to the Owner.

1.08. PERMITS AND INSPECTIONS

- A. Cost of fees shall be included in the bid as follows:
 - 1. Construction permits.
 - 2. Inspections and tests as described in this section.
 - 3. The Contractor is responsible for all fees associated with required construction permits.
- B. Underwriters' Certificate - Prior to submittal of Request for Final Payment, an electrical inspection certificate shall be obtained and submitted for approval. List of approved third-party inspecting underwriters is listed below:
 - 1. Code Inspection Services, Inc.
 - 2. Electrical Underwriters of NY, LLC (845-569-1759)
 - 3. The Inspector, LLC (800-487-0535)
 - 4. Other Underwriters are not restricted; however, credentials shall be provided for Engineer approval prior to inspection.
- C. Contractor shall coordinate all required utility electrical service inspections with the utility.
 - 1. Contractor shall coordinate with National Grid regarding the site electrical service.
 - 2. Refer to Contract Drawings for additional information.
 - 3. Contractor is responsible for completing a National Grid Form G for the proposed emergency generator systems as part of this project. Coordinate with the Owner and utility to complete the required form.
 - 4. The Contractor is responsible for all fees associated with utility required inspections.

1.09. CODES, STANDARDS, AND LISTINGS

- A. All wiring, conduit, and materials shown on the drawings and/or herein specified shall be in accordance with the NEC, New York State Uniform Fire Prevention Building Code, and Life Safety Code.
- B. Wiring, conduit, and materials for all systems shall be provided in sizes and numbers sufficient to function as specified and in accordance with manufacturer's recommendations.
- C. Any discrepancies shall be called to the attention of the Engineer before bids are taken. Bids shall be based on code and functional adequacy. Failure of the Contractor in this respect shall not relieve him of responsibility for a fully adequate installation at no increase in cost.
- D. If requested by the Engineer, when equipment that is not specified is proposed, then provide a list of usages in New York State when the proposed equipment has been in operation for at least three years.

1.10. TEMPORARY POWER

- A. The pump station is to be operational at all times. Provide temporary power provisions as required to facilitate pump station operation during electrical demolition and connections. Provide all necessary equipment, portable power stations, starters, generator, devices, cabling, etc. as required for an overall complete and operable temporary power system. Provide temporary power plan to engineer for approval prior to performing electrical disruptions in service. Refer to the contract drawings for additional information. All requirements to be per NEC.
- B. Coordinate the overall sequence of removals with the Owner.

PART 2 PRODUCTS

2.01. MATERIALS

- A. All equipment and/or materials shall be new and shall carry the label of Underwriter's Laboratories Inc., whenever UL requirements are applicable.
- B. Materials of same general type, such as wiring devices and luminaries, shall be of the same make throughout the building so that appearance and operation are uniform.
- C. "Equal materials" shall comply with the Supplementary Conditions.
- D. Drawings and specifications are based on one manufacturer's equipment requirements. The costs of all revisions required to meet the requirements of a different manufacturer's equipment (even though mentioned on the Drawings or specified) furnished by the Contractor shall be borne by the Contractor.

PART 3 EXECUTION

3.01. INFORMATION FOR OTHER DIVISIONS

- A. Provide all information concerning the equipment or work of Division 16 required by other Divisions in ample time to prevent delay in building progress.

3.02. INSTALLATION

- A. All new material required shall be provided as part of this contract.
- B. Electrical Contractor shall include all work as shown and described on site drawings, including site electrical drawings.
- C. Closely coordinate sequence of removals and construction with the Owner. Refer to Division 1 specifications for additional information. Contractor to submit anticipated project schedule. Schedule to be fully coordinated with the proposed work of Contractor.

3.03. OPENINGS AND CHASES

- A. Contractor to provide all boxed openings, chases, recesses, lintels, and bucks required for the admission of the work shown on the contract drawings. Furnish him with all necessary information and sleeves in ample time.
- B. Do not cut walls or floors that are waterproofed or pierce any structural member without written permission from the Engineer.

3.04. MOUNTING HARDWARE/EQUIPMENT

- A. All control panels, instrument panels, power panels, motor control centers, or VFDs furnished as part of this contract are to be installed. Contractor is responsible for providing all Unistrut, hardware, equipment pads, and equipment as necessary to mount provided control panels, instrument panels, power panels, motor control centers, and VFDs as indicated on the Contract Drawings.

3.05. ANCHORS

- A. Provide anchor bolts, sleeves, washers, nuts, and templates for anchoring of equipment. Check locations as work progresses.

3.06. SLEEVES AND INSERTS

- A. Provide sleeves and inserts ahead of the general construction work and maintain them in position.
- B. Contractor shall bear the cost of cutting and patching required to make corrections resulting from the omission or improper location of sleeves and/or inserts.
- C. Make sleeves in floors and partitions of galvanized steel with lock seam joints.
- D. Make sleeves of extra heavy cast iron pipe or rigid galvanized steel pipe in outside walls, foundations, and footings.
- E. Conduit sleeves shall be two sizes larger than the conduit passing through it.
- F. Terminate sleeves flush with walls, partitions, and ceilings. Terminate sleeves 1/4 inch above floors.
- G. Fill space between sleeve and conduit in underground walls with oakum and caulk with lead on both sides of wall, or use "Link Seal."
- H. Fill space between sleeve and conduit with fiberglass blanket insulation when sleeve does not occur in an underground wall. Seal with an approved fire seal caulk.

3.07. PAINTING AND PROTECTIVE COATING

- A. Unfinished Areas (Except Crawlspace) - Hanger rods, brackets, angle supports, straps, etc., shall be cadmium plated per ASTM 165, Type NS.
- B. Outdoor Work - All ferrous equipment and fittings cadmium plated after fabrication (ASTM 165 Type NS); all screws, nuts, washers, etc., brass or stainless steel.

3.08. ROUGHING

- A. Before roughing for equipment furnished by others, obtain approved roughing drawings and exact location for each piece of equipment. Do not "rough-in" services without approved drawings.
- B. Obtain drawings or proper information giving final location of all motor and control connections.
- C. Unless otherwise detailed or specified:
 - 1. All services shall be concealed in wall, above ceilings, etc.
 - 2. Work shall be exposed only where approved by the Engineer.
 - 3. Notify Engineer if work cannot be concealed, as intended.
 - 4. Conduit to be buried in concrete with approval of Engineer only and then a conduit plan must be submitted.
 - 5. Wiremold is to be used only per drawings as indicated. Usage otherwise only by written consent of Engineer.

3.09. CLEAN-UP

- A. Contractor shall at all times keep the project free from accumulation of waste material or rubbish caused by his operation. Shall be done on a daily basis as required or directed by Engineer.
- B. When directed, just prior to final acceptance, clean all equipment including, but not limited to the following:
 - 1. Lighting fixtures, panelboards, control centers, clocks, receptacles and switchplates.
 - 2. All equipment to be painted, removing all rust, etc., and leave ready for painting.
 - 3. Building, by removing all debris, leftover conduits, wire insulation, cartons, etc., left as a result of this work.

3.10. SUPPORTS

- A. After thorough investigation of architectural, structural and shop drawings related to work to determine how and where equipment, fixtures, conduit, panelboards, etc., are to be supported, mounted or suspended, provide:
 - 1. Extra steel, bolts, inserts, pipe stands, brackets or any other items required for proper support.
 - 2. Supporting accessories where required, whether or not shown on Drawings.

END OF SECTION

SECTION 16060

POWER SYSTEM ANALYSIS

PART 1 GENERAL

1.01. DESCRIPTION

- A. Under this section, the Contractor shall provide a Power System Analysis as prepared by an approved engineering firm.
- B. The Power System Analysis shall include short-circuit analysis study, protective device coordination study, and an arc flash hazard analysis study.
- C. Scope - The scope of the Power System Analysis shall include all new distribution equipment supplied under this contract. The Power System Analysis shall be performed to account for all normal and emergency sources of power.
- D. References - The publications listed below and their latest revisions form a part of this Specification. Adhere to applicable sections of the following publications:
 - 1. American National Standards Institute (ANSI) Publications.
 - 2. Institute of Electrical and Electronics Engineers (IEEE) Publications.
 - 3. National Fire Protection Association (NFPA) Publications:
 - 4. National Electric Code (NEC)
 - 5. OSHA
- E. Related Requirements – Sections 16055, Basic Electrical Requirements, and 16196, Identification for Electrical Systems, apply to this section with additions and modifications specified herein.
- F. Definition of Electrical Terms - Unless otherwise specified or indicated, electrical terms used in these specifications and on the Drawings shall be as defined in IEEE Standard No. 100.
- G. Submittals - The Power System Analysis shall be submitted to the design engineer prior to receiving final approval of the distribution equipment shop drawings and/or prior to release of equipment drawings for manufacturing. If formal completion of the studies may cause delay in equipment manufacturing, approval from the Engineer may be obtained for preliminary submittal of sufficient study data to ensure that the selection of device and characteristics will be satisfactory.
 - 1. Report - The results of the Power System Analysis studies shall be summarized in a final report. No more than three bound copies of the complete final report shall be submitted. For large system studies, submittals requiring more than three copies of the report will be provided without the section containing the computer printout of the short-circuit input and output data. Additional copies of the short-circuit input and output data, where required, shall be provided on CD in PDF format.
 - 2. Report Sections - The report shall include the following sections:

- a. Executive Summary.
 - b. Descriptions, purpose, basis and scope of the study.
 - c. Tabulations of circuit breaker, fuse and other protective device ratings versus calculated short-circuit duties.
 - d. Protective device time versus current coordination curves, tabulations of relay and circuit breaker trip unit settings, fuse selection.
 - e. Fault current calculations including a definition of terms and guide for interpretation of the computer printout.
 - f. Details of the incident energy and flash protection boundary calculations.
 - g. Details of required personal protective equipment (PPE) required to work on the gear in question while energized.
 - h. Recommendations for system improvements, where needed.
 - i. One-line diagram.
3. ARC Flash Hazard Marking - Submittal shall include representative label and report showing required data for all equipment and devices which require an ARC flash label.

H. Qualifications

1. The Power System Analysis shall be conducted under the supervision and approval of a Registered Professional Electrical Engineer skilled in performing and interpreting the power system studies.
2. The Registered Professional Electrical Engineer shall be a full-time employee of the equipment manufacturer, or an approved engineering firm. The Registered Professional Electrical Engineer shall have a minimum of three years of experience in performing power system studies.
3. The equipment manufacturer or approved engineering firm shall demonstrate experience with Arc Flash Hazard Analysis by submitting names of at least five actual arc flash hazard analysis it has performed in the past year.
4. COMPUTER ANALYSIS SOFTWARE - The Power System Analysis shall be performed using the latest revision of the SKM Systems Analysis Power*Tools for Windows (PTW) software program, or approved equal.

PART 2 PRODUCTS**2.01. STUDIES**

- A. Contractor to furnish short-circuit and protective device coordination studies as prepared by equipment manufacturer, or an approved engineering firm.
- B. 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.

2.02. DATA COLLECTION

- A. Contractor shall furnish all data as required for the Power System Analysis. 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. The Contractor shall expedite collection of the data to assure completion of the studies as required for final approval of the distribution equipment shop drawings and/or prior to the release of the equipment for manufacturing.
- B. Source combination may include present and future motors and generators.
- C. Load data utilized may include existing and proposed loads obtained from Contract Documents provided by Owner, or Contractor.
- D. If applicable, include fault contribution of existing motors in the study. The Contractor shall obtain required existing equipment data, if necessary, to satisfy the study requirements.

2.03. SHORT CIRCUIT AND PROTECTIVE DEVICE EVALUATION STUDY

- A. Use actual conductor impedances if known. If unknown, use typical conductor impedances based on IEEE Standard 141-1993.
- B. Transformer design impedances shall be used when test impedances are not available.
- C. Provide the following:
 - 1. Calculation methods and assumptions.
 - 2. Single line diagram of the system being evaluated.
 - 3. Source impedance data, including electric utility system and motor fault contribution.
 - 4. System characteristics.
 - 5. Tabulations of calculated quantities.
 - 6. Results, conclusions, and recommendations.
- D. Calculate short-circuit momentary and interrupting duties for a three-phase bolted fault at each:

1. Electric utility's supply termination point.
 2. Incoming switchgear.
 3. Low voltage switchgear.
 4. Motor control center.
 5. Standby generators and automatic transfer switch.
 6. Branch circuit panelboard.
 7. Major equipment disconnects.
 8. Other significant location throughout the system.
- E. For grounded systems, provide a bolted line-to-ground fault current study for areas as defined for the three-phase bolted fault short-circuit study.
- F. Protective Device Evaluation - Evaluate equipment and protective devices and compare to short-circuit ratings
1. Evaluate the adequacy of switchgear, motor control centers, and panelboard bus bars to withstand short-circuit stresses.
 2. Notify Owner and Engineer in writing, of existing, circuit protective devices improperly rated for the calculated available fault current.
- G. Service Equipment is to be labeled with the maximum available fault current per NEC article 110.24.

2.04. PROTECTIVE DEVICE COORDINATION STUDY:

- A. Proposed protective device coordination time-current curves (TCC) shall be displayed on log-log scale graphs.
- B. Include on each TCC graph, a complete title and one-line diagram with legend identifying the specific portion of the system covered.
- C. Terminate device characteristic curves at a point reflecting maximum symmetrical or asymmetrical fault current to which the device is exposed.
- D. Identify the device associated with each curve by manufacturer type, function, and, if applicable, tap, time delay, and instantaneous settings recommended.
- E. Plot the following characteristics on the TCC graphs, where applicable:
 1. Medium and low voltage fuses including manufacturer's minimum melt, total clearing, tolerance, and damage bands.
 2. Low voltage equipment circuit breaker trip devices, including manufacturer's tolerance bands.

3. Transformer full-load current, magnetizing inrush current, and ANSI through-fault protection curves.
 4. Conductor damage curves.
 5. Ground fault protective devices, as applicable.
 6. Pertinent motor starting characteristics and motor damage points, where applicable.
 7. Pertinent generator short-circuit decrement curve and generator damage point.
 8. The largest feeder circuit breaker in each motor control center and applicable panelboard.
- F. Provide adequate time margins between device characteristics such that selective operation is provided, while providing proper protection.
- G. Contractor to field apply all recommended settings (upon completion of the coordination study) to all provided protective devices in which contain settings.

2.05. ARC FLASH HAZARD ANALYSIS:

- A. The arc flash hazard analysis shall be performed according to the IEEE 1584 equations that are presented in NFPA70E-LATEST EDITION, Annex D.
- B. The flash protection boundary and the incident energy shall be calculated at all significant locations in the electrical distribution system (switchboards, switchgear, motor-control centers, panelboards, enclosed circuit breakers, major equipment disconnects, busway and splitters) where work could be performed on energized parts.
- C. The Arc-Flash Hazard Analysis shall include all electrical distribution equipment such as panelboards, disconnect switches, pump control panel, etc. where work could be performed on energized parts.
- D. Safe working distances shall be based upon the calculated arc flash boundary considering an incident energy of 1.2 cal/cm².
- E. Overcurrent devices will be retrieved from the short-circuit and coordination study model. Ground overcurrent relays should not be taken into consideration when determining the clearing time when performing incident energy calculations.
- F. The short-circuit calculations and the corresponding incident energy calculations for multiple system scenarios must be compared and the greatest incident energy must be uniquely reported for each equipment location. Calculations must be performed to represent the maximum and minimum contributions of fault current magnitude for all normal and emergency operating conditions. The minimum calculation will assume that the utility contribution is at a minimum and will assume a minimum motor contribution (all motors off). Conversely, the maximum calculation will assume a maximum contribution from the utility and will assume the maximum amount of motors to be operating. Calculations shall take into consideration the parallel operation of synchronous generators with the electric utility, where applicable.

- G. The incident energy calculations must consider the accumulation of energy over time when performing arc flash calculations on buses with multiple sources. Iterative calculations must take into account the changing current contributions, as the sources are interrupted or decremented with time. Fault contribution from motors and generators should be decremented as follows:
 - 1. Fault contribution from induction motors should not be considered beyond three to five cycles.
 - 2. Fault contribution from synchronous motors and generators should be decayed to match the actual decrement of each as closely as possible (e.g. contributions from permanent magnet generators will typically decay from 10 per unit to 3 per unit after 10 cycles).
- H. For each equipment location with a separately enclosed main device (where there is adequate separation between the line side terminals of the main protective device and the work location), calculations for incident energy and flash protection boundary shall include both the line and load side of the main breaker.
- I. When performing incident energy calculations on the line side of a main breaker (as required per above), the line side and load side contributions must be included in the fault calculation.
- J. Miscoordination should be checked amongst all devices within the branch containing the immediate protective device upstream of the calculation location and the calculation should utilize the fastest device to compute the incident energy for the corresponding location.
- K. 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. Where it is not physically possible to move outside of the flash protection boundary in less than 2 seconds during an arc flash event, a maximum clearing time based on the specific location shall be utilized.

2.06. ARC FLASH WARNING LABELS

- A. Provide a 4-inch x 6-inch thermal transfer type label of high adhesion polyester for each work location analyzed. Labels affixed to equipment enclosures rated NEMA 3R, 4, 4X, 6, or 8 shall be rated for outdoor use.
- B. All labels will be based on recommended overcurrent device settings and will be provided after the results of the analysis have been presented to the Owner and after any system changes, upgrades, or modifications have been incorporated in the system.
- C. The label shall include the following information, at a minimum:
 - 1. Location designation (Equipment ID).
 - 2. Nominal voltage.
 - 3. Arc flash boundary.
 - 4. Incident energy.
 - 5. PPE description.

6. Working distance.
 7. Shock protection boundaries (Limited and Restricted).
 8. Engineering firm and issue date.
- D. Labels shall be machine printed, with no field markings.

2.07. MAXIMUM AVAILABLE FAULT CURRENT LABELS (SERVICE EQUIPMENT ONLY)

- A. Provide a 2-inch x 4-inch thermal transfer type label of high adhesion polyester for each piece of service entrance equipment. Labels affixed to equipment enclosures rated NEMA 3R, 4, 4X, 6, or 8 shall be rated for outdoor use.
- B. The label shall include the following information, at a minimum:
 1. Location designation (Equipment ID).
 2. Maximum Available Fault Current
 3. Engineering firm and issue date.

PART 3 EXECUTION

3.01. FIELD ADJUSTMENT

- A. Adjust relay and protective device settings according to the recommended settings table provided by the coordination study. Field adjustments to be completed by the engineering service division of the equipment manufacturer or Contractor under the direct supervision of the engineering firm completing the analysis.
- B. Make minor modifications to equipment as required to accomplish conformance with short-circuit and protective device coordination studies.
- C. Notify Owner in writing of any required major equipment modifications.
- D. Maximum Available Short Circuit Labels – Short circuit labels shall be provided in the following manner:
 1. All service entrance equipment.
- E. Arc Flash Warning Labels - Arc flash labels shall be provided in the following manner and all labels shall be based on recommended overcurrent device settings. Provide the following:
 1. For each 600, 480, and applicable 208 volt panelboard, one arc flash label shall be provided.
 2. For each motor control center, one arc flash label shall be provided.
 3. For each low voltage switchboard, one arc flash label shall be provided.

4. For each switchgear, one flash label shall be provided.
5. For each major equipment disconnect, one arc flash label shall be provided.
6. For each enclosed circuit breaker, one arc flash label shall be provided.

END OF SECTION

SECTION 16095
CONTROL PANELS AND INTEGRATION

PART 1 GENERAL

1.01 DESCRIPTION:

- A. It is the intent that the Contractor will work with a system integrator to successfully fulfill the requirements herein and shown on the Contract Drawings to provide a complete and operable control system (fully integrated) with the intent specified and shown on the Contract Drawings.
- B. System integrator referenced throughout this specification is referring to the panel provider.

1.02 SECTION INCLUDES

- A. Pump Control Panel (PCP)
- B. Wetwell Level Transmitter
- C. Wetwell Float Switches
- D. Cellular Equipment (Add Alternate)
- E. HVAC Monitoring Alarm Lights/Horns
- F. Tablet Computer (Add Alternate)
- G. Commissioning, Programming, Screen Development, Startup Services, & Training
- H. Integration within existing WWTP SCADA system (Add Alternate)
- I. Mission M110 Control System (Base Bid)

1.03 REFERENCE STANDARDS

- A. All control systems as specified herein shall be provided in accordance with the latest additions of the NEC and IEC.
- B. All wiring shall be in complete conformance with the National Electrical Code, State, local and NEMA electrical standards. All incoming and outgoing wires shall be connected to numbered terminal blocks and all wiring neatly tied and fastened to chassis as required.
- C. All control panels shall be UL 508A listed or UL 698A whichever may be applicable. The UL "sticker" shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A listed equipment or UL 698 listed equipment shall be strictly prohibited.
- D. All equipment and installations shall satisfy applicable Federal, State, and local codes.
- E. Furnish products listed and classified by Underwriters Laboratories (UL), CSA, or FM approval as suitable for purpose specified and indicated.
- F. Auxiliary and accessory devices necessary for system operation or performance, such as transducers, relays, signal amplifiers, intrinsic safety barriers, signal isolators, software, and drivers to interface with

existing equipment or equipment provided by others under other Sections of these specifications, shall be included whether they are shown on the Drawings or not.

- G. Use the equipment, instrument, and loop numbering scheme shown on the Drawings and specifications in the development of the submittals. Do not deviate from or modify the numbering scheme without the Engineer's approval.

1.04 RELATED SECTIONS

- A. All Division 16 Specifications.

1.05 SUBMITTALS

- A. The Systems Integrator shall for review, provide to the contractor, for submission to the engineer, three (3) hardcopy sets and one (1) electronic copy (USB) of the following documentation:
 - 1. Written Sequence of Control System Operation (coordinate as required with the engineer and owner).
 - 2. Electrical and Mechanical Schematic Drawings.
 - 3. Bill of Materials.
 - 4. Vendor Data Sheets.
 - 5. System Warranty (see below).

1.06 OPERATIONS AND MAINTENANCE DOCUMENTATION

- A. The Systems Integrator shall provide to the contractor, three (3) hardcopy sets and one (1) electronic copy (USB) of the following Operations and Maintenance documentation; all documentation shall be neatly bound in 3-ring binders.
 - 1. Final Written sequence of control system operation (coordinate as required with the engineer and owner).
 - 2. As-Installed Electrical and Mechanical Schematic Drawings.
 - 3. Bill of Materials.
 - 4. Vendor Operation, Maintenance and troubleshooting documentation.
 - 5. PLC and OIU program printouts.
 - 6. Back-up Copies of As-installed PLC and OIU programs on CD and USB thumb drive.

1.07 WARRANTY

- A. The Systems Integrator shall provide with the above submittals, a written parts warranty against system failure for twelve (12) months from system startup, not to exceed eighteen (18) months from date of shipment from their factory. This warranty period will, apart from human negligence or acts of nature such as lightning, floods, etc., provide for repair or replacement of any defective or failed components, at the project site, and at no cost to others.

1.08 QUALITY ASSURANCE

- A. The Equipment, controls and accessories covered in this specification section constitute a completely integrated system, designed, constructed, programmed and tested by one Systems Integrator, accountable for its operation and performance. The Systems Integrator named hereafter has been chosen

as the basis of design based their ability to engineer, design and manufacture systems of the type herein specified. In addition, they possess a New York State based, factory trained, service staff experienced in routine and emergency service of the type of equipment herein specified.

- B. The Contractor shall submit to the Engineer the name of the System Integrator to whom they propose to award the work. No Systems Integrator will be approved by the Engineer who cannot furnish satisfactory proof of at least five (5) successful installations which in the judgment of the Engineer are of equal or greater complexity to that described herein.
- C. The Systems Integrator shall be a reputable firm that has been in the business of providing automated control systems specifically for the water and wastewater treatment industry for a minimum of ten (10) years. Systems Integrators with less than ten (10) years of experience will not be accepted.
- D. The Systems Integrator shall have as a minimum, five (5) full time employees whom are experience in routine and emergency services of the equipment herein specified. The Systems Integrator shall as a minimum provide two (2) direct cell phone numbers in which service personnel can be reached 24hrs, 7 days a week.
- E. The System Integrator shall be U.L. approved for manufacturing systems in compliance with UL 508A and/or UL 698A whichever may be applicable. Each assembly and subassembly of the system shall be listed and labeled as U.L. approved. Systems Integrators whom outsource panel fabrication services for the purpose of providing UL labeling will not be accepted.
- F. For serviceability reasons the system integrator's service facility shall be located within 250 miles of the project site.
- G. The Systems Integrator shall be AquaLogics Systems, Inc., 5 Dwight Park Drive, Syracuse, NY 13209, Phone: (315) 413-0400 or approved equal.
- H. Control panels shall be fabricated with the following features as a minimum:
 - 1. All sub panel wiring shall be run in plastic wire duct sized with 50% spare space, AC and DC wiring shall be run in separate wire ducts.
 - 2. All power supplies shall be sized for an additional 50% spare ampacity over expected load. Each power supply shall include an AC input fuse and independent output fuses for each device requiring DC power.
 - 3. All field terminations shall be made on compression type terminal blocks labeled according to wire number, separate terminal strips shall be provided for AC and DC signals. A minimum of 20% spare terminals shall be provided.
 - 4. Wiring to door mounted components shall be neatly bundled wiring harnesses protected by plastic spiral wire wrap when crossing door hinge. Wiring harnesses shall have adequate stress loops and be fastened at both sides of hinge crossing.

5. All wiring shall be wire numbered at both ends with plastic Brady type labels.
 6. All nameplates shall be engraved on lamacoid material providing black lettering on a white background. Lettering shall be no smaller than 1/8 of an inch in height.
 7. Twenty percent spare mounting space is required for future modifications.
- I. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

1.09 ENVIRONMENTAL CONTROL OF PANELS

- A. Panels shall be provided with louvers, sun shields, heat sinks, forced air ventilation, or air conditioning units as required to prevent temperature buildup inside of panel. Internal temperature of all panels shall be regulated to a range of 45 Deg F to 104 Deg F under all conditions. Under no circumstances shall panel cooling or heating equipment compromise the NEMA rating of the panel.
- B. Except for panels mounted with their backs directly adjacent to a wall, louvers shall be in the rear of the panels, top and bottom, and shall be stamped sheet metal construction.
- C. For panels mounted with their backs directly adjacent to a wall, louvers shall be on the sides.
- D. Forced air ventilation fans, where used, shall provide a positive internal pressure within the panel, and shall be provided with washable or replaceable filters. Fan motors shall operate on 120-volt, 60-Hz power.
- E. For panels with internal heat that cannot be adequately dissipated with natural convection and heat sinks, or forced air ventilation, an air conditioner shall be provided.
- F. Provide custom fabricated sun shields for all outdoor panels in accordance with the following requirements:
 1. Sun shields shall be fabricated from minimum 12-gauge Type 316 stainless steel. Units shall be designed, fabricated, installed, and supported to fully cover and shade the top, sides and back of the enclosure, and to partially shade the front panel of the enclosure, from direct exposure to sunlight from sunrise to sunset.
 2. Depending on overall size, sun shields may be fabricated in single or multiple segments for attachment to the enclosure support framing or to separate free standing framing around the enclosure.
 3. Sun shields shall not be attached directly to the enclosure by drilling holes through, or welding studs to, the enclosure surfaces, and shall be designed and mounted to provide a minimum 3-inch air gap all around the enclosure for air circulation and heat dissipation.
 4. Top section of all sun shields shall be sloped at a minimum angle of 5 degrees from horizontal. For wall mounted enclosures, the top section shall slope downward away from the wall and towards the

front of the enclosure. For free standing, floor mounted and frame mounted enclosures the top section shall slope downward towards the back side of the enclosure.

5. Front edge of the top section of all sun shields shall incorporate a narrow and more steeply sloped drip shield segment which sheds water away from the front of the enclosure and prevents it from dripping or running directly onto the front panel of the enclosure.
 6. Seam welds used in sun shield fabrication shall be continuous and shall be ground smooth.
 7. Exposed corners, edges, and projections shall be smooth rounded or chamfered to prevent injury
- G. Outdoor enclosures and enclosures located in unheated areas indoors or in areas subject to humidity and moisture shall be provided with an integral heater, fan, and adjustable thermostat to reduce condensation and maintain the minimum internal panel temperature. Mount unit near bottom of the enclosure with discharge away from heat-sensitive equipment. Heater shall be 120V, 60Hz, and sized per manufacturer/system integrators recommendations.

1.10 DESCRIPTION OF OPERATION

A. OVERVIEW

1. The Systems Integrator shall provide for contractor installation a completely integrated pump control system, consisting of a Pump Control Panel (PCP), wetwell level transmitter and redundant high and low level alarm float switches. The pump control system, accessories and associated services shall be provided as herein specified.
2. The PCP shall be PLC based completely factory programmed as required to provide the follow control strategies. A door mounted color touch screen Operator Interface Unit (OIU) shall be provided for system monitoring and control.
 - a. Wetwell Level Monitoring:
 - 1) A submersible level transmitter shall be provided for installation within the pump station wetwell. The transmitter shall be of the two-wire type powered by the PCP and shall provide a 4-20 mAdc signal linear and proportional to wetwell level. The PCP shall utilize this signal for control, monitoring, trending and alarm functions.
 - 2) Float switches shall be provided for redundant high and low level alarm notification. The float switches shall be fail safe with the high level float switch being normally-closed, open on alarm and the low level float being normally-open, held closed, open on alarm.
 - b. Wetwell Level Control:
 - 1) As level in the pump station wetwell rises above an adjustable "Lead Pump ON" setpoint, system logic shall start the lead pump by use of an across the line starter integral to the PCP. The pump shall continue to run until wetwell level falls below the "All Pumps Off" setpoint.
 - 2) Should influent wetwell flow exceed the capacity of the lead pump and the wetwell level continues to rise above the "Lag Pump On" setpoint, system logic shall automatically start the lag pump by use of an across the line starter integral to the PCP. Both the lead

and lag pumps shall continue to run until the wetwell level falls below the "All Pumps Off" setpoint.

- 3) High and low level alarm setpoints shall be provided for alarm annunciation of an abnormally high or low wetwell level condition.
 - 4) All level control, alarm and time delay setpoints shall be fully adjustable via the PCP door mounted OIU.
- c. Pump Seal and Motor Winding Temperature Monitoring:
- 1) Each pump is equipped with seal failure/moisture detection probes and high motor winding temperature switch. The PCP shall be provided with leak detection and motor winding temperature circuitry for monitoring each pump. Should moisture in the pump be detected while the pump is operating, system logic shall annunciate the alarm but allow the pump to continue operating. In the event of a motor winding temperature alarm, system logic shall shutdown the respective pump and consider it unavailable for operation. All seal failure and motor high temperature alarms shall be annunciated on the PCP door mounted OIU, common alarm light and alarm horn.
- d. Hand-Off-Auto Pump Operation
- 1) Each pump operational mode shall be provided by a panel mounted Hand-Off-Auto selector switch; each mode shall operate as follows:
 - (a) Hand: When "Hand" mode is selected the respective pump shall start regardless of system logic, all pump interlock conditions shall be overridden in the "Hand" mode.
 - (b) Off: When in "Off" mode the respective pump shall be prohibited from operation, system logic shall consider the pump unavailable for operation.
 - (c) Auto: When "Auto" mode is selected the respective pump shall operate as required by system logic and as described above; all pump safety interlocks shall be fully operational.
- e. Pump Alternation and Sequence Selection
- 1) Pump Alternation and sequence selection (1-2/Auto/2-1) shall be provided by the PCP door mounted operator Interface Unit (OIU).
 - (a) Selection 1-2: Pump 1 remains lead and pump 2 remains lag on each pump down cycle, alternation of pump(s) only occurs in the event of pump 1 not being available for operation.
 - (b) Selection 2-1: Pump 2 remains lead and pump 1 remains lag on each pump down cycle, alternation of pump(s) only occurs in the event of pump 2 not being available for operation.
 - (c) Selection Auto: Lead Pump determined by system logic, alternation between pumps on each pump down cycle or upon the lead pump not being available for operation.
- f. Pump Availability:
- 1) A pump shall be considered unavailable for operation when any of the following conditions occur:

- (a) Respective pump mode of operation selector switch is in the "OFF" position
 - (b) Respective pump fails to start
 - (c) Respective pump motor winding high temperature
 - (d) Wetwell low-level condition
- g. Alarm Monitoring:
- 1) All level alarms shall be locally annunciated on the PCP door mounted OIU, common alarm light and alarm horn.
 - 2) Alarm acknowledgement reset, and horn silence of system alarms shall be provided by a PCP door mounted pushbutton.
3. Refer to the Contract Drawings for intent and all equipment/components that control panel is to interface with.

PART 2 PRODUCTS

2.01 PUMP CONTROL PANEL (PCP)

- A. The control panel shall be housed in NEMA 12 wall mount enclosure constructed of 14-gauge steel with white polyester powder paint inside, ANSI 61 gray polyester powder paint outside over phosphatized surfaces. The enclosure shall be approximately 48" high by 48" wide by 12" deep (or as required to house equipment specified and perform intended operations specified). The enclosure shall be Hoffman or approved equal.
- B. Control panel shall be UL 508A listed or UL 698A Listed where appropriate. The UL "sticker" shall be clearly displayed in the appropriate location within the panel. Third party substitutions of UL 508A listed equipment or UL 698 listed equipment shall be strictly prohibited.
- C. Panel Input power shall be 208VAC, 3 Phase, 60Hz. Provide a sufficiently sized main circuit breaker disconnecting means. Interlock main circuit breaker disconnect with the control panel door handle.
- D. Refer to Electrical Drawings for additional information/requirements.
- E. A 208VAC three phase surge protector shall be provided for the incoming 208VAC supply. The surge protector shall be designed to protect electrical and electronic equipment against transients caused by lightning, induction, load switching, EMP and other sources. Line to line, line to neutral, line to ground and neutral to ground protection shall be provided. The surge protector shall have a protection level of 1kV and a maximum discharge current of 140 kA as a minimum. The surge protector shall have a remote signaling device for fault indication to the PLC. The AC surge protector shall be as manufactured by CITEL or approved equal.
- F. All communication cabling that exits the building shall have surge protection provided.
- G. Short circuit protection of 120VAC input and UPS control power shall be provided by a miniature branch rated circuit breaker with an interruptive capacity of 10K amperes at 240VAC. Circuit Breakers shall be Allen-Bradley 1489 series or approved equal.

- H. One print pocket shall be provided on the control panel door. One complete set of electrical control drawings shall be provided in the pocket.
- I. Separate circuit breaker disconnects for each load supplied from the control panel shall be provided. All branch circuits shall be short circuit protected.
- J. Individual molded case, thermal-magnetic circuit breakers shall be provided for each of the wetwell pumps; the breakers shall be of sufficient size to operate the respective pump. All requirements to be per NEC.
- K. An across the line motor starter with adjustable overload relay and reset solenoid shall be provided for operating each wetwell pump, the starters shall be integral to the PCP. The systems integrator shall coordinate horsepower, voltage and current ratings to ensure electrical characteristics match that of the wetwell pumps.
- L. The control panel shall be provided with an Uninterruptible Power Supply (UPS) for protection against power disturbances, noise and brownouts. Refer to article below for UPS specifications.
- M. The Control panel shall be provided with a Programmable Logic Controller (PLC). The PLC shall be factory programmed, tested and debugged to meet all the requirements of the applicable process. Refer to article below for PLC specifications.
- N. The control panel shall be provided with a door mounted 15" Operator Interface Unit (OIU) for system monitoring, setpoint entry/review and alarm annunciation. Communications between the OIU and PLC shall be Ethernet. The OIU shall be color touchscreen. Coordinate OIU installation height on the panel with the Owner. Refer to article below for OIU specifications.
- O. The PCP shall be provided with an industrial Ethernet switch for network communications between the PLC and OIU. Additional Ethernet ports shall be available for system programming and connectivity to future Local Area Network (LAN). Refer to article below for network switch specifications.
- P. Control panel shall be provided with a DC power supply: a 24V direct current power supply shall be provided to power the PLC, OIU, I/O, cellular modem, and all ancillary equipment. The power supply shall have an operational input range of 85 to 132VAC and shall have a minimum rated output of 24 to 28VDC/240 watts. Power supply shall be PULS QS10.241 or approved equal.
- Q. The control panel shall provide visual alarm annunciation via common alarm pilot light and OIU alarm screen. Pilot light shall be 30mm, industrial grade, push-to-test type, Allen-Bradley 800T series or approved equal.
- R. The control panel shall provide audible alarm annunciation via alarm horn. Alarm horn shall provide a typical sound pressure of 95 + 5 dB(A) at 30VDC, at 24 inches and shall have a built-in volume control providing variable attenuation up to 20 dB(A). The alarm horn shall be Floyd Bell model MC-V09-530-Q or approved equal.

- S. A momentary pushbutton shall be provided for alarm acknowledgment/reset and alarm horn silence, pushbutton shall be 30mm industrial grade, Allen-Bradley 800T series or approved equal.
- T. Control panel shall have a single tube, LED light fixture, 10 Watt in size, mounted internally to the ceiling of the panel. Light fixture shall be switched and shall be complete with the lamp.
- U. Control panel shall have a specification grade duplex convenience receptacle with ground fault interrupter, mounted internally within a stamped steel device box with appropriate cover. Convenience receptacle shall not be powered from a UPS and shall be protected by a dedicated fuse or circuit breaker.
- V. AC power fuses shall be provided as required for over current protection of individual AC powered panel components. Single circuit fusible terminal blocks with neon blown fuse indicators suitable for use with ¼" x 1 ¼" glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 100 to 300VAC, and have a current rating of 12 Amps, fuse blocks shall be Allen-Bradley model 1492-H4 or approved equal.
- W. DC power fuses shall be provided as required for over current protection of individual DC powered panel components. Single circuit fusible terminal blocks with LED blown fuse indicators suitable for use with ¼" x 1 ¼" glass fuses shall be provided for each circuit requiring fuse protection. Fusible terminal strips shall have a working voltage rating of 10 to 57V AC/DC, and have a current rating of 12 Amps, fuse blocks shall be Allen-Bradley model 1492-H5 or approved equal.
- X. Interposing and control relays shall be provided as required. They shall be of industrial grade, plug-in socket type, and shall have 24VDC or 120VAC coils and 2PDT or 4PDT form C relays as required. All relay contacts shall be silver nickel plated, 2PDT relay contacts shall be rated for 10A at 300VAC and 4PDT relay contacts shall be rated for 7A at 300VAC. All relays shall be provided with a standard ON/OFF flag indicator, mounting base and retainer clip. Control relays shall be Allen-Bradley series 700-HC or approved equal.
- Y. Compression type terminal blocks shall be provided for all field connections, wiring field equipment directly to PLC I/O bases or other panel components is not acceptable. Terminal blocks shall have the following electrical ratings as a minimum:
 - 1. Two Level Terminal Blocks
 - a. Rated Voltage: 300V AC/DC
 - b. Rated Current: 20 Amp
 - c. Wire Size Range: 30-12 AWG
 - 2. Three Level Terminal Blocks
 - a. Rated Voltage: 300V AC/DC
 - b. Rated Current: 10 Amp
 - c. Wire Size Range: 26-14 AWG
 - 3. Terminal blocks shall be Allen-Bradley series 1492 or approved equal.
- Z. The control panel shall be provided with an integrally mounted and wired telephone alarm dialer for remote annunciation of system alarms. The dialer shall have as a minimum the following features:
 - 1. The dialer enclosure shall be NEMA 1, with integral LED display and keypad.

2. The dialer shall include an integral battery and associated charger to provide 20-hour operation during power outages. All the dialer's inputs including power supply, telephone line and alarm inputs shall be individually surge protected. The dialer shall be capable of synthesizing the operator's own voice messages and will be capable of monitoring sixteen (16) discrete inputs plus 120VAC power source. The dialer shall be capable of calling up to sixteen (16) phone numbers, independently programmable to any or all the alarms.
 3. Programmable functions such as independent time delay before calling out, time between consecutive calls and alarm input sense that is normally open or normally closed, shall be inherent.
 4. All voice messages and functions will be programmable locally via the dialer's integral keypad or remotely via telephone communications. Security codes (up to 8 digits) shall be programmable to prevent unauthorized access to the dialer's configuration.
 5. The alarm dialer shall be modular in design, allowing future expansion of discrete input channels, analog input channels, and remote supervisory control outputs.
 6. The alarm dialer shall have a five (5) year parts and labor warranty.
 7. Provide expansion card as required to monitor 16 inputs.
 8. Coordinate with the owner for which alarms/signals are to be incorporated in the proposed autodialer. Contractor to program the dialer as required.
 9. The alarm dialer shall be RACO model VSS-16C or approved equal.
- AA. The PCP to be provided with a Cellular Modem (furnished by the owner/service provider) for proper operation of the telephone alarm dialer specified above. Modem is to provide a dial tone for the alarm dialer's use. The panel fabricator is to coordinate activation of this cellular modem with the Town's service provider. Panel fabricator to provide sufficient room for installation within panel.
1. Note, this cellular modem is in addition to the cellular modem specified below for internet access and SCADA connectivity.
- AB. The PCP shall be provided with a door mounted operator control for each wetwell pump. Each Control station shall include the following:
1. Engraved lamacoid nameplate, 5"H x 5"W
 2. Three position Hand-Off-Auto pump mode selector switch, 22 mm
 3. Pump call to run pilot light, 18mm, Amber
 4. Pump running pilot light, 18mm, Green
 5. Pump failure pilot light, 18mm, Red
- AC. The PCP shall be provided with door mounted Elapsed Time Meters (ETMs) for accumulating each of the pump's operating runtime. The ETMs shall have a six-digit counter indicating accumulated runtime to 1/10th of an hour.
- AD. The PCP shall provide for seal leak probe and motor winding over temperature switch inputs from each pump. All required seal leak detection relays, temperature control relays and ancillary devices to provide

seal leak and over temperature alarms as recommended by the pump manufacture shall be an integral part of the PCP.

1. The PCP is to be provided with a pump monitoring relay for monitoring of each pump overtemperature and seal leak features. Provide sufficient space within control panel for installation of these monitoring relays. Coordinate final requirements closely with the pump manufacturer. For bidding purposes assume two (2) FLYGT MINICASII Relays are to be provided as part of this package.
- AE. The PCP shall be provided with an intrinsically safe barrier for the wetwell level transmitter and float switch inputs. All Intrinsically safe wiring shall be separated from other wiring by a distance of at least 2 inches, secured from conductors and cables of non-intrinsically safe circuits. Physical barriers shall be installed where required to prevent intrinsically safe circuits from coming in contact with non-intrinsically safe circuitry.
- AF. The PCP shall be provided with a 24VDC analog signal surge protector for the wetwell level transmitter input signal. The surge protector shall be provided as part of the level transmitter's lifetime surge protection warranty.
- AG. The PCP shall be provided with an aneroid bellows for terminating the wetwell level transmitter vent tube, protecting the transmitter from damage due to moisture.
- AH. As part of Add Alternate the PCP to be provided with an Encrypted Ethernet Tunnel for Remote Access and Monitoring of the System via a tablet computer running an Encrypted Ethernet Tunnel Software Client. Refer to article below for Encrypted Ethernet Tunnel Specifications.
- AI. As part of Add Alternate the PCP to be provided with a Cellular Modem for Internet Access and Network Communications to the tablet computer via the Encrypted Ethernet Tunnel. Refer to article below for Cellular Modem Specifications.
- AJ. As part of Add Alternate the PCP to be provided with two (2) remote mount, permanent mount cellular antennas. The cellular antennas shall be Panorama Antennas model WMMG-7-27-5SP or approved equal. Cellular antennas are to be mounted directly to the control panel enclosure. Antennas to be provided with factory cable in which is to be continuous (no splices permitted). Refer to electrical drawings for additional information.
- AK. As part of Add Alternate lightning and surge protection shall be provided for the cellular antenna input by a bulkhead mounted coaxial surge protector. Antenna surge protectors shall be CITEL P8AX series or approved equal
- AL. The control panel shall be completely factory assembled, wired, configured and tested prior to being shipped to the project site.

2.02 WETWELL LEVEL TRANSMITTER

- A. The submersible pressure transducer shall be specifically designed for wastewater service and be certified intrinsically safe for hazardous locations.
- B. The transducer shall be non-fouling design incorporate a 4.10" PTFE isolated diaphragm with a 2.75" sensing area fitted to a rugged 316 stainless steel case.
- C. The sensor shall utilize a silicon pressure cells fitted into the case with an integral, compliant stainless steel barrier diaphragm and have a .25% static accuracy.
- D. The transducer shall be 2-wire (22 AWG) design and produce a 4-20 mAdc signal linear to wetwell level. The conductors shall be encased in a polyurethane jacketed shielded cable with a polyethylene vent tube and Kevlar tension members. The cable shall have a 200 lbs. pull strength and be of enough length to reach the pump control panel in a continuous run without splices.
- E. The transducer shall have a ½" MNPT conduit fitting to provide for mounting the transducer to a conduit or suspension kit.
- F. The transducer range shall be suitable for the operating range of the wetwell plus any potential high water condition without any damage to the transducer.
- G. The transducer shall carry a lifetime surge protection warranty which shall include a din rail mount 24VDC surge protector for installation in the pump control panel.
- H. The level transmitter shall be provided with an aneroid bellows for transmitter vent tube termination. The bellows shall be mounted in the pump control panel
- I. The level transmitter shall be provided with a weighted suspension kit consisting of a 1" stainless steel pipe (a minimum of 40" long) which shall be attached to the transmitter conduit fitting. The suspension kit shall be provided with 40' of 1/8" stainless steel cable and clamps to facilitate suspending the transmitter into the wetwell, while allowing it to be easily removed for service without entry into the wetwell.
- J. The level transmitter shall be TE Connectivity/Masurement Specialties model 750 or approved equal.

2.03 WETWELL FLOAT SWITCHES

- A. Each float switch shall be of the direct acting type, containing a single pole non-mercury switch, which actuates when the longitudinal axis of the float is horizontal, and deactivates when the liquid level falls 1" below the actuation elevation.
- B. Each float shall be housed in a chemical resistant polypropylene casing with a firmly bonded electrical cable protruding. One end of the cable shall be permanently connected to the enclosed switch with the entire assembly encapsulated to form a completely watertight and impact resistant unit, provide enough

cable length as required by wetwell depth and lower level depth to reach the control panel as indicated on the Contract Drawings.

- C. Float switches shall be suitable for low-current operation compatible with intrinsically safe barriers and/or PLC inputs.
- D. A coated steel anchor assembly with stainless steel chain and float clamps shall be provided for installing the float switches within the wetwell and lower level as indicated on the Contract Drawings. The anchor assembly shall allow for removal of floats without entering the wetwell or lower level.
- E. Float switches shall be SJE Rhombus Milli-Amp-Master or equal. Typical of three (3) float switches required. Refer to the Contract Drawings for additional information.

2.04 VENTILATION ALARMING LIGHTS AND HORNS

- A. Contractor to provide an LED light and audible sounder/horn (for each H/S indicated on the Contract Drawings) in quantities and locations as shown on the Contract Drawings to indicate a failure of a continuous ventilation system.
 - 1. Note, H/S refers to Horn/Strobe
 - 2. Note, HVAC monitoring is required in all areas in which ventilation is utilized to de-classify a space. Upon failure/inadequacy of the ventilation system in these spaces an alarm light/horn is to be energized alerting personnel to the unsafe condition. Refer to the Contract Drawings for additional information. Provide necessary control panel programming to achieve alarm light energization and horn energization upon a ventilation system failure. When ventilation system is operating properly the green "go" LED light shall be illuminated.
- B. Lights and sounders/horns shall possess the following features:
 - 1. One LED light with amber colored lens and one LED light with green colored lens. Green light will be energized to indicate a "go" condition and amber light and sounder/horn will be energized for "no go" condition. The amber colored LED light and sounder/horn may be provided as a combination audible/visual warning signal where applicable.
 - 2. Lights and sounder/horn shall be energized by contact closure within the control panels.
 - 3. Lights and sounder/horn shall operate on 24 VDC powered by contact closures to each light's LED and sounder.
 - 4. Lights and sounder/horn shall be rated NEMA 4X and shall be suitable for use in outdoor areas where indicated/shown on the Contract Drawings.
 - 5. Sounder/horn shall be suitable for mounting outdoors where indicated/shown on the Contract Drawings.
 - 6. Provide wall mounting appurtenances and back boxes for lights and sounder/horn as required.
 - 7. Each LED light and sounder/horn to be labeled/identified. Refer to Section 16196, Identification for Electrical Systems, for additional information.
 - 8. Manufacturer
 - a. Lights - Federal Signal or equal.
 - b. Sounder/Horn - Federal Signal or equal.
- C. Note, the ventilation alarming lights and horns are associated with the exhaust fan within the pump station building. Refer to Contract Drawings for additional information.

2.05 UNINTERRUPTIBLE POWER SUPPLIES (UPS)

A. AC Input Parameters

1. Surge Protection: 570J
2. Voltage Range: 84VAC - 140VAC (+/- 10VAC)
3. Frequency Range: 55-64 Hz. (+/- .1 Hz)
4. Input Power Cord: 6 ft. attached, w/NEMA 5-15 P

B. AC Output Parameters

1. Output Receptacles: Battery backup and surge protected Six (6) NEMA 5-15R, Surge protected only Two (2) NEMA 5-15R
2. Voltage Normal Mode: Nominal (110, 120, 127VAC) +/-10%
3. Voltage Battery Mode: 120VAC +/- 8%
4. Output: 1000VA, 8.3A
 - a. Contractor to confirm UPS sizing based upon devices shown on Contract Drawings requiring UPS power. Adjust UPS output size/configuration as required to provide UPS power to devices shown on the Contract Drawings.
5. Battery Mode Waveform: Stepped Sinewave
6. Frequency: 50/ 60 Hz (auto sensing)
7. Overload warning: greater than 100%
8. Overload shutdown: greater than 110%

C. Data Line

1. RJ11 (1 in/1 out), surge protected

D. Battery Parameters

1. Battery Type: Valve-regulated, non-spillable, lead acid
2. Battery Quantity: One (1), user replaceable
3. Transfer Time: 4 - 6 milliseconds.
4. Back-up Time: Full Load 6 minutes, half Load 13 minutes
5. Recharge Time: 6 hours to 90% at rated capacity, after full discharge into resistive load.

E. The UPS shall be Liebert, APC (true sine wave) or approved equal.

2.06 PROGRAMMABLE LOGIC CONTROLLERS (PLC)

A. Input Power

1. 24VDC

B. User Program / User Data Space

1. 10 Kbytes / 10 Kbytes

C. Memory Storage

1. Non-volatile battery backed RAM
2. Back-up Memory Module

- D. Data Logging / Recipe Storage
 - 1. Up to 128 Kbytes for data logging and up to 64 Kbytes for recipe (recipe memory subtracted from available data logging)
- E. Online Editing
 - 1. The PLC shall be capable of allowing online editing to the application program without interruption. PLCs that require stopping the processor to download changes are not acceptable
- F. Programming Software Support:
 - 1. RSLogix5000
- G. I/O Local to PLC Base Unit
 - 1. Digital Inputs
 - a. Eight (8) 24VDC
 - b. Twelve (12) Fast 24VDC
 - 2. Digital Outputs
 - a. Six (6) Relay
 - b. Three (3) 24VDC FET
 - c. Three (3) Fast, 24VDC FET
 - 3. Analog Inputs
 - a. Four (4) 0-10VDC, 12 Bit
 - 4. Analog Outputs
 - a. Two (2) 0-10VDC, 12 Bit
- H. I/O Expansion
 - 1. By use of up to seven (7) 1762 I/O modules (analog, digital, RTD or thermocouple)
 - 2. Provide all I/O modules and cards to meet site specific I/O requirements, plus 10% spare I/O points of each type used. Coordinate requirements with the owner and Contract Drawings.
- I. I/O Module Banks
 - 1. Three (3) maximum
- J. Serial Ports
 - 1. One RS-232 / RS-485 Combo Port
- K. Serial Protocols
 - 1. DF1 Full Duplex
 - 2. DF1 Half Duplex Master/Slave
 - 3. DF1 Radio Modem
 - 4. DH-485
 - 5. Modbus RTU Master/Slave
 - 6. ASCII
- L. Ethernet Ports
 - 1. One 10/100 Mbps port

- M. Ethernet Protocols
 - 1. Ethernet/IP messaging
- N. Real Time Clock
 - 1. Embedded
- O. PID Control Loops
 - 1. Multiple loops limited only by program and stack memory
- P. The PLC shall be capable of executing floating point math
- Q. The PLC shall have an integral LCD display for monitoring controller data
- R. PLC shall be capable of stand-alone operation in the event of failure of the communication link to the HMI subsystem.
- S. Software:
 - 1. Provide RSLogix5000 part number 9324-RLD700NXENE or approved equal.
- T. The Programmable Logic Controllers (PLCs) shall be Allen-Bradley MicroLogix 1400 model 1766-L32BXBBA with 1762 I/O modules or approved equal.

2.07 OPERATOR INTERFACE UNIT (OIU)

- A. Display:
 - 1. Display Type: Color active-matrix TFT
 - 2. Size: 15-inch, 13.39"W x 9.65"H display area
 - 3. Resolution: 1024 x 768, 18-bit color graphics
 - 4. Touch Screen: analog resistive
- B. Operating System:
 - 1. Microsoft Windows CE with extended features and MS Office Viewers.
- C. System Memory:
 - 1. 512 MB RAM, 512 MB nonvolatile storage for applications.
- D. External Storage:
 - 1. Secure Digital (SD) card, cat. no.1784-SDx
 - 2. USB flash drives supported by high-speed, hot-swappable, 2.0 USB host ports
- E. Battery (Real-Time Clock)
 - 1. Battery-backed time clock timestamps critical data. Accuracy +/-2 minutes per month
- F. 6. Environmental Operating Temperature:
 - 1. 0 - 55°C (32 - 131°F)

- G. Ratings
 - 1. NEMA 12, 13, 4X, IP66 as classified by UL
- H. USB Ports:
 - 1. Two USB high-speed 2.0 host ports (type A) support removable flash drives for external storage
- I. Ethernet Ports:
 - 1. Two 10/100Base-T, Auto MDI/MDI-X Ethernet Ports that support Device Level Ring (DLR), linear or star network topologies
- J. Input Power
 - 1. 18-32V DC (24VDC nominal)
- K. Standard Software:
 - 1. Software FactoryTalk View Machine Edition software, version 7.0 or later
 - 2. FactoryTalk ViewPoint software, version 2.6 or later
 - 3. PDF viewer
 - 4. Active X Controls
 - 5. Remote Terminal Control
 - 6. FTP Server
- L. The Operator Interface Unit (OIU) shall be Allen-Bradley PanelView Plus 7 model 2711P-T15C22D9P, 15" or approved equal.

2.08 ETHERNET SWITCH

- A. Full IEEE 802.3 Compliance
- B. Eight 10/100BaseTX RJ-45 Ports
- C. Unmanaged Operation
- D. Extended Environmental Specifications
 - 1. -40° to 80°C Operating Temperature
 - 2. >2M Hours MTBF
- E. Supports Full/Half Duplex Operation
- F. Up to 800 Mb/s Maximum Throughput
- G. MDIX Auto Sensing Cable
- H. Auto Sensing Speed and Flow Control
- I. Full Wire Speed Communications
- J. ESD Protection Diodes on RJ-45 Ports
- K. Surge Protection Diodes on Power Inputs
- L. Store-and-forward Technology
- M. Redundant Power Inputs (10-30 VDC)
- N. LED Link/Activity Status Indication
- O. Hardened Metal DIN-Rail Enclosure
- P. The Ethernet switch shall be N-TRON model 108TX or approved equal.

2.09 ENCRYPTED ETHERNET TUNNEL (ADD ALTERNATE)

A. General

1. One asynchronous DE-9P RS-232 serial port for setup
2. One 10/100BaseT and one 10BaseT Ethernet port
3. Sustained greater than 700 Kbps with AES, greater with encryption disabled
4. Supports up to 8 UT client devices
5. Bridge/tunnel supports 4,096 MAC address table entries
6. Interoperates with other UT-3300 or UT-6602 products

B. Protocol Features

1. AES 128, 192, and 256 bit encryption
2. Dynamic DNS support
3. Auto-Disconnect timers
4. Automatic fail-over for critical links
5. Web browser configuration and management from local trusted interface
6. Default IP address: 192.168.0.1
7. Initial setup via local serial terminal
8. Supports 802.1Q VLAN
9. Extensive filtering on MAC, IP, and Protocol
10. Tunnels multicast packets and all Ethernet protocols

C. Performance

1. Throughput greater than 700 kbps with AES encryption
2. Throughput greater than 2 Mbps with ISAAC fast software encryption
3. Throughput greater than 3 Mbps with software encryption configured off
4. Transfers up to 200 packets per second, typically the requirement for four audio channels in commonly used VOIP applications

D. Indicators

1. Front - Power, port activity, CF Disk (2)
2. Rear - LAN connection (3), LAN activity (3)

E. Physical/Electrical

1. Power requirements: 12 VDC, 500 ma.
2. Wide range 12, 24, 48, and 125 VDC options are available
3. Supplied with 120-240 VAC external power supply
4. Dimensions: 8 ¼" x 6" x 1.3"

F. Environmental

1. Operational Temperature: -20 to +70 C
2. Storage Temperature: -50 to +85 C
3. Humidity: Non-condensing

G. The Ethernet Tunnel shall be UT-3302 with UT-SOFT software or approved equal.

2.10 TABLET COMPUTER AND ACCESSORIES (ADD ALTERNATE)

A. A Windows based tablet shall be provided for remotely accessing and controlling the system via the Internet. The tablet shall as a minimum have an 11.6" screen and shall be provided with Windows 10 and DCB UTSoft preloaded and ready for operation when delivered to the Village. The tablet shall have the follow features as a minimum:

1. Processor: Intel® Core™ i3-71DOU (Dual Core, up to 2.4 GHz, 3M Cache, 15W)
2. Operating System: Windows 10 Professional 64bit English
3. Microsoft Office: Microsoft Office Professional 2016
4. Memory: 8GB 1866MHz LPDDR3 Memory
5. Hard Drive: M.2 128GB SATA Class 20 Solid State Drive
6. Wireless: Qualcomm QCA61 x4A 802.11ac Dual Band (2x2) Wireless Adapter+ Bluetooth 4.1
7. Mobile Broadband: DW5811 Gobi5000 4G/LTE Wireless WAN Card for Verizon (Windows 8.1/10)
8. Display: 11.6" HD (1366x768) Outdoor-Readable Glove-Capable Touchscreen with Gorilla Glass
9. Battery: 2-cell (34Wh) Lithium Ion
10. A/C Adapter: 45W AC adapter
11. Chassis: WLAN/WWAN Chassis 11.6 FHD (1920X1080) Outdoor-Readable Glove-Capable Touchscreen w/Gorilla Glass
12. Warranty: 3Year Ltd Hardware Warranty
13. The Tablet shall be Dell Latitude 7212 Rugged Extreme Tablet or approved equal.
14. Provide pre-configured with DCB UTSoft Encrypted Ethernet Tunnel Client Software
15. Provide accessory 32GB USB stick.
16. Provide with caring case.

2.11 CELLULAR MODEM (ADD ALTERNATE)

A. WAN

1. Integrated 4G LTE modem (with 3G failover)
2. Three LAN/WAN switchable 10/100 Ethernet ports - one default WAN (cable/DSL/T1/satellite/Metro Ethernet)
3. WiFi as WAN, Metro WiFi; 2x2 MIMO "N" 2.4 GHz or 5 GHz; 802.11 a/b/g/n/ac (IBR1100 only)

B. LAN

1. Dual-band dual-concurrent WiFi; 802.11 a/b/g/n/ac (IBR1100 only)
2. Three LAN/WAN switchable 10/100 Ethernet ports - two default LAN

3. Serial console support for out-of-band management of a connected device

C. Ports

1. Power
2. 2-wire GPIO
3. USB 2.0
4. 3 Ethernet LAN/WAN
5. 2 cellular antenna connectors (SMA)
6. 1 active GPS antenna connector (SMA)
7. 2 WiFi antenna connectors (R-SMA)
8. Serial DE-9 (commonly called "DB-9") connector - RS-232 (out-of-band management of an external device requires a null modem adapter/cable)

D. Temperature

1. -30° C to 70° C (-22 °F to +158 °F) operating
2. -40 °C to 85 °C (-40 °F to +185 °F) storage
3. Includes temperature sensor with options for alerts and automatic shutoff

E. Humidity

1. 5% to 95% operating
2. 5% to 95% storage

F. Power

1. DC input steady state voltage range: 9-36 VDC
2. Reverse polarity and transient voltage protection per ISO 7637-2
3. Power Consumption:
 - a. Idle: typical=400mA@12VDC (4.8W); worst case=800mA@12VDC (9.6W)
 - b. Tx/Rx: typical=650mA@12VDC (7.8W); worst case=1300mA@12VDC (15.6W)
 - c. 12VDC 2A adapter recommended

G. Physical

1. Size - 5.3 in x 4.4 in x 1.4 in (134 mm x 112 mm x 35 mm)
2. Weight - 16.1 oz. (457 g)

H. Certifications

1. FCC, CE, IC
2. WiFi Alliance (IBR1100 only) - 802.11a/b/g/n certified, 802.11ac supported
3. Safety: UL/CUL, CB Scheme, EN60950-1
4. Hazardous Locations: Class I, Div. 2 (pending)

5. Shock/Vibration/Humidity: compliant with MIL STD 810G and SAEJ1455
6. Ingress Protection: compliant with IP64 (includes protection from dust and splashing water)
7. Materials: WEEE, RoHS, RoHS-2, California Prop 65
8. Vehicle: E-Mark, compliant with ISO 7637-2
9. Telecom: PTCRB/CTIA, GCF-CC

I. GPS

1. GPS Protocols: TAIP and NMEA 0183 V3.0
2. Satellite channels: 12 channel, continuous tracking
3. 1 Hz refresh rate
4. Accuracy:
 - a. < 2m: 50%
 - b. < 5m: 90%
5. Acquisition
 - a. Hot start: 1 second
 - b. Warm start: 29 seconds
 - c. Cold start: 32 seconds
6. Sensitivity
 - a. Tracking: -161 dBm (tracking sensitivity is the lowest GNSS signal level for which the device can still detect an in-view satellite 50% of the time when in sequential tracking mode)
 - b. Acquisition (standalone): -145 dBm (acquisition sensitivity is the lowest GNSS signal level for which the device can still detect an in-view satellite 50% of the time)

J. The panel fabricator shall provide all cell modems activated and ready for service. The panel fabricator shall coordinate activation of all cell modems with the owner and service provider. All cell modems shall have a 5GB (to be verified and coordinated with the engineer/owner prior to purchasing) service plan with public static IP address.

K. The Cellular modems shall be Cradlepoint MA1-0900LPE-VNA WITH NetCloud Software, 1-year of support and the IBR900 for cellular service or approved equal.

2.12 SPARE PARTS

- A. The following spare parts shall be provided:
 1. PLC CPU of each type
 2. PLC power supply of each type
 3. PLC I/O module of each type
 4. 24VDC panel power supply of each type
 5. Two (2) surge protectors of each type

6. Five (5) fuses of each type
7. Five (5) pilot light bulbs of each type
8. One ventilation warning light of each type
9. One ventilation sounder/horn of each type
10. Five miniature circuit breakers of each type/size

2.13 MISSION M110 (BASE BID)

- A. Contractor to provide Mission M110 series control system within NEMA 1 enclosure. Provide necessary startup services and web development/hosting services to initiate Mission system.
- B. Features at minimum to include:
 - Hardware: 8 supervised digital inputs; 3 configurable to runtime/starts accumulators.
 - 2 analog inputs: 4-20 mA or 0-5 VDC, 10-bit resolution, 4 real-time alarm set points per input.
 - 4 built-in alarms (AC, low battery, temperature and communications fail).
 - 1 electronic key reader for site activity tracking and service mode.
 - 3 remotely controllable, form C dry contact relay outputs (1 amp @ 12 VDC), SPDT, N.O./N.C.
 - Supervised 120 VAC to 12 VAC, 1.2 amp power supply with UL Recognized Class II / Class III transformer.
 - 5 AH battery provides up to 40 hours of back-up power.
 - Include Antenna Kit (PN R8005) with mounting bracket and 11' of cable. Omnidirectional outdoor antenna to be wall mounted as indicated on drawings.
 - 8 vertical LEDs for diagnostics.
 - 8 digital input LEDs display input status and wiring faults.
 - RJ45 connection
 - Radio: Units automatically self-enroll with no startup delays. Radios make live, continuous, encrypted socket connections with all data and alarms being "end-to-end" acknowledged. Mission does not use SMS "text" messaging to transmit RTU data.
 - AT&T, Verizon and Sprint radios have 128-bit encryption. All use TCP data transmission protocol.
 - GSM: HSPA+ (ATT 3.5G and lower) Penta band (850, 900, 1700, 1900, 2100 MHz).
 - CDMA: 1XRTT.
 - 0.6 to 2 watt maximum transmit power and -112 dBm sensitivity.
 - Data Frequency: Digital alarm inputs and analog alarm set points: real-time.
 - Digital runtime inputs: summarized hourly.
 - Built-in telemetry and analog inputs: reported hourly.
 - Physical: Operating temperature -20F° to +160F°
 - Software Requires Service Package - M110 Series (PN 51X).
 - Include a 1 year manufacturing and material warranty

PART 3 EXECUTION

3.01 INSTALLATION

- A. When a change from normal power to emergency power occurs and vice versa all equipment to be restarted automatically. Final requirements to be coordinated with the engineer. Provide as required.

- B. Install equipment at locations indicated on the drawings.
- C. Provide all necessary cable, conduits, and fittings as required to provide a fully operable system. All wiring external to control panels shall be in conduit or sealtite. Refer to the raceway schedule on the contract drawings for additional information/requirements.
- D. Refer to the contract drawings for all field wiring specifications/requirements.
- E. Coordinate all circuitry (conduit & conductor) requirements closely with the electrical drawings.
- F. Installation of ventilation system monitoring equipment to follow NFPA 820.

3.02 GRAPHIC DISPLAYS/SCREEN DEVELOPMENT

- A. Systems integrator responsible for developing all screens associated with each control panel specified as part of this section and loading onto control panels as required. Coordinate with the owner and engineer.
- B. General Requirements:
 - 1. All displays shall contain and continuously update the displayed process variables, date and time of day. All process values shall be displayed in engineering units. All displays shall incorporate references to both instrumentation tag numbers and plant equipment numbers. All process variables shall be displayed on their associated display(s) with correct engineering units. Process variables shall display their associated data quality flags.
 - 2. All operator commands related to controlling field devices or system attributes shall require multiple keystrokes or mouse actions to protect against inadvertent operations. The operator shall receive confirmation of the selected point to be controlled, at which time a cancellation of the control can be affected.
 - 3. Process graphic displays, shall be based on the P&ID's, site plan drawings, mechanical drawings and electrical drawings included as part of these Contract Documents. The graphic displays shall depict process flow streams, process structures, and all major items of process equipment and control devices in a schematic format.
 - 4. All main graphical screens shall include a title bar, main graphic area, navigational buttons, and alarm summary bar. Title bar shall be displayed on the top of each screen and include display name, description and time/date. The main graphical area shall contain primary screen data in graphical format. Navigational buttons shall include a minimum of main menu, trends, main alarm summary, and security log in. The alarm summary bar shall display the last three valid alarms on the bottom of each screen.
 - 5. Animation shall be provided to mimic level changes in tanks or vessels, and to mimic rotation of rotating equipment when running. Valve colors shall change when opened and closed.
 - 6. Unless specifically noted, all timers, setpoints, alarm actuation levels, etc., shall be adjustable from the operator interface.
 - 7. The system shall show field conditions with text that can alternate (i.e., OPEN/CLOSE, START/STOP, HIGH/LOW) and change color correspondingly. Field devices that are tri state must be represented in three conditions.
 - 8. Conditions in the field designated as alarm conditions shall report to the operator workstation, actuate an audible alarm, and provide a visual blinking image on the associated graphic page. All alarms and events shall be displayed on the screen and archived.
 - 9. All interlocks that affect equipment operation shall be identified both by alarm and by HMI indication.
 - 10. All analog inputs shall be checked for out of range (via high and low limit checks) and alarmed.
 - 11. All process flow streams shall be labeled and color coded. All structures and equipment shall be identified by name and appropriate equipment and loop tags.
 - 12. Color coding for equipment status and alarms shall be as follows:
 - a. Green for on or open.
 - b. Red for off or closed.
 - 13. Automatically record all alarm and events should any of the following sequences or events occur:

- a. Date/Time entry
 - b. Limit changes
 - c. Any commanded or un-commanded change of any point
 - d. Alarm conditions
 - e. PLC activation or deactivation
 - f. Operator login or logout activity
- C. Specific Requirements:
1. Plant Overview screen shall include a site plan representation, indicating the geographic location of each process, and each building.
 2. Main menu screen shall be developed to link to all screens and process areas. The screen shall be a complete and logical listing of the names and number of all screens
 3. Overall plant process block flow diagram screen shall show all major processes in block form with flow arrows. Each block shall include a text description of key individual treatment processes. Navigational buttons to the individual treatment processes shall be performed by pressing on the text description.
 4. Individual treatment process screens shall graphically screen key process variables and equipment. No operator entries shall be done from these screens. Individual process flow screens for each process shall include all process components, including tanks, pumps, blowers, mixers, drives, flow meters, valves, mechanical devices, as well as manual shutoff and isolation valves. These diagrams shall be generally depicted from the P&ID's and there shall be at least 1 screen per P&ID on average.
 5. Individual unit process screens depicted from the P&ID's are used for control and screen of each major item of process equipment, process variables, and control devices, including pumps, blowers, valves, gates, mixers, drives etc. Navigational buttons shall consist of the P&ID's flow arrows to other individual unit processes. The unit process screens shall provide the ability for the operator to go to individual equipment popup screens. These diagrams shall be generally depicted from the P&ID's and there shall be at least 2 screens per P&ID on average.
 6. Popup screens shall be provided for each piece of equipment to start/stop equipment, open/close valves, implement automatic control, adjust set points, establish and adjust tuning parameters, set alarm limits and initiate a sequence.
 7. PLC system diagnostic screens, showing the operational status, and fault conditions of all PLC components, including processors, I/O modules, OIU's, power supplies and UPS units.
 8. Communications diagnostic screens, showing the details of network status, communications status of all major components including Operator Work Stations, peripheral devices and network components.
 9. Maintenance screens shall screen the raw value for each analog and digital I/O point in the system. They shall also allow the operators/maintenance personnel to enter an override value for an analog point that is then used by the system instead of the value read from the input card / communications link.
 10. Trend screens with the capability to screen up to eight, operator assigned, analog and/or digital process variables. Each analog value will be shown on a trend screen.
 11. Main alarm summary screen shall screen the following information on each alarm: Time, tag name, description, alarm type, current value and status. An acknowledge alarm button shall acknowledge all new unacknowledged alarms. The acknowledged and unacknowledged alarms shall be different colors. Acknowledged alarms shall clear automatically after the condition is corrected.
 12. Analog variable screens showing a tabular summary of all plant process variables, in operator assigned groupings.
- D. Security:

1. The system shall be configured and implemented with security to prevent unauthorized access. The system shall allow authorized changes to system operation through defined user accounts and password verification.
 2. Coordinate with Owner user account information, including login name and password for each account.
 3. Security levels of "display only", "operator mode", "supervisor mode", and "engineer mode" shall be available through assignable passwords. On system startup, the "display only" security level shall automatically be entered. In the "display only" mode, information is available to be displayed on the screen, but no changes may be made. In the "operator mode", changes may be made to process set points, times, etc.; however, the overall control concepts may not be modified. In the "supervisor mode", all operator functions can be modified, and any special reports or critical process set points (data can be modified; however, the overall control concepts may not be modified). In the "engineer mode" level, all user modifiable parameters of the system shall be available for modification.
- E. Alarm/Equipment Status Reporting:
1. The alarm log shall display all alarms as they occur. The alarm message shall include the time of occurrence, tag name, tag number, and whether it is a low, high, or failure alarm. When the point in alarm returns to normal, the time, point identification number, and return to normal shall be displayed. All reports shall include the plant equipment number of the associated device.
 2. The equipment status shall be logged whenever a change in status occurs (i.e., start, stop). The equipment status log shall include the time, equipment name, tag number, and the change in status.
- F. Historical Data Management:
1. Each system point (analog or digital, real or pseudo) shall have the capability of being historically logged. A point shall have the capability of being deleted from historical log at any time. It shall be easy to add or delete system points using minimal keystrokes.
 2. All process analogs and all flow totals and run time indications of all primary process equipment motors shall be sampled and stored in the historical data management system.
 3. Data Processing: The real time instantaneous values shall be stored in a historical log file on the hard disk at defined sampling rates.
 4. Data Correction: Historical data shall be manually modifiable by personnel with appropriate security levels. Such data shall be differentiated from actual monitored values on reports, in the database and in trends.
 5. Data Quality: Data Quality flags shall propagate to the next higher level of the history based on user selectable percentage determining tolerance levels for averages and totals. If the percentage of suspect data exceeds the tolerance level, the suspect data flag propagates to the next higher level. Maximums and minimums shall be taken from good data.
 6. Manual Input Data Handling: This data shall consist of additional values not obtainable by the system such as laboratory analysis for use in reports. All manually entered data shall be entered and stored in the appropriate engineering units. All data entered shall be displayed for confirmation on the display prior to incorporation to the database.
- G. Reports:
1. Quantity and format of reports shall be coordinated with the owner and as a minimum shall include shift, daily, monthly and yearly reports. Provide a minimum of 5 reports.
 2. The system shall be able to generate reports from on-line historical data files or prompt the user for the appropriate archived data files.
 3. Reports shall be initiated automatically based upon time of day or manually upon operator request.
 4. User interface displays for report generation shall be developed with easy recall of reports by entering time:day:year target values.

5. User interface displays shall allow the operator to define the destination of the report (e.g., display, printer, computer file, etc.) and when it is to be printed (e.g., immediately, on demand, or automatically at a specified time).
6. It shall be possible to print quality tags alongside the value.
7. Values for which there are no data available shall be identified with a special character. Thus, only values which are zero shall be printed as such.
8. Operational Report Types. The following operational report types shall be provided with the system:
 - a. Shift Operation Summary Report:
 - 1) An operator-adjustable time interval shift operation report shall summarize plant operation from the start and finish time of operation. .
 - 2) The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identification, and engineering units.
 - b. Daily Operation Summary Report:
 - 1) The daily operation report shall summarize plant operation for the previous day. The printed information shall be the stored values (not averages) including scanned, lab, and manually entered data.
 - 2) The report format shall consist of the following: correct date, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
 - 3) The daily minimum, average, maximum, and total where applicable shall also be calculated and printed for each point and stored.
 - c. Monthly Operation Summary Report:
 - 1) The monthly operation summary report shall summarize plant operation for the previous calendar month.
 - 2) The report format shall be arranged so that the first several pages shall conform to the requirements of the state regulatory agencies and may be separated from the rest of the monthly operation report for transmittal to the regulatory agency.
 - 3) The report format shall be like the daily operation summary report and shall consist of the following: month and year, plant name, report name, page number, group headings, subheadings, point identifications, and engineering units.
 - 4) Monthly minimum, average, maximum, and totals, where applicable, shall also be printed for each column of points printed.
 - d. Annual Operation Summary Report:
 - 1) The annual operation summary report shall summarize plant operation for the previous calendar year. The report shall consist of scanned data, lab data, and manually entered data.
 - 2) The format of the report shall be identical with the monthly operation summary report except for replacing month with year in the heading and replacing date with calendar month.

3.03 START-UP SERVICE

- A. The system integrator/supplier shall provide the services of a qualified service technician/engineer to perform the following service duties.
 1. Provide a minimum of two (2) days on-site services to provide installation instruction to the contractor on all aspects of equipment installation.
 2. Provide a minimum of one (1) 8-hour day of onsite startup services to provide a final system calibration, programming, and testing after completion of equipment installations.
 3. Provide a minimum of one (1) 4-hour session at the job site to provide instruction to facility personnel in the operation, proper maintenance, trouble shooting, and repair of the equipment. Contractor to demonstrate proper operation of system to owner.

4. As part of Add Alternate **XX**, contractor to provide two (2) days of on-site services to integrate the proposed PCP into the existing wastewater treatment plant SCADA system. It is assumed that programming, integration, and screen development services will be required at the wastewater treatment plant SCADA system end only. No major overhauls, modifications, or hardware anticipated or included at the wastewater treatment plant SCADA system end. Final requirements to be closely coordinated with the owner.
5. Following system startup, contractor is to correct any deficiencies at no additional cost to the owner.

END OF SECTION 26 0912

SECTION 16100

GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Grounding and bonding requirements.
- B. Conductors for grounding and bonding.
- C. Connectors for grounding and bonding.
- D. Ground bars.
- E. Ground rod electrodes.

1.02. RELATED REQUIREMENTS

- A. Section 16120 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES - Additional requirements for conductors for grounding and bonding, including conductor color coding.
- B. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.
- C. Section 16502 - EXTERIOR LIGHTING: Additional grounding and bonding requirements for pole-mounted luminaires.

1.03. REFERENCE STANDARDS

- A. IEEE 81 - IEEE Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Grounding System; 2012.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NEMA GR 1 - Grounding Rod Electrodes and Grounding Rod Electrode Couplings; 2007.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. NFPA 780 - Standard for the Installation of Lightning Protection Systems; 2014.
- G. UL 467 - Grounding and Bonding Equipment; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination

1. Verify exact locations of underground metal water service pipe entrances to building.
 2. Coordinate the work with other trades to provide steel reinforcement complying with specified requirements for concrete-encased electrode.
 3. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing - Do not install ground rod electrodes until final backfill and compaction is complete.
- 1.05. SUBMITTALS
- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for grounding and bonding system components.
 - B. Manufacturer's Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
 - C. Field quality control test reports.
 - D. Project Record Documents - Record actual locations of grounding electrode system components and connections.
- 1.06. QUALITY ASSURANCE
- A. Conform to requirements of NFPA 70.
 - B. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- 1.07. DELIVERY, STORAGE, AND HANDLING
- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01. GROUNDING AND BONDING REQUIREMENTS

- A. Existing Work - Where existing grounding and bonding system components are indicated to be reused, they may be reused only where they are free from corrosion, integrity and continuity are verified, and where acceptable to the authority having jurisdiction.
- B. Do not use products for applications other than as permitted by NFPA 70 and product listing.
- C. Unless specifically indicated to be excluded, provide all required components, conductors, connectors, conduit, boxes, fittings, supports, accessories, etc. as necessary for a complete grounding and bonding system.

- D. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- E. Grounding System Resistance
 - 1. Achieve specified grounding system resistance under normally dry conditions unless otherwise approved by Engineer. Precipitation within the previous 48 hours does not constitute normally dry conditions.
 - 2. Grounding Electrode System - Not greater than 5 ohms to ground, when tested according to IEEE 81 using "fall-of-potential" method.
 - 3. Between Grounding Electrode System and Major Electrical Equipment Frames, System Neutral, and Derived Neutral Points - Not greater than 0.5 ohms, when tested using "point-to-point" methods.
- F. Grounding Electrode System
 - 1. Provide connection to required and supplemental grounding electrodes indicated to form grounding electrode system.
 - a. Provide continuous grounding electrode conductors without splice or joint.
 - b. Install grounding electrode conductors in raceway where exposed to physical damage. Bond grounding electrode conductor to metallic raceways at each end with bonding jumper.
 - 2. Metal Underground Water Pipe(s)
 - a. Provide connection to underground metal domestic and fire protection (where present) water service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5 m) from the point of entrance to the building.
 - b. Provide bonding jumper(s) around insulating joints/pipes as required to make pipe electrically continuous.
 - c. Provide bonding jumper around water meter of sufficient length to permit removal of meter without disconnecting jumper.
 - 3. Metal In-Ground Support Structure - Provide connection to metal in-ground support structure that is in direct contact with earth in accordance with NFPA 70.
 - 4. Gas Piping - Provide connection to underground metal (where present) gas service pipe(s) that are in direct contact with earth for at least 10 feet (3.0 m) at an accessible location not more than 5 feet (1.5m) from the point of entrance to the building. All requirements to be per applicable codes/regulations.
 - 5. Concrete-Encased Electrode - Provide connection to concrete-encased electrode consisting of not less than 20 feet (6.0 m) of either steel reinforcing bars or bare copper conductor not

smaller than 4 AWG embedded within concrete foundation or footing that is in direct contact with earth in accordance with NFPA 70.

5. Ground Rod Electrode(s)
 - a. Provide three electrodes in an equilateral triangle configuration unless otherwise indicated or required.
 - b. Space electrodes not less than 10 feet (3.0 m) from each other and any other ground electrode.
 - c. Where location is not indicated, locate electrode(s) at least 5 feet (1.5 m) outside building perimeter foundation as near as possible to electrical service entrance; where possible, locate in softscape (uncovered) area.
 6. Provide additional ground electrode(s) as required to achieve specified grounding electrode system resistance.
- G. Service-Supplied System Grounding
1. For each service disconnect, provide grounding electrode conductor to connect neutral (grounded) service conductor to grounding electrode system. Unless otherwise indicated, make connection at neutral (grounded) bus in service disconnect enclosure.
 2. For each service disconnect, provide main bonding jumper to connect neutral (grounded) bus to equipment ground bus where not factory-installed. Do not make any other connections between neutral (grounded) conductors and ground on load side of service disconnect.
- H. Separately Derived System Grounding
1. Provide grounding electrode conductor to connect derived system grounded conductor to nearest effectively grounded metal building frame. Unless otherwise indicated, make connection at neutral (grounded) bus in source enclosure.
 2. Provide bonding jumper to connect derived system grounded conductor to nearest metal building frame and nearest metal water piping in the area served by the derived system, where not already used as a grounding electrode for the derived system. Make connection at same location as grounding electrode conductor connection.
 3. Where common grounding electrode conductor ground riser is used for tap connections to multiple separately derived systems, provide bonding jumper to connect the metal building frame and metal water piping in the area served by the derived system to the common grounding electrode conductor.
 4. Outdoor Source - Where the source of the separately derived system is located outside the building or structure supplied, provide connection to grounding electrode at source in accordance with NFPA 70.
 5. Provide system bonding jumper to connect system grounded conductor to equipment ground bus. Make connection at same location as grounding electrode conductor connection. Do not

make any other connections between neutral (grounded) conductors and ground on load side of separately derived system disconnect.

6. Where the source and first disconnecting means are in separate enclosures, provide supply-side bonding jumper between source and first disconnecting means.

I. Bonding and Equipment Grounding

1. Provide bonding for equipment grounding conductors, equipment ground busses, metallic equipment enclosures, metallic raceways and boxes, device grounding terminals, and other normally non-current-carrying conductive materials enclosing electrical conductors/equipment or likely to become energized as indicated and in accordance with NFPA 70.
2. Provide insulated equipment grounding conductor in each feeder and branch circuit raceway. Do not use raceways as sole equipment grounding conductor.
3. Where circuit conductor sizes are increased for voltage drop, increase size of equipment grounding conductor proportionally in accordance with NFPA 70.
4. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
5. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on neutral (grounded) or isolated/insulated ground bus.
6. Provide bonding jumper across expansion or expansion/deflection fittings provided to accommodate conduit movement.
7. Provide bonding for interior metal piping systems in accordance with NFPA 70. This includes, but is not limited to:
 - a. Metal water piping where not already effectively bonded to metal underground water pipe used as grounding electrode.
 - b. Metal gas piping.
 - c. Metal process piping.
8. Provide bonding for interior metal air ducts.
9. Provide bonding for metal building frame.

J. Communications Systems Grounding and Bonding

1. Provide intersystem bonding termination at service equipment or metering equipment enclosure and at disconnecting means for any additional buildings or structures in accordance with NFPA 70.
2. Provide bonding jumper in raceway from intersystem bonding termination to each communications room or backboard and provide ground bar for termination.

- a. Bonding Jumper Size - 6 AWG, unless otherwise indicated or required.
- b. Raceway Size - 3/4 inch (21 mm) trade size unless otherwise indicated or required.
- c. Ground Bar Size - 1/4 by 2 by 12 inches (6 by 50 by 300 mm) unless otherwise indicated or required.
- d. Ground Bar Mounting Height - 18 inches (450 mm) above finished floor unless otherwise indicated.

2.02. GROUNDING AND BONDING COMPONENTS

A. General Requirements

1. Provide products listed, classified, and labeled as suitable for the purpose intended.
2. Provide products listed and labeled as complying with UL 467 where applicable.

B. Conductors for Grounding and Bonding, in Addition to Requirements of Section 16100, Grounding and Bonding for Electrical Systems.

1. Use insulated copper conductors unless otherwise indicated.
 - a. Exceptions
 - 1) Use bare copper conductors where installed underground in direct contact with earth.
 - 2) Use bare copper conductors where directly encased in concrete (not in raceway).

C. Connectors for Grounding and Bonding

1. Description - Connectors appropriate for the application and suitable for the conductors and items to be connected; listed and labeled as complying with UL 467.
2. Unless otherwise indicated, use exothermic welded connections for underground, concealed and other inaccessible connections.
3. Unless otherwise indicated, use mechanical connectors, compression connectors, or exothermic welded connections for accessible connections.

D. Ground Bars

1. Description - Copper rectangular ground bars with mounting brackets and insulators.
2. Size - As indicated.
3. Holes for Connections - As indicated or as required for connections to be made.

E. Ground Rod Electrodes

1. Comply with NEMA GR 1.
2. Material - Copper-bonded (copper-clad) steel.
3. Size - 3/4 inch (19 mm) diameter by 10 feet (3.0 m) length, unless otherwise indicated.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that work likely to damage grounding and bonding system components has been completed.
- B. Verify that field measurements are as indicated.
- C. Verify that conditions are satisfactory for installation prior to starting work.
- D. Ground rod locations and other grounding component locations shown on the contract drawings are shown as diagrammatical in nature. Exact locations to be determined in the field by the contractor to avoid interferences with existing conditions and proposed work.

3.02. INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Ground Rod Electrodes - Unless otherwise indicated, install ground rod electrodes vertically. Where encountered rock prohibits vertical installation, install at 45 degree angle or bury horizontally in trench at least 30 inches (750 mm) deep in accordance with NFPA 70 or provide ground plates
 1. Outdoor Installations - Unless otherwise indicated, install with top of rod 6 inches (150 mm) below finished grade.
 2. Indoor Installations - Unless otherwise indicated, install with 4 inches (100 mm) of top of rod exposed.
- D. Make grounding and bonding connections using specified connectors.
 1. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors. Do not remove conductor strands to facilitate insertion into connector.
 2. Remove nonconductive paint, enamel, or similar coating at threads, contact points, and contact surfaces.
 3. Exothermic Welds - Make connections using molds and weld material suitable for the items to be connected in accordance with manufacturer's recommendations.

4. Mechanical Connectors - Secure connections according to manufacturer's recommended torque settings.
 5. Compression Connectors - Secure connections using manufacturer's recommended tools and dies.
- E. Identify grounding and bonding system components in accordance with Section 16196.

3.03. FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.13.
- C. Perform ground electrode resistance tests under normally dry conditions. Precipitation within the previous 48 hours does not constitute normally dry conditions.
- D. Investigate and correct deficiencies where measured ground resistances do not comply with specified requirements.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.

END OF SECTION

SECTION 16110

CONDUIT

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Galvanized steel rigid metal conduit (RGS).
- B. PVC-coated galvanized steel rigid metal conduit.
- C. Flexible metal conduit (FMC).
- D. Liquidtight flexible metal conduit (LFMC).
- E. Electrical metallic tubing (EMT).
- F. Rigid polyvinyl chloride (PVC) conduit.
- G. Liquidtight flexible nonmetallic conduit (LFNC).
- H. Conduit fittings.
- I. Accessories.

1.02. RELATED REQUIREMENTS

- B. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS. Includes additional requirements for fittings for grounding and bonding.
- A. Section 16120 – LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Metal clad cable (Type MC), armored cable (Type AC), and manufactured wiring systems, including uses permitted.
- D. Section 16130 - BOXES
- C. Section 16191 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- E. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

1.03. REFERENCE STANDARDS

- A. ANSI C80.1 - American National Standard for Electrical Rigid Steel Conduit (ERSC); 2005.
- B. ANSI C80.3 - American National Standard for Steel Electrical Metallic Tubing (EMT); 2005.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 101 - Standard for Installing Steel Conduits (Rigid, IMC, EMT); 2013.

- E. NECA 111 - Standard for Installing Nonmetallic Raceways (RNC, ENT, LFNC); 2003.
- F. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- G. NEMA RN 1 - Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit; 2005.
- H. NEMA TC 2 - Electrical Polyvinyl Chloride (PVC) Conduit; 2013.
- I. NEMA TC 3 - Polyvinyl Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing; 2015.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 1 - Flexible Metal Conduit; Current Edition, Including All Revisions.
- L. UL 6 - Electrical Rigid Metal Conduit-Steel; Current Edition, Including All Revisions.
- M. UL 360 - Liquid-Tight Flexible Steel Conduit; Current Edition, Including All Revisions.
- N. UL 514B - Conduit, Tubing, and Cable Fittings; Current Edition, Including All Revisions.
- O. UL 651 - Schedule 40, 80, Type EB and A Rigid PVC Conduit and Fittings; Current Edition, Including All Revisions.
- P. UL 797 - Electrical Metallic Tubing-Steel; Current Edition, Including All Revisions.
- Q. UL 1660 - Liquid-Tight Flexible Nonmetallic Conduit; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate minimum sizes of conduits with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate the arrangement of conduits with structural members, ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 - 3. Verify exact conduit termination locations required for boxes, enclosures, and equipment installed under other sections or by others.
 - 4. Coordinate the work with other trades to provide roof penetrations that preserve the integrity of the roofing system and do not void the roof warranty.
 - 5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing - Do not begin installation of conductors and cables until installation of conduit is complete between outlet, junction and splicing points.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for conduits and fittings.
- B. Project Record Documents - Record actual routing for conduits installed underground, conduits embedded within concrete slabs, and conduits 2 inch (53 mm) trade size and larger.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conduit and fittings in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01. CONDUIT APPLICATIONS

- A. Do not use conduit and associated fittings for applications other than as permitted by NFPA 70 and product listing.
- B. Refer to the Raceway Schedule on the Electrical Drawings for permitted usage and restrictions. The Raceway Schedule indicates required conduit types for each area of the project.
- C. Unless otherwise indicated and where not otherwise restricted, use the conduit types indicated for the specified applications. Where more than one listed application applies, comply with the most restrictive requirements. Where conduit type for a particular application is not specified, use galvanized steel rigid metal conduit.
- D. Hazardous (Classified) Locations - Use PVC-coated galvanized steel rigid metal conduit.
- E. Connections to Luminaires - Use flexible metal conduit only where necessary/required (use of conduit type specified is not feasible). The length of flexible metal conduit is to be limited to the greatest extent possible.
 - 1. Dry Locations - Use flexible metal conduit.
 - 2. Damp, Wet, or Corrosive Locations - Use liquid-tight flexible metal conduit.
 - 3. Maximum Length - 3.28 feet (1 m).
 - a. Contractor to minimize length of flexible metal conduit to greatest extent possible.
- F. Connections to Vibrating Equipment:
 - 1. Dry Locations - Use flexible metal conduit.

2. Damp, Wet, or Corrosive Locations - Use liquid-tight flexible metal conduit.
3. Maximum Length - 3.28 feet (1 m) unless otherwise indicated.
 - a. Contractor to limit the length of flexible conduit connections to the greatest extent possible.

2.02. CONDUIT REQUIREMENTS

- A. Existing Work - Where existing conduits are indicated to be reused, they may be reused only where they comply with specified requirements, are free from corrosion, and integrity is verified by pulling a mandrel through them.
- B. Electrical Service Conduits - Also comply with Section 16421, Low-Voltage Electrical Service Entrance.
- C. Provide all conduit, fittings, supports, and accessories required for a complete raceway system.
- D. Provide products listed, classified, and labeled as suitable for the purpose intended.
- E. Minimum Conduit Size, Unless Otherwise Indicated
 1. Branch Circuits - 1/2 inch (16 mm) trade size.
 2. Branch Circuit Homeruns - 3/4 inch (21 mm) trade size.
 3. Control Circuits - 1/2 inch (16 mm) trade size.
 4. Flexible Connections to Luminaires - 3/8 inch (12 mm) trade size.
 5. Underground, Interior - 3/4 inch (21 mm) trade size.
 6. Underground, Exterior - 1 inch (27 mm) trade size.
- F. Where conduit size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified and as shown within the Branch Circuit Schedule on the Contract Drawings.

2.03. GALVANIZED STEEL RIGID METAL CONDUIT

- A. Description - NFPA 70, Type RGS galvanized steel rigid metal conduit complying with ANSI C80.1 and listed and labeled as complying with UL 6.
- B. Fittings
 1. Fittings to be manufactured by American Fittings Corporation or approved equal.
 2. Non-Hazardous Locations - Use fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.

3. Hazardous (Classified) Locations - Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
4. Material - Use steel or malleable iron.
 - a. Do not use diecast zinc fittings.
5. Connectors and Couplings - Use threaded type fittings only. Threadless set screw and compression (gland) type fittings are not permitted.

2.04. PVC-COATED GALVANIZED STEEL RIGID METAL CONDUIT

- A. Description - NFPA 70, Type RGS galvanized steel rigid metal conduit with external polyvinyl chloride (PVC) coating complying with NEMA RN 1 and listed and labeled as complying with UL 6.
- B. Exterior Coating - PVC, nominal thickness of 40 mil (1.02 mm).
- C. PVC-Coated Fittings
 1. Manufacturer - Same as manufacturer of PVC-coated conduit to be installed, Plasti-Bond, American Fittings Corporation, or approved equal.
 2. Non-Hazardous Locations - Use fittings listed and labeled as complying with UL 514B.
 3. Hazardous (Classified) Locations - Use fittings listed and labeled as complying with UL 1203 for the classification of the installed location.
 4. Material - Use steel or malleable iron.
 5. Exterior Coating - PVC, minimum thickness of 40 mil (1.02 mm).
- D. PVC-Coated Supports - Furnish with exterior coating of polyvinyl chloride (PVC), minimum thickness of 15 mil (0.38 mm).
- E. When using PVC-coated galvanized steel rigid metal conduit, Contractor is to use a corrosion-resistant product line as manufactured by Power-Strut Defender or approved equal for all associated channel, fittings, and conduit supports/clamps.
- F. PVC-coated galvanized steel rigid metal conduit and associated components/fittings to be by Plasti-Bond or approved equal.

2.05. FLEXIBLE METAL CONDUIT

- A. Description - NFPA 70, Type FMC standard wall steel flexible metal conduit listed and labeled as complying with UL 1, and listed for use in classified firestop systems to be used.
- B. Fittings
 1. Fittings to be manufactured by American Fittings Corporation or approved equal.

2. Description - Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
3. Material - Use steel or malleable iron.
 - a. Do not use diecast zinc fittings.
4. Contractor to minimize the use/lengths to greatest extent possible.

2.06. LIQUIDTIGHT FLEXIBLE METAL CONDUIT (LFMC)

- A. Description - NFPA 70, Type LFMC polyvinyl chloride (PVC) jacketed steel flexible metal conduit listed and labeled as complying with UL 360.
- B. Fittings
 1. Fittings to be manufactured by American Fittings Corporation or approved equal.
 2. Description - Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material - Use steel or malleable iron.
 - a. Do not use diecast zinc fittings.
 4. Contractor to minimize the use/lengths to greatest extent possible.

2.07. ELECTRICAL METALLIC TUBING

- A. Description - NFPA 70, Type EMT steel electrical metallic tubing complying with ANSI C80.3 and listed and labeled as complying with UL 797.
- B. Fittings
 1. Fittings to be manufactured by American Fittings Corporation or approved equal.
 2. Description - Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B.
 3. Material - Use steel or malleable iron.
 - a. Do not use diecast zinc fittings.
 4. Connectors and Couplings - Use set-screw type.
 - a. Do not use indenter-type connectors and couplings.

2.08. RIGID PVC CONDUIT

- A. Description - NFPA 70, Type PVC rigid polyvinyl chloride conduit complying with NEMA TC 2 and listed and labeled as complying with UL 651; Schedule 40 unless otherwise indicated, Schedule 80 where subject to physical damage; rated for use with conductors rated 90 degrees C.
- B. Fittings
 - 1. Manufacturer - Same as manufacturer of conduit to be connected, American Fittings Corporation, or approved equal.
 - 2. Description - Fittings complying with NEMA TC 3 and listed and labeled as complying with UL 651; material to match conduit.

2.09. LIQUIDTIGHT FLEXIBLE NONMETALLIC CONDUIT

- A. Description - NFPA 70, Type LFNC liquid-tight flexible nonmetallic conduit listed and labeled as complying with UL 1660.
 - 1. Contractor to limit lengths of LFNC to greatest extent possible.
- B. Fittings
 - 1. Manufacturer - Same as manufacturer of conduit to be connected, American Fittings Corporation, or approved equal.
 - 2. Description - Fittings complying with NEMA FB 1 and listed and labeled as complying with UL 514B; suitable for the type of conduit to be connected.
- C. Contractor to minimize the use/lengths to greatest extent possible.

2.10. ACCESSORIES

- A. Conduit Joint Compound - Corrosion-resistant, electrically conductive; suitable for use with the conduit to be installed.
- B. Solvent Cement for PVC Conduit and Fittings - As recommended by manufacturer of conduit and fittings to be installed.
- C. Pull Strings - Use nylon cord with average breaking strength of not less than 200 pound-force (890 N).
- D. Sealing Compound for Sealing Fittings - Listed for use with the particular fittings to be installed.
- E. Modular Seals for Conduit Penetrations - Rated for minimum of 40 psig; suitable for the conduits to be installed.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive conduits.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install galvanized steel RGS in accordance with NECA 101.
- D. Install PVC-coated galvanized steel rigid metal conduit using only tools approved by the manufacturer.
- E. Install rigid PVC conduit in accordance with NECA 111.
- F. Install liquid-tight flexible nonmetallic conduit (LFNC) in accordance with NECA 111.
 - 1. Limit use to greatest extent possible.
- G. Conduit Routing
 - 1. Unless dimensioned, conduit routing indicated is diagrammatic.
 - 2. When conduit destination is indicated without specific routing, determine exact routing required.
 - 3. Conceal all conduits within new walls where feasible/possible. Conduits within the admin spaces of the control building to be concealed to greatest extent possible.
 - 4. The majority of conduits throughout the site/buildings will be exposed.
 - 5. Conduits installed underground or embedded in concrete may be routed in the shortest possible manner unless otherwise indicated. Route all other conduits parallel or perpendicular to building structure and surfaces, following surface contours where practical.
 - 6. Arrange conduit to maintain adequate headroom, clearances, and access.
 - 7. Arrange conduit to provide no more than the equivalent of four 90-degree bends between pull points.
 - 8. Arrange conduit to provide no more than 150 feet (46 m) between pull points.
 - 9. Route conduits above water and drain piping where possible.

10. Arrange conduit to prevent moisture traps. Provide drain fittings at low points and at sealing fittings where moisture may collect.
11. Maintain minimum clearance of 6 inches (150 mm) between conduits and piping for other systems.
12. Maintain minimum clearance of 12 inches (300 mm) between conduits and hot surfaces. This includes, but is not limited to:
 - a. Heaters.
 - b. Hot water piping.
 - c. Flues.
13. Group parallel conduits in the same area together on a common rack.

H. Conduit Support

1. Secure and support conduits in accordance with NFPA 70 and Section 16191, Hangers and Supports for Electrical Systems, using suitable supports and methods approved by the authority having jurisdiction.
2. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
3. Installation Above Suspended Ceilings - Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conduits to lay on ceiling tiles.
4. Use metal channel (strut) with accessory conduit clamps to support multiple parallel surface-mounted conduits.
5. Use conduit clamp to support single conduit from beam clamp or threaded rod.
6. Use non-penetrating rooftop supports to support conduits routed across rooftops (only where approved).
7. Use of wire for support of conduits is not permitted.
8. Where conduit support intervals specified in NFPA 70 and NECA standards differ, comply with the most stringent requirements.

I. Connections and Terminations

1. Use approved zinc-rich paint or conduit joint compound on field-cut threads of galvanized steel conduits prior to making connections.
2. Where two threaded conduits must be joined and neither can be rotated, use three-piece couplings or split couplings. Do not use running threads.
3. Use suitable adapters where required to transition from one type of conduit to another.

4. Provide drip loops for liquidtight flexible conduit connections to prevent drainage of liquid into connectors.
5. Terminate threaded conduits in boxes and enclosures using threaded hubs or double lock nuts for dry locations and raintight hubs for wet locations.
6. Where spare conduits stub up through concrete floors and are not terminated in a box or enclosure, provide threaded couplings equipped with threaded plugs set flush with finished floor.
7. Provide insulating bushings or insulated throats at all conduit terminations to protect conductors.
8. Secure joints and connections to provide maximum mechanical strength and electrical continuity.

J. Penetrations

1. Do not penetrate or otherwise notch or cut structural members, including footings and grade beams, without approval of structural engineer.
2. Make penetrations perpendicular to surfaces unless otherwise indicated.
3. Provide sleeves for penetrations as indicated or as required to facilitate installation. Set sleeves flush with exposed surfaces unless otherwise indicated or required.
4. Conceal bends for conduit risers emerging above ground.
5. Seal interior of conduits entering the building from underground at first accessible point to prevent entry of moisture and gases.
6. Where conduits penetrate waterproof membrane (all floors, walls to the exterior, etc.), seal as required to maintain integrity of membrane.
7. Make penetrations for roof-mounted equipment within associated equipment openings and curbs where possible to minimize roofing system penetrations. Where penetrations are necessary, seal as indicated or as required to preserve integrity of roofing system and maintain roof warranty. Include proposed locations of penetrations and methods for sealing with submittals.
8. All conduit penetrations to be properly caulked, sealed, and patched to match adjacent finished surfaces. Coordinate final requirements with the owner.
9. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
10. All conduit sleeves/penetrations to be properly sealed/caulked. Contractor to create conduit sleeves/penetrations as small as possible for conduit passing through (i.e., do not core a 4-inch hole to pass a 3/4-inch" conduit).

K. Underground Installation

1. Minimum Cover, Unless Otherwise Indicated or Required:
 - a. Underground, Exterior - 24 inches (610 mm).
 - b. Under Slab on Grade - 12 inches (300 mm) to bottom of slab.
 2. Provide underground warning tape in accordance with Section 16196, Identification for Electrical Systems, and the Contract Drawings along entire conduit length for all underground conduits.
 3. Refer to Burial Details on Electrical Drawings for additional details.
- L. Embedment Within Structural Concrete Slabs
1. Include proposed conduit arrangement with submittals.
 2. Maximum Conduit Size - 1 inch (27 mm) unless otherwise approved.
 3. Secure conduits to prevent floating or movement during pouring of concrete.
- M. Hazardous (Classified) Locations - Where conduits cross boundaries of hazardous (classified) locations, provide sealing fittings located as indicated or in accordance with NFPA 70.
- N. Conduit Movement Provisions - Where conduits are subject to movement, provide expansion and expansion/deflection fittings to prevent damage to enclosed conductors or connected equipment. This includes, but is not limited to:
1. Where conduits cross structural joints intended for expansion, contraction, or deflection.
 2. Where conduits are subject to earth movement by settlement or frost.
- O. Condensation Prevention - Where conduits cross barriers between areas of potential substantial temperature differential, provide sealing fitting or approved sealing compound at an accessible point near the penetration to prevent condensation. This includes, but is not limited to:
1. Where conduits pass from outdoors into conditioned interior spaces.
 2. Where conduits pass from unconditioned interior spaces into conditioned interior spaces.
- P. Provide pull string in all empty conduits and in conduits where conductors and cables are to be installed by others. Leave minimum slack of 12 inches (300 mm) at each end.
- Q. Provide grounding and bonding in accordance with Section 16100, Grounding and Bonding For Electrical Systems .
- R. Identify conduits in accordance with Section 16196, Identification For Electrical Systems.

3.03. FIELD QUALITY CONTROL

- A. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.

- B. Where coating of PVC-coated galvanized steel rigid metal conduit contains cuts or abrasions, Contractor is to repair in accordance with manufacturer's instructions.
- C. Correct deficiencies and replace damaged or defective conduits.

3.04. CLEANING

- A. Clean interior of conduits to remove moisture and foreign matter.

3.05. PROTECTION

- A. Immediately after installation of conduit, use suitable manufactured plugs to provide protection from entry of moisture and foreign material and do not remove until ready for installation of conductors.

END OF SECTION

SECTION 16120

LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Single conductor building wire.
- B. Metal-clad cable.
- C. Wiring connectors.
- D. Electrical tape.
- E. Heat shrink tubing.
- F. Wire pulling lubricant.
- G. Cable ties.

1.02. RELATED REQUIREMENTS

- A. Section 16051 - MINOR ELECTRICAL DEMOLITION: Disconnection, removal, and/or extension of existing electrical conductors and cables.
- B. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS: Additional requirements for grounding conductors and grounding connectors.
- C. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification of products and requirements.

1.03. REFERENCE STANDARDS

- A. ASTM B3 - Standard Specification for Soft or Annealed Copper Wire; 2013.
- B. ASTM B8 - Standard Specification for Concentric-Lay-Stranded Copper Conductors, Hard, Medium-Hard, or Soft; 2011.
- C. ASTM B33 - Standard Specification for Tin-Coated Soft or Annealed Copper Wire for Electrical Purposes; 2010 (Reapproved 2014).
- D. ASTM B787/B787M - Standard Specification for 19 Wire Combination Unilay-Stranded Copper Conductors for Subsequent Insulation; 2004 (Reapproved 2014).
- E. ASTM D3005 - Standard Specification for Low-Temperature Resistant Vinyl Chloride Plastic Pressure-Sensitive Electrical Insulating Tape; 2010.
- F. ASTM D4388 - Standard Specification for Nonmetallic Semi-Conducting and Electrically Insulating Rubber Tapes; 2013.

- G. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- H. NEMA WC 70 - Nonshielded Power Cable 2000 V or Less for the Distribution of Electrical Energy; 2009.
- I. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- J. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- K. UL 44 - Thermoset-Insulated Wires and Cables; Current Edition, Including All Revisions.
- L. UL 83 - Thermoplastic-Insulated Wires and Cables; Current Edition, Including All Revisions.
- M. UL 486A-486B - Wire Connectors; Current Edition, Including All Revisions.
- N. UL 486C - Splicing Wire Connectors; Current Edition, Including All Revisions.
- O. UL 486D - Sealed Wire Connector Systems; Current Edition, Including All Revisions.
- P. UL 510 - Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape; Current Edition, Including All Revisions.
- Q. UL 1569 - Metal-Clad Cables; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate sizes of raceways, boxes, and equipment enclosures installed under other sections with the actual conductors to be installed, including adjustments for conductor sizes increased for voltage drop.
 - 2. Coordinate with electrical equipment installed under other sections to provide terminations suitable for use with the conductors to be installed.
 - 3. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for conductors and cables, including detailed information on materials, construction, ratings, listings, and available sizes, configurations, and stranding.
- B. Field Quality Control Test Reports.
- C. Manufacturer's Installation Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

- D. Project Record Documents - Record actual installed circuiting arrangements. Record actual routing for underground circuits.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store conductors and cables in accordance with manufacturer's instructions.

1.08. FIELD CONDITIONS

- A. Do not install or otherwise handle thermoplastic-insulated conductors at temperatures lower than 14 degrees F (-10 degrees C), unless otherwise permitted by manufacturer's instructions. When installation below this temperature is unavoidable, notify Engineer and obtain direction before proceeding with work.

PART 2 PRODUCTS

2.01. CONDUCTOR AND CABLE APPLICATIONS

- A. Do not use conductors and cables for applications other than as permitted by NFPA 70 and product listing.
- B. Provide single conductor building wire installed in suitable raceway unless otherwise indicated, permitted, or required.
- C. Nonmetallic-sheathed cable is not permitted.
- D. Underground feeder and branch-circuit cable is not permitted.
- E. Service entrance cable is not permitted.
- F. Armored cable is not permitted.
- G. Metal-clad cable is not permitted.
 - 1. Where not otherwise restricted, may be used:
 - a. Where concealed above accessible ceilings for final connections from junction boxes to luminaires.
 - b. Where concealed in hollow stud walls, above accessible ceilings, and under raised floors for branch circuits up to 20 A.

- 1) Exception - Provide single conductor building wire in raceway for circuit homerun from first outlet to panelboard.
2. In addition to other applicable restrictions, may not be used:
 - a. Where exposed to view.
 - b. Where exposed to damage.
 - c. For damp, wet, or corrosive locations, unless provided with a PVC jacket listed as suitable for those locations.

2.02. CONDUCTOR AND CABLE GENERAL REQUIREMENTS

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Provide new conductors and cables manufactured not more than one year prior to installation.
- D. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, etc. as required for a complete operating system.
- E. Comply with NEMA WC 70.
- F. Thermoplastic-Insulated Conductors and Cables - Listed and labeled as complying with UL 83.
- G. Thermoset-Insulated Conductors and Cables - Listed and labeled as complying with UL 44.
- H. Conductors for Grounding and Bonding - Also comply with Section 16100, Grounding And Bonding For Electrical Systems.
- I. Conductors and Cables Installed Where Exposed to Direct Rays of Sun - Listed and labeled as sunlight resistant.
- J. Conductors and Cables Installed Exposed in Spaces Used for Environmental Air (only where specifically permitted) - Plenum rated, listed and labeled as suitable for use in return air plenums.
- K. Conductor Material
 1. Provide copper conductors only. Aluminum conductors are not acceptable for this project. Conductor sizes indicated are based on copper.
 2. Copper Conductors - Soft drawn annealed, 98 percent conductivity, uncoated copper conductors complying with ASTM B3, ASTM B8, or ASTM B787/B787M unless otherwise indicated.
 3. Tinned Copper Conductors - Comply with ASTM B33.
- L. Minimum Conductor Size

1. Branch Circuits - 12 AWG.
 - a. Exceptions:
 - 1) 20 A, 120 V circuits longer than 75 feet (23 m) - 10 AWG, for voltage drop.
 - 2) 20 A, 120 V circuits longer than 150 feet (46 m) - 8 AWG, for voltage drop.
 - 3) 20 A, 277 V circuits longer than 150 feet (46 m) - 10 AWG, for voltage drop.
 2. Control Circuits - 14 AWG.
- M. Where conductor size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
- N. Conductor Color Coding:
1. Color code conductors as indicated unless otherwise required by the authority having jurisdiction. Maintain consistent color coding throughout project.
 2. Color Coding Method - Integrally colored insulation.
 - a. Conductors size 4 AWG and larger may have black insulation color coded using vinyl color coding electrical tape.
 3. Color Code:
 - a. 208Y/120 V, 3 Phase, 4 Wire System:
 - 1) Phase A - Black.
 - 2) Phase B - Red.
 - 3) Phase C - Blue.
 - 4) Neutral/Grounded - White.
 - b. Equipment Ground, All Systems - Green.
 - c. Isolated Ground, All Systems - Green with yellow stripe.
 - d. Travelers for 3-Way and 4-Way Switching - Pink.
 - e. For modifications or additions to existing wiring systems, comply with existing color code when existing code complies with NFPA 70 and is approved by the authority having jurisdiction.
 - f. For control circuits, comply with manufacturer's recommended color code.

2.03. SINGLE CONDUCTOR BUILDING WIRE

A. Manufacturers

1. Copper Building Wire
 - a. Cerro Wire LLC - www.cerrowire.com.
 - b. Encore Wire Corporation - www.encorewire.com.
 - c. Southwire Company - www.southwire.com.
 - d. Approved equal.

B. Description - Single conductor insulated wire.

C. Conductor Stranding

1. All circuitry to be of the stranded type.

D. Insulation Voltage Rating - 600 V.

E. Insulation

1. Copper Building Wire - Type THHN/THWN or THHN/THWN-2, except as indicated below.
 - a. Installed Underground - Type XHHW-2.

2.04. METAL-CLAD CABLE

A. Manufacturers

1. AFC Cable Systems Inc - www.afcweb.com.
2. Encore Wire Corporation - www.encorewire.com.
3. Southwire Company - www.southwire.com.
4. Approved equal.

B. Description - NFPA 70, Type MC cable listed and labeled as complying with UL 1569, and listed for use in classified firestop systems to be used.

C. Conductor Stranding

1. Size 10 AWG and Smaller - Solid.
2. Size 8 AWG and Larger - Stranded.

D. Insulation Voltage Rating - 600 V.

- E. Insulation - Type THHN, THHN/THWN, or THHN/THWN-2.
- F. Provide oversized neutral conductors where indicated or required.
- G. Grounding - Full-size integral equipment grounding conductor.
- H. Armor - Steel, interlocked tape.
- I. Provide PVC jacket applied over cable armor where indicated or required for environment of installed location.

2.05. WIRING CONNECTORS

- A. Description - Wiring connectors appropriate for the application, suitable for use with the conductors to be connected, and listed as complying with UL 486A-486B or UL 486C as applicable.
- B. Connectors for Grounding and Bonding - Comply with Section 16100, Grounding and Bonding For Electrical Systems.
- C. Wiring Connectors for Splices and Taps
 - 1. Copper Conductors Size 8 AWG and Smaller - Use twist-on insulated spring connectors.
 - 2. Copper Conductors Size 6 AWG and Larger - Use mechanical connectors or compression connectors.
- D. Wiring Connectors for Terminations
 - 1. Provide terminal lugs for connecting conductors to equipment furnished with terminations designed for terminal lugs.
 - 2. Provide compression adapters for connecting conductors to equipment furnished with mechanical lugs when only compression connectors are specified.
 - 3. Where over-sized conductors are larger than the equipment terminations can accommodate, provide connectors suitable for reducing to appropriate size, but not less than required for the rating of the overcurrent protective device.
 - 4. Copper Conductors Size 8 AWG and Larger - Use mechanical connectors or compression connectors where connectors are required.
 - 5. Stranded Conductors Size 10 AWG and Smaller - Use crimped terminals for connections to terminal screws.
 - 6. Conductors for Control Circuits - Use crimped terminals for all connections.
- E. Twist-on Insulated Spring Connectors - Rated 600 V, 221 degrees F (105 degrees C) for standard applications and 302 degrees F (150 degrees C) for high temperature applications; pre-filled with sealant and listed as complying with UL 486D for damp and wet locations.
- F. Push-in Wire Connectors - Rated 600 V, 221 degrees F (105 degrees C).

- G. Mechanical Connectors - Provide bolted type or set-screw type.
- H. Compression Connectors - Provide circumferential type or hex type crimp configuration.
- I. Crimped Terminals - Nylon-insulated, with insulation grip and terminal configuration suitable for connection to be made.

2.06. WIRING ACCESSORIES

A. Electrical Tape

- 1. Vinyl Insulating Electrical Tape - Complying with ASTM D3005 and listed as complying with UL 510; minimum thickness of 7 mil (0.18 mm); resistant to abrasion, corrosion, and sunlight; conformable for application down to 0 degrees F (-18 degrees C) and suitable for continuous temperature environment up to 221 degrees F (105 degrees C).
 - a. Product - Scotch Super 33+ or approved equal.
- 2. Rubber Splicing Electrical Tape - Ethylene Propylene Rubber (EPR) tape, complying with ASTM D4388; minimum thickness of 30 mil (0.76 mm); suitable for continuous temperature environment up to 194 degrees F (90 degrees C) and short-term 266 degrees F (130 degrees C) overload service.
 - a. Product - Scotch 130C or approved equal.

- B. Heat Shrink Tubing - Heavy-wall, split-resistant, with factory-applied adhesive; rated 600 V; suitable for direct burial applications; listed as complying with UL 486D.
- C. Wire Pulling Lubricant - Listed; suitable for use with the conductors or cables to be installed and suitable for use at the installation temperature.
- D. Cable Ties - Material and tensile strength rating suitable for application.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that interior of building has been protected from weather.
- B. Verify that work likely to damage wire and cable has been completed.
- C. Verify that raceways, boxes, and equipment enclosures are installed and are properly sized to accommodate conductors and cables in accordance with NFPA 70.
- D. Verify that field measurements are as indicated.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02. PREPARATION

- A. Clean raceways thoroughly to remove foreign materials before installing conductors and cables.

3.03. INSTALLATION

A. Circuiting Requirements:

1. Unless dimensioned, circuit routing indicated is diagrammatic.
 2. When circuit destination is indicated without specific routing, determine exact routing required.
 3. Arrange circuiting to minimize splices.
 4. Include circuit lengths required to install connected devices within 10 feet (3.0 m) of location indicated.
 5. Maintain separation of Class 1, Class 2, and Class 3 remote-control, signaling, and power-limited circuits in accordance with NFPA 70.
 6. Maintain separation of wiring for emergency systems in accordance with NFPA 70.
 7. Circuiting Adjustments - Unless otherwise indicated, when branch circuits are indicated as separate, combining them together in a single raceway is not permitted.
 - a. Provide no more than six current-carrying conductors in a single raceway. Dedicated neutral conductors are considered current-carrying conductors.
 - b. Increase size of conductors as required to account for ampacity derating.
 - c. Size raceways, boxes, etc. to accommodate conductors.
 8. Common Neutrals - Unless otherwise indicated, sharing of neutral/grounded conductors among up to three single phase branch circuits of different phases installed in the same raceway is not permitted. Provide dedicated neutral/grounded conductor for each individual branch circuit.
 9. Provide oversized neutral/grounded conductors where indicated and as specified below.
- B. Install products in accordance with manufacturer's instructions.
- C. Perform work in accordance with NECA 1 (general workmanship).
- D. Installation in Raceway
1. Tape ends of conductors and cables to prevent infiltration of moisture and other contaminants.
 2. Pull all conductors and cables together into raceway at same time.
 3. Do not damage conductors and cables or exceed manufacturer's recommended maximum pulling tension and sidewall pressure.

4. Use suitable wire pulling lubricant where necessary, except when lubricant is not recommended by the manufacturer.
- E. Exposed Cable Installation (only where specifically permitted)
1. Route cables parallel or perpendicular to building structural members and surfaces.
 2. Protect cables from physical damage.
- F. Paralleled Conductors - Install conductors of the same length and terminate in the same manner.
- G. Secure and support conductors and cables in accordance with NFPA 70 using suitable supports and methods approved by the authority having jurisdiction. Provide independent support from building structure. Do not provide support from raceways, piping, ductwork, or other systems.
1. Installation Above Suspended Ceilings - Do not provide support from ceiling support system. Do not provide support from ceiling grid or allow conductors and cables to lay on ceiling tiles.
- H. Terminate cables using suitable fittings.
1. Metal-Clad Cable (Type MC)
 - a. Use listed fittings.
 - b. Cut cable armor only using specialized tools to prevent damaging conductors or insulation. Do not use hacksaw or wire cutters to cut armor.
- I. Install conductors with a minimum of 12 inches (300 mm) of slack at each outlet.
- J. Where conductors are installed in enclosures for future termination by others, provide a minimum of 5 feet (1.5 m) of slack.
- K. Neatly train and bundle conductors inside boxes, wireways, panelboards and other equipment enclosures.
- L. Group or otherwise identify neutral/grounded conductors with associated ungrounded conductors inside enclosures in accordance with NFPA 70.
- M. Make wiring connections using specified wiring connectors.
1. Make splices and taps only in accessible boxes. Do not pull splices into raceways or make splices in conduit bodies or wiring gutters.
 2. Remove appropriate amount of conductor insulation for making connections without cutting, nicking or damaging conductors.
 3. Do not remove conductor strands to facilitate insertion into connector.
 4. Clean contact surfaces on conductors and connectors to suitable remove corrosion, oxides, and other contaminants. Do not use wire brush on plated connector surfaces.

5. Mechanical Connectors - Secure connections according to manufacturer's recommended torque settings.
 6. Compression Connectors - Secure connections using manufacturer's recommended tools and dies.
- N. Insulate splices and taps that are made with uninsulated connectors using methods suitable for the application, with insulation and mechanical strength at least equivalent to unspliced conductors.
1. Dry Locations - Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For taped connections, first apply adequate amount of rubber splicing electrical tape or electrical filler tape, followed by outer covering of vinyl insulating electrical tape.
 2. Damp Locations - Use insulating covers specifically designed for the connectors, electrical tape, or heat shrink tubing.
 - a. For connections with insulating covers, apply outer covering of moisture sealing electrical tape.
 - b. For taped connections, follow same procedure as for dry locations but apply outer covering of moisture sealing electrical tape.
 3. Wet Locations - Use heat shrink tubing.
- O. Insulate ends of spare conductors using vinyl insulating electrical tape.
- P. Field-Applied Color Coding - Where vinyl color coding electrical tape is used in lieu of integrally colored insulation as permitted in Part 2 under "Color Coding", apply half overlapping turns of tape at each termination and at each location conductors are accessible.
- Q. Identify conductors and cables in accordance with Section 16196, Identification For Electrical Systems.
- R. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
- S. Unless specifically indicated to be excluded, provide final connections to all equipment and devices, including those furnished by others, as required for a complete operating system.
- 3.04. FIELD QUALITY CONTROL
- A. Inspect and test in accordance with NETA ATS, except Section 4.
 - B. Perform inspections and tests listed in NETA ATS, Section 7.3.2. The insulation resistance test is only required for services and feeders. The resistance test for parallel conductors listed as optional is not required.
 1. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.

- C. Correct deficiencies and replace damaged or defective conductors and cables.

END OF SECTION

SECTION 16130

BOXES

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Outlet and device boxes up to 100 cubic inches (1,650 cu cm), including those used as junction and pull boxes.
- B. Cabinets and enclosures, including junction and pull boxes larger than 100 cubic inches (1,650 cu cm).
- C. Boxes for hazardous (classified) locations.
 - 1. In addition, reference Section 16250, Equipment for Hazardous Locations.
- D. Underground boxes/enclosures.

1.02. RELATED REQUIREMENTS

- A. Section 16200 – ELECTRICAL FIRESTOPPING
- B. Section 16191 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- C. Section 16110 - CONDUIT
 - 1. Conduit bodies and other fittings.
 - 2. Additional requirements for locating boxes to limit conduit length and/or number of bends between pulling points.
- D. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS - Identification products and requirements.
- E. Section 16140 - WIRING DEVICES
 - 1. Wall plates.
 - 2. Additional requirements for locating boxes for wiring devices.
- F. Section 16250 - EQUIPMENT FOR HAZARDOUS LOCATIONS

1.03. REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.

- C. NEMA FB 1 - Fittings, Cast Metal Boxes, and Conduit Bodies for Conduit, Electrical Metallic Tubing, and Cable; 2012.
- D. NEMA OS 1 - Sheet-Steel Outlet Boxes, Device Boxes, Covers, and Box Supports; 2013.
- E. NEMA OS 2 - Nonmetallic Outlet Boxes, Device Boxes, Covers and Box Supports; 2013.
- F. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. SCTE 77 - Specification for Underground Enclosure Integrity; 2013.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 508A - Industrial Control Panels; Current Edition, Including All Revisions.
- L. UL 514A - Metallic Outlet Boxes; Current Edition, Including All Revisions.
- M. UL 514C - Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers; Current Edition, Including All Revisions.
- N. UL 1203 - Explosion-Proof and Dust-Ignition-Proof Electrical Equipment for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
 - 2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
 - 3. Coordinate minimum sizes of boxes with the actual installed arrangement of conductors, clamps, support fittings, and devices, calculated according to NFPA 70.
 - 4. Coordinate minimum sizes of pull boxes with the actual installed arrangement of connected conduits, calculated according to NFPA 70.
 - 5. Coordinate the placement of boxes with millwork, furniture, devices, equipment, etc. installed under other sections or by others.
 - 6. Coordinate the work with other trades to preserve insulation integrity.

7. Coordinate the work with other trades to provide walls suitable for installation of flush-mounted boxes where indicated.
8. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for cabinets and enclosures, boxes for hazardous (classified) locations, and underground boxes/enclosures.
- B. Manufacturer's Installation Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- C. Project Record Documents - Record actual locations for cabinets and enclosures and underground boxes/enclosures.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01. BOXES

- A. General Requirements
 1. Do not use boxes and associated accessories for applications other than as permitted by NFPA 70 and product listing.
 2. Provide all boxes, fittings, supports, and accessories required for a complete raceway system and to accommodate devices and equipment to be installed.
 3. Provide products listed, classified, and labeled as suitable for the purpose intended.
 4. Where box size is not indicated, size to comply with NFPA 70 but not less than applicable minimum size requirements specified.
 5. Provide grounding terminals within boxes where equipment grounding conductors terminate.
 6. All new/modified boxes to be provided with covers and caps (all conduit knock-outs to be closed).

- B. Outlet and Device Boxes Up to 100 cubic inches (1,650 cu cm), Including Those Used as Junction and Pull Boxes
1. Use sheet-steel boxes for dry locations unless otherwise indicated or required.
 2. Use cast iron boxes or cast aluminum boxes for damp or wet locations unless otherwise indicated or required; furnish with compatible weatherproof gasketed covers.
 3. Use cast iron boxes or cast aluminum boxes where exposed galvanized steel rigid metal conduit or exposed intermediate metal conduit (IMC) is used.
 4. Use nonmetallic boxes where exposed rigid PVC conduit is used.
 5. Use suitable concrete type boxes where flush-mounted in concrete.
 6. Use suitable masonry type boxes where flush-mounted in masonry walls.
 7. Use raised covers suitable for the type of wall construction and device configuration where required.
 8. Use shallow boxes where required by the type of wall construction.
 9. Do not use "through-wall" boxes designed for access from both sides of wall.
 10. Sheet-Steel Boxes - Comply with NEMA OS 1, and list and label as complying with UL 514A.
 11. Cast Metal Boxes - Comply with NEMA FB 1, and list and label as complying with UL 514A; furnish with threaded hubs.
 12. Nonmetallic Boxes - Comply with NEMA OS 2, and list and label as complying with UL 514C.
 13. Boxes for Supporting Luminaires and Ceiling Fans - Listed as suitable for the type and weight of load to be supported; furnished with fixture stud to accommodate mounting of luminaire where required.
 14. Boxes for Ganged Devices - Use multigang boxes of single-piece construction. Do not use field-connected gangable boxes.
 15. Wall Plates - Comply with Section 16140, Wiring Devices.
- C. Cabinets and Enclosures, Including Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm)
1. Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E, or UL 508A.
 2. Provide block-off plates for all existing cabinets, enclosures, and boxes in which are existing to remain but have had conduits/circuits removed. To clarify, cabinets, enclosures, and boxes are to be 100 percent closed with no openings upon completion of project. Contract to field verify.
 3. NEMA 250 Environment Type, Unless Otherwise Indicated

- a. Indoor Clean, Dry Locations - Type 1, painted steel.
 - b. Indoor Process rooms: Type 4X, Stainless steel.
 - c. Outdoor Locations - Type 4X, stainless steel.
 - d. Hazardous Locations: Type 7 (explosionproof).
4. Junction and Pull Boxes Larger Than 100 cubic inches (1,650 cu cm)
 - a. Provide screw-cover or hinged-cover enclosures unless otherwise indicated.
 5. Finish for Painted Steel Enclosures - Manufacturer's standard grey unless otherwise indicated.
- D. Boxes for Hazardous (Classified) Locations - Listed and labeled as complying with UL 1203 for the classification of the installed location.
1. Manufacturers
 - a. Appleton, a brand of Emerson Industrial Automation - www.emersonindustrial.com.
 - b. Cooper Crouse-Hinds, a division of Eaton Corporation - www.cooperindustries.com.
 - c. Hubbell Incorporated; Killark Products - www.hubbell-killark.com.
- E. Underground Boxes/Enclosures
1. Description - In-ground, open bottom boxes furnished with flush, non-skid covers with legend indicating type of service and stainless steel tamper resistant cover bolts.
 2. Size - As indicated on Drawings.
 3. Depth - As required to extend below frost line to prevent frost upheaval, but not less than 12 inches (300 mm).
 4. Provide logo on cover to indicate type of service.
 5. Refer to Section 16301, Underground Electrical Work, for additional info.
 6. Polymer Concrete Underground Boxes/Enclosures - Comply with SCTE 77.
 - a. Manufacturers - Hubbell Incorporated; Quazite Products - www.hubbellpowersystems.com.
 - b. Combination fiberglass/polymer concrete boxes/enclosures are acceptable.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive boxes.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install boxes in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards where mounting heights are not indicated.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide separate boxes for emergency power and normal power systems.
- E. Unless otherwise indicated, provide separate boxes for line voltage and low voltage systems.
- F. Flush-mount boxes in finished areas unless specifically indicated to be surface-mounted.
- G. Unless otherwise indicated, boxes may be surface-mounted where exposed conduits are indicated or permitted.
- H. Box Locations
 - 1. Locate boxes to be accessible. Provide access panels in accordance with specifications as required.
 - 2. Unless dimensioned, box locations indicated are approximate.
 - 3. Locate boxes as required for devices installed under other sections or by others.
 - 4. Locate boxes so that wall plates do not span different building finishes.
 - 5. Locate boxes so that wall plates do not cross masonry joints.
 - 6. Unless otherwise indicated, where multiple outlet boxes are installed at the same location at different mounting heights, install along a common vertical center line.
 - 7. Do not install flush-mounted boxes on opposite sides of walls back-to-back. Provide minimum 6 inches (150 mm) horizontal separation unless otherwise indicated.
 - 8. Acoustic-Rated Walls - Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) horizontal separation.

9. Fire Resistance Rated Walls - Install flush-mounted boxes such that the required fire resistance will not be reduced.
 - a. Do not install flush-mounted boxes on opposite sides of walls back-to-back; provide minimum 24 inches (610 mm) separation where wall is constructed with individual noncommunicating stud cavities or protect both boxes with listed putty pads.
 10. Locate junction and pull boxes as indicated, as required to facilitate installation of conductors, and to limit conduit length and/or number of bends between pulling points in accordance with Section 16110, Conduit.
- I. Box Supports
1. Secure and support boxes in accordance with NFPA 70 and Section 16191, Identification for Electrical Systems, using suitable supports and methods approved by the authority having jurisdiction.
 2. Provide independent support from building structure except for cast metal boxes (other than boxes used for fixture support) supported by threaded conduit connections in accordance with NFPA 70. Do not provide support from piping, ductwork, or other systems.
 3. Installation Above Suspended Ceilings - Do not provide support from ceiling grid or ceiling support system.
- J. Install boxes plumb and level.
- K. Flush-Mounted Boxes
1. Install boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that front edge of box or associated raised cover is not set back from finished surface more than 1/4 inch (6 mm) or does not project beyond finished surface.
 2. Install boxes in combustible materials such as wood so that front edge of box or associated raised cover is flush with finished surface.
 3. Repair rough openings around boxes in noncombustible materials such as concrete, tile, gypsum, plaster, etc. so that there are no gaps or open spaces greater than 1/8 inch (3 mm) at the edge of the box.
- L. Install boxes as required to preserve insulation integrity.
- M. Underground Boxes/Enclosures
1. Install enclosure on gravel base, minimum 6 inches (150 mm) deep.
 2. Flush-mount enclosures located in concrete or paved areas.
 3. Mount enclosures located in landscaped areas with top at 1 inch (25 mm) above finished grade.

- 4. Install additional bracing inside enclosures in accordance with manufacturer's instructions to minimize box sidewall deflections during backfilling. Backfill with cover bolted in place.
 - 5. Refer to Contract Drawings and Section 16301, Underground Electrical Work.
 - N. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
 - O. Install firestopping to preserve fire resistance rating of partitions and other elements, using materials and methods specified.
 - P. Close unused box openings.
 - Q. Install blank wall plates on junction boxes and on outlet boxes with no devices or equipment installed or designated for future use.
 - R. Provide grounding and bonding in accordance with Section 16100, Grounding and Bonding for Electrical Systems.
 - S. Identify boxes in accordance with Section 16196, Hangers and Supports for Electrical Systems.
- 3.03. CLEANING
- A. Clean interior of boxes to remove dirt, debris, plaster and other foreign material.
- 3.04. PROTECTION
- A. Immediately after installation, protect boxes from entry of moisture and foreign material until ready for installation of conductors.

END OF SECTION

SECTION 16140

WIRING DEVICES

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Wall switches.
- B. Receptacles.
- C. Wall plates.

1.02. RELATED REQUIREMENTS

- A. Section 16201 - EQUIPMENT WIRING: Manufactured wiring systems for use with access floor boxes with compatible pre-wired connectors.
- B. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- C. Section 16130 - BOXES
- D. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.
- E. Section 16201 - EQUIPMENT WIRING: Cords and plugs for equipment.

1.03. REFERENCE STANDARDS

- A. FS W-C-596 - Connector, Electrical, Power, General Specification for; Revision H, 2014.
- B. FS W-S-896 - Switches, Toggle (Toggle and Lock), Flush-mounted (General Specification); Revision G, 2014.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA 130 - Standard for Installing and Maintaining Wiring Devices; 2010.
- E. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- F. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- H. UL 20 - General-Use Snap Switches; Current Edition, Including All Revisions.
- I. UL 498 - Attachment Plugs and Receptacles; Current Edition, Including All Revisions.
- J. UL 514D - Cover Plates for Flush-Mounted Wiring Devices; Current Edition, Including All Revisions.

K. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate the placement of outlet boxes with millwork, furniture, equipment, etc. installed under other sections or by others.
2. Coordinate wiring device ratings and configurations with the electrical requirements of actual equipment to be installed.
3. Coordinate the placement of outlet boxes for wall switches with actual installed door swings.
4. Coordinate the installation and preparation of uneven surfaces, such as split face block, to provide suitable surface for installation of wiring devices.
5. Coordinate the core drilling of holes for poke-through assemblies with the work covered under other sections.
6. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

B. Sequencing - Do not install wiring devices until final surface finishes and painting are complete.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's catalog information showing dimensions, colors, and configurations.
- B. Manufacturer's Installation Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- C. Operation and Maintenance Data
1. GFCI Receptacles - Include information on status indicators.
- D. Project Record Documents - Record actual installed locations of wiring devices.
- E. Maintenance Materials - Furnish the following for Owner's use in maintenance of project.
1. Extra Keys for Locking Switches - Two of each type.
 2. Extra Wall Plates - Two of each style, size, and finish.

1.06. QUALITY ASSURANCE

A. Conform to requirements of NFPA 70.

- B. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
- C. Products - Listed, classified, and labeled as suitable for the purpose intended.

1.07. DELIVERY, STORAGE, AND PROTECTION

- A. Store in a clean, dry space in original manufacturer's packaging until ready for installation.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Lutron Electronics Company, Inc - www.lutron.com.
- B. Legrand.

2.02. WIRING DEVICE APPLICATIONS

- A. Provide wiring devices suitable for intended use and with ratings adequate for load served.
- B. For single receptacles installed on an individual branch circuit, provide receptacle with ampere rating not less than that of the branch circuit.
- C. Provide weather resistant GFCI receptacles with specified weatherproof covers for receptacles installed outdoors or in damp or wet locations.
- D. Provide GFCI protection for receptacles installed within 6 feet (1.8 m) of sinks.
- E. Provide GFCI protection for receptacles installed in kitchens.
- F. Provide GFCI protection for receptacles serving electric drinking fountains.
- G. Unless noted otherwise, do not use combination switch/receptacle devices.

2.03. WIRING DEVICE FINISHES

- A. Provide wiring device finishes as noted on E001, Legend.

2.04. WALL SWITCHES

- A. Manufacturers
 - 1. Pass & Seymour, a brand of Legrand North America, Inc. - www.legrand.us.
- B. Wall Switches - General Requirements - AC only, quiet operating, general-use snap switches with silver alloy contacts, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 20 and where applicable, FS W-S-896; types as indicated on the drawings.

1. Wiring Provisions - Terminal screws for side wiring and screw actuated binding clamp for back wiring with separate ground terminal screw.
 2. Coordinate device and faceplate cover colors with the Architect and Owner.
- C. Standard Wall Switches - Industrial specification grade, 20 A, 120/277 V with standard toggle type switch actuator and maintained contacts; single pole single throw, double pole single throw, three way, or four way as indicated on the Drawings.
- D. Pilot Light Wall Switches - Industrial specification grade, 20 A, 120/277 V with red illuminated standard toggle-type switch actuator and maintained contacts; illuminated with load on; single-pole single throw, double-pole single throw, three-way, or four-way as indicated on the Drawings.

2.05. RECEPTACLES

A. Manufacturers

1. Pass & Seymour, a brand of Legrand North America, Inc. - www.legrand.us.
2. Source Limitations - Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wall plates by the same manufacturer in locations indicated.

B. Receptacles - General Requirements - Self-grounding, complying with NEMA WD 1 and NEMA WD 6, and listed as complying with UL 498, and where applicable, FS W-C-596; types as indicated on the drawings.

1. Wiring Provisions - Terminal screws for side wiring or screw actuated binding clamp for back wiring with separate ground terminal screw.
2. NEMA configurations specified are according to NEMA WD 6.

C. Convenience Receptacles

1. Standard Convenience Receptacles - Industrial specification grade, 20A, 125V, NEMA 5-20R; single or duplex as indicated on the drawings.
2. Weather Resistant Convenience Receptacles - Industrial specification grade, 20A, 125V, NEMA 5-20R, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations; single or duplex as indicated on the drawings.

D. GFCI Receptacles

1. GFCI Receptacles - General Requirements - Self-testing, with feed-through protection and light to indicate ground fault tripped condition and loss of protection; listed as complying with UL 943, class A.
 - a. Provide test and reset buttons of same color as device.

2. Standard GFCI Receptacles - Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style.
3. Weather Resistant GFCI Receptacles - Industrial specification grade, duplex, 20A, 125V, NEMA 5-20R, rectangular decorator style, listed and labeled as weather resistant type complying with UL 498 Supplement SE suitable for installation in damp or wet locations.

2.06. WALL PLATES

A. Manufacturers

1. Pass & Seymour, a brand of Legrand North America, Inc - www.legrand.us.
2. Source Limitations - Where wall controls are furnished as part of lighting control system, provide accessory matching receptacles and wall plates by the same manufacturer in locations indicated.

B. Wall Plates - Comply with UL 514D.

1. Configuration - One piece cover as required for quantity and types of corresponding wiring devices.
2. Finish - Refer to E-001, Legend.

C. Weatherproof Covers for Wet Locations - Gasketed, cast aluminum, with hinged lockable cover and corrosion-resistant screws; listed as suitable for use in wet locations while in use with attachment plugs connected and identified as extra-duty type.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate devices and conductors in accordance with NFPA 70.
- C. Verify that wall openings are neatly cut and will be completely covered by wall plates.
- D. Verify that final surface finishes are complete, including painting.
- E. Verify that floor boxes are adjusted properly.
- F. Verify that branch circuit wiring installation is completed, tested, and ready for connection to wiring devices.
- G. Verify that conditions are satisfactory for installation prior to starting work.

3.02. PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03. INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship) and, where applicable, NECA 130, including mounting heights specified in those standards unless otherwise indicated.
- B. Coordinate locations of outlet boxes provided under Section 16130, Boxes, as required for installation of wiring devices provided under this section.
 - 1. Mounting Heights - Unless otherwise indicated, as follows:
 - a. Wall Switches - 48 inches (1200 mm) above finished floor.
 - b. Receptacles - 18 inches (450 mm) above finished floor, 6 inches (150 mm) above counter, or as indicated on the Contract Drawings.
 - 2. Orient outlet boxes for vertical installation of wiring devices unless otherwise indicated.
 - 3. Where multiple receptacles or wall switches are installed at the same location and at the same mounting height, gang devices together under a common wall plate.
 - 4. Locate wall switches on strike side of door with edge of wall plate 3 inches (80 mm) from edge of door frame. Where locations are indicated otherwise, notify Engineer to obtain direction prior to proceeding with work.
 - 5. Locate receptacles for electric drinking fountains concealed behind drinking fountain according to manufacturer's instructions.
- C. Install wiring devices in accordance with manufacturer's instructions.
- D. Install permanent barrier between ganged wiring devices when voltage between adjacent devices exceeds 300 V.
- E. Where required, connect wiring devices using pigtails not less than 6 inches (150 mm) long. Do not connect more than one conductor to wiring device terminals.
- F. Connect wiring devices by wrapping conductor clockwise 3/4 turn around screw terminal and tightening to proper torque specified by the manufacturer. Where present, do not use push-in pressure terminals that do not rely on screw-actuated binding.
- G. Unless otherwise indicated, connect wiring device grounding terminal to branch circuit equipment grounding conductor and to outlet box with bonding jumper.
- H. Provide GFCI receptacles with integral GFCI protection at each location indicated. Do not use feed-through wiring to protect downstream devices.

- I. Install wiring devices plumb and level with mounting yoke held rigidly in place.
- J. Install wall switches with Off position down.
- K. Install vertically mounted receptacles with grounding pole on top and horizontally mounted receptacles with grounding pole on left.
- L. Install wall plates to fit completely flush to wall with no gaps and rough opening completely covered without strain on wall plate. Repair or reinstall improperly installed outlet boxes or improperly sized rough openings. Do not use oversized wall plates in lieu of meeting this requirement.
- M. Install blank wall plates on junction boxes and on outlet boxes with no wiring devices installed or designated for future use.
- N. Identify wiring devices in accordance with Section 16196, Identification For Electrical Systems.

3.04. FIELD QUALITY CONTROL

- A. Inspect each wiring device for damage and defects.
- B. Operate each wall switch with circuit energized to verify proper operation.
- C. Test each receptacle to verify operation and proper polarity.
- D. Test each GFCI receptacle for proper tripping operation according to manufacturer's instructions.
- E. Correct wiring deficiencies and replace damaged or defective wiring devices.

3.05. ADJUSTING

- A. Adjust devices and wall plates to be flush and level.
- B. Adjust presets for wall dimmers according to manufacturer's instructions as directed by Engineer.

3.06. CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

END OF SECTION

SECTION 16191

HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Support and attachment components for equipment, conduit, cable, boxes, and other electrical work.

1.02. RELATED REQUIREMENTS

- A. Section 16110 - CONDUIT: Additional support and attachment requirements for conduits.
- B. Section 16130 - BOXES: Additional support and attachment requirements for boxes.
- C. Section 16501 - INTERIOR LIGHTING: Additional support and attachment requirements for interior luminaires.
- D. Section 16502 - EXTERIOR LIGHTING: Additional support and attachment requirements for exterior luminaires.

1.03. REFERENCE STANDARDS

- A. ASTM A123/A123M - Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products; 2015.
- B. ASTM A153/A153M - Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware; 2009.
- C. ASTM B633 - Standard Specification for Electrodeposited Coatings of Zinc on Iron and Steel; 2013.
- D. MFMA-4 - Metal Framing Standards Publication; 2004.
- E. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate sizes and arrangement of supports and bases with the actual equipment and components to be installed.
 - 2. Coordinate the work with other trades to provide additional framing and materials required for installation.
 - 3. Coordinate compatibility of support and attachment components with mounting surfaces at the installed locations.

4. Coordinate the arrangement of supports with ductwork, piping, equipment and other potential conflicts installed under other sections or by others.
 5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.
- B. Sequencing - Do not install products on or provide attachment to concrete surfaces until concrete has fully cured in accordance with specifications.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for metal channel (strut) framing systems, non-penetrating rooftop supports, and post-installed concrete and masonry anchors.
- B. Shop Drawings - Include details for fabricated hangers and supports where materials or methods other than those indicated are proposed for substitution.
- C. Manufacturer's Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06. QUALITY ASSURANCE

- A. Comply with NFPA 70.
- B. Comply with applicable Building Code.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store products in accordance with manufacturer's instructions.

PART 2 PRODUCTS

2.01. SUPPORT AND ATTACHMENT COMPONENTS

- A. General Requirements
 1. Provide all required hangers, supports, anchors, fasteners, fittings, accessories, and hardware as necessary for the complete installation of electrical work.
 2. Provide products listed, classified, and labeled as suitable for the purpose intended, where applicable.
 3. Where support and attachment component types and sizes are not indicated, select in accordance with manufacturer's application criteria as required for the load to be supported with a minimum safety factor of 25 percent. Include consideration for vibration, equipment operation, and shock loads where applicable.

4. Do not use products for applications other than as permitted by NFPA 70 and product listing.
 5. Do not use wire, chain, perforated pipe strap, or wood for permanent supports unless specifically indicated or permitted.
 6. Steel Components - Use corrosion-resistant materials suitable for the environment where installed.
 - a. Indoor Dry Locations - Use zinc-plated steel or approved equivalent unless otherwise indicated.
 - b. Outdoor and Damp or Wet Indoor Locations - Use galvanized steel, stainless steel, or approved equivalent unless otherwise indicated or specified on the Drawings. Supports shall match the materials of the equipment required to be supported.
 - c. Zinc-Plated Steel - Electroplated in accordance with ASTM B633.
 - d. Galvanized Steel - Hot-dip galvanized after fabrication in accordance with ASTM A123/A123M or ASTM A153/A153M.
- B. Conduit and Cable Supports - Straps, clamps, etc. suitable for the conduit or cable to be supported.
1. Conduit Straps - One-hole or two-hole type; steel or malleable iron.
 2. Conduit Clamps - Bolted type unless otherwise indicated.
 3. When using PVC-coated galvanized steel rigid metal conduit, Contractor is to use a corrosion-resistant product line as manufactured by Power-Strut Defender or approved equal for all associated channel, fittings, and conduit supports/clamps.
- C. Outlet Box Supports - Hangers, brackets, etc. suitable for the boxes to be supported.
- D. Metal Channel (Strut) Framing Systems - Factory-fabricated continuous-slot metal channel (strut) and associated fittings, accessories, and hardware required for field-assembly of supports.
1. Comply with MFMA-4.
- E. Hanger Rods - Threaded zinc-plated steel unless otherwise indicated.
1. Minimum Size, Unless Otherwise Indicated or Required:
 - a. Equipment Supports - 1/2 inch (13 mm) diameter.
 - b. Busway Supports - 1/2 inch (13 mm) diameter.
 - c. Single Conduit up to 1 inch (27 mm) trade size - 1/4 inch (6 mm) diameter.
 - d. Single Conduit larger than 1 inch (27 mm) trade size - 3/8 inch (10 mm) diameter.
 - e. Trapeze Support for Multiple Conduits - 3/8 inch (10 mm) diameter.

- f. Outlet Boxes - 1/4 inch (6 mm) diameter.
- g. Luminaires - 1/4 inch (6 mm) diameter.

F. Anchors and Fasteners

1. Unless otherwise indicated and where not otherwise restricted, use the anchor and fastener types indicated for the specified applications.
2. Concrete - Use preset concrete inserts, expansion anchors, or screw anchors.
3. Solid or Grout-Filled Masonry - Use expansion anchors or screw anchors.
4. Hollow Masonry - Use toggle bolts.
5. Hollow Stud Walls - Use toggle bolts.
6. Steel - Use beam clamps, machine bolts, or welded threaded studs.
7. Sheet Metal - Use sheet metal screws.
8. Wood - Use wood screws.
9. Plastic and lead anchors are not permitted.
10. Preset Concrete Inserts - Continuous metal channel (strut) and spot inserts specifically designed to be cast in concrete ceilings, walls, and floors.
 - a. Comply with MFMA-4.
 - b. Channel Material - Use galvanized steel.
 - c. Manufacturer - Same as manufacturer of metal channel (strut) framing system.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that mounting surfaces are ready to receive support and attachment components.
- C. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Provide independent support from building structure. Do not provide support from piping, ductwork, or other systems.
- D. Unless specifically indicated or approved by Engineer, do not provide support from suspended ceiling support system or ceiling grid.
- E. Unless specifically indicated or approved by Engineer, do not provide support from roof deck.
- F. Do not penetrate or otherwise notch or cut structural members without approval of Structural Engineer.
- G. Equipment Support and Attachment
 - 1. Use metal fabricated supports or supports assembled from metal channel (strut) to support equipment as required.
 - 2. Use metal channel (strut) secured to studs to support equipment surface mounted on hollow stud walls when wall strength is not sufficient to resist pull-out.
 - 3. Use metal channel (strut) to support surface-mounted equipment in wet or damp locations to provide space between equipment and mounting surface.
 - 4. Unless otherwise indicated, mount floor-mounted equipment on properly sized 4-inch (100 mm) high concrete pad constructed in accordance with specifications.
 - 5. Securely fasten floor-mounted equipment. Do not install equipment such that it relies on its own weight for support.
- H. Conduit Support and Attachment - Also comply with Section 16110, Conduit.
- I. Box Support and Attachment - Also comply with Section 16130, Boxes.
- J. Interior Luminaire Support and Attachment - Also comply with Section 16501, Interior Lighting.
- K. Preset Concrete Inserts - Use manufacturer provided closure strips to inhibit concrete seepage during concrete pour.
- L. Secure fasteners according to manufacturer's recommended torque settings.
- M. Remove temporary supports.
- N. Identify independent electrical component support wires above accessible ceilings (only where specifically indicated or permitted) with color distinguishable from ceiling support wires in accordance with NFPA 70.

3.03. FIELD QUALITY CONTROL

- A. Inspect support and attachment components for damage and defects.
- B. Repair cuts and abrasions in galvanized finishes using zinc-rich paint recommended by manufacturer. Replace components that exhibit signs of corrosion.
- C. Correct deficiencies and replace damaged or defective support and attachment components.

END OF SECTION

SECTION 16196

IDENTIFICATION FOR ELECTRICAL SYSTEMS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Electrical identification requirements.
- B. Identification nameplates and labels.
- C. Wire and cable markers.
- D. Voltage markers.
- E. Underground warning tape.
- F. Floor marking tape.
- G. Warning signs and labels.

1.02. RELATED REQUIREMENTS

- A. Section 16060 - POWER SYSTEM ANALYSIS: Arc flash hazard warning labels.
- B. Section 16120 - LOW-VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES: Color coding for power conductors and cables 600 V and less; vinyl color coding electrical tape.
- C. Section 16140 - WIRING DEVICES

1.03. REFERENCE STANDARDS

- A. ANSI Z535.2 - American National Standard for Environmental and Facility Safety Signs; 2011.
- B. ANSI Z535.4 - American National Standard for Product Safety Signs and Labels; 2011.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- D. UL 969 - Marking and Labeling Systems; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination - Verify final designations for equipment, systems, and components to be identified prior to fabrication of identification products.
- B. Sequencing
 - 1. Do not conceal items to be identified, in locations such as above suspended ceilings, until identification products have been installed.

2. Do not install identification products until final surface finishes and painting are complete.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for each product.
- B. Shop Drawings - Provide schedule of items to be identified indicating proposed designations, materials, legends, and formats.
- C. Manufacturer's Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation and installation of product.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.

1.07. FIELD CONDITIONS

- A. Do not install adhesive products when ambient temperature is lower than recommended by manufacturer.

PART 2 PRODUCTS

2.01. IDENTIFICATION REQUIREMENTS

- A. Existing Work - Unless specifically excluded, identify existing elements to remain that are not already identified in accordance with specified requirements herein.
- B. Identification for Equipment
 1. Use identification nameplate to identify each piece of electrical distribution and control equipment and associated sections, compartments, and components.
 - a. Panelboards
 - 1) Identify ampere rating.
 - 2) Identify voltage and phase.
 - 3) Identify power source and circuit number. Include location when not within sight of equipment.
 - 4) Identify main overcurrent protective device. Use identification label for panelboards with a door. For power distribution panelboards without a door, use identification nameplate.
 - 5) Use typewritten circuit directory to identify load(s) served for panelboards with a door. Identify spares and spaces using pencil.

- 6) For power panelboards without a door, use identification nameplate to identify load(s) served for each branch device. Do not identify spares and spaces.
 - b. Enclosed Switches, Circuit Breakers and Motor Controllers
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - c. Time switches
 - d. Transfer Switches
 - 1) Identify voltage and phase.
 - 2) Identify power source and circuit number for both normal power source and standby power source. Include location when not within sight of equipment.
 - 3) Identify load(s) served. Include location when not within sight of equipment.
 - 4) Identify short circuit current rating based on the specific overcurrent protective device type and settings protecting the transfer switch.
 - e. Electricity meters.
 - f. Motor-Rated Switches - Identify load served and location of load.
 - g. Alarm Lights - Identify function and associated system.
2. Service Equipment
 - a. Use identification nameplate to identify each service disconnecting means. All requirements to be per NEC.
 - b. For buildings or structures supplied by more than one service, or any combination of branch circuits, feeders, and services, use identification nameplate or means of identification acceptable to authority having jurisdiction at each service disconnecting means to identify all other services, feeders, and branch circuits supplying that building or structure. Verify format and descriptions with authority having jurisdiction.
 - c. Provide label indicating maximum available fault current for all service entrance equipment per NEC article 110.24.
3. Emergency System Equipment
 - a. Use identification nameplate or voltage marker to identify emergency system equipment in accordance with NFPA 70.

- b. Use identification nameplate at each piece of service equipment to identify type and location of on-site emergency power sources.
 - c. Use identification nameplate to identify emergency operating instructions for emergency system equipment.
 4. Use identification nameplate to identify switchboards and panelboards utilizing a high leg delta system in accordance with NFPA 70.
 5. Use identification nameplate to identify disconnect location for equipment with remote disconnecting means.
 6. Use field-painted floor markings, floor marking tape, or warning labels to identify required equipment working clearances where indicated or where required by the authority having jurisdiction.
 - a. Field-Painted Floor Markings - Alternating black and white stripes, 3 inches (76 mm) wide, painted in accordance with painting specifications. Contractor to provide field-painted floor markings for all electrical distribution equipment.
 7. Available Fault Current Documentation - Use identification label to identify the maximum available fault current and date calculations were performed at locations requiring documentation by NFPA 70 (NEC), including but not limited to the following. Refer to specification section 16060 for additional information.
 - a. Service equipment.
 - b. Switchboards.
 8. Arc Flash Hazard Warning Labels - Comply with Section 16060, Power System Analysis.
- C. Identification for Conductors and Cables
 1. Color Coding for Power Conductors 600 V and Less - Comply with Section 16120, Low voltage Electrical Power Conductors and Cables.
 2. Use identification nameplate or identification label to identify color code for ungrounded and grounded power conductors inside door or enclosure at each piece of feeder or branch-circuit distribution equipment when premises has feeders or branch circuits served by more than one nominal voltage system.
 3. Use wire and cable markers to identify circuit number or other designation indicated for power, control, and instrumentation conductors and cables at the following locations:
 - a. At each source and load connection.
 - b. Within boxes when more than one circuit is present.
 - c. Within equipment enclosures when conductors and cables enter or leave the enclosure.
 4. Use underground warning tape to identify direct buried cables.

- D. Identification for Raceways - Use underground warning tape to identify underground raceways.
- E. Identification for Boxes
 - 1. Use identification labels or handwritten text using indelible marker to identify circuits enclosed.
 - 2. Use warning labels to identify electrical hazards for boxes containing exposed live parts or exposed conductors operating at over 600 V nominal with the word message "DANGER; HIGH VOLTAGE; KEEP OUT".
- F. Identification for Devices
 - 1. Wiring Device and Wall Plate Finishes - Comply with Section 16140, Wiring Devices.
 - 2. Use identification label or engraved wall plate to identify serving branch circuit for all receptacles.
- G. Identification for Luminaires - Use permanent red dot on luminaire frame to identify luminaires connected to emergency power system.

2.02. IDENTIFICATION NAMEPLATES AND LABELS

- A. Identification Nameplates
 - 1. Materials
 - a. Indoor Clean, Dry Locations - Use plastic nameplates.
 - b. Outdoor Locations - Use plastic, stainless steel, or aluminum nameplates suitable for exterior use.
 - 2. Plastic Nameplates - Two- or three-layer laminated acrylic or electrically non-conductive phenolic with beveled edges; minimum thickness of 1/16 inch (1.6 mm); engraved text.
 - 3. Stainless Steel Nameplates - Minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
 - 4. Aluminum Nameplates - Anodized; minimum thickness of 1/32 inch (0.8 mm); engraved or laser-etched text.
 - 5. Mounting Holes for Mechanical Fasteners - Two, centered on sides for sizes up to 1 inch (25 mm) high; four, located at corners for larger sizes.
- B. Identification Labels
 - 1. Materials - Use self-adhesive laminated plastic labels; UV, chemical, water, heat, and abrasion resistant.
 - a. Use only for indoor locations.

2. Text - Use factory pre-printed or machine-printed text. Do not use handwritten text unless otherwise indicated.
- C. Format for Equipment Identification
1. Minimum Size - 1 inch (25 mm) by 2.5 inches (64 mm).
 2. Legend - Equipment designation or other approved description.
 3. Text - All capitalized unless otherwise indicated.
 4. Minimum Text Height
 - a. Equipment Designation - 1/2 inch (13 mm).
 - b. Exception - Provide minimum text height of 1 inch (25 mm) for equipment located more than 10 feet (3.0 m) above floor or working platform.
 5. Color
 - a. Normal Power System - White text on black background.
- 2.03. WIRE AND CABLE MARKERS
- A. Markers for Conductors and Cables - Use wrap-around self-adhesive vinyl cloth, wrap-around self-adhesive vinyl self-laminating, heat-shrink sleeve, plastic sleeve, plastic clip-on, or vinyl split sleeve type markers suitable for the conductor or cable to be identified.
 - B. Markers for Conductor and Cable Bundles - Use plastic marker tags secured by nylon cable ties.
 - C. Legend - Power source and circuit number or other designation indicated.
 - D. Text - Use factory pre-printed or machine-printed text, all capitalized unless otherwise indicated.
 - E. Minimum Text Height - 1/8 inch (3 mm).
 - F. Color - Black text on white background unless otherwise indicated.
- 2.04. VOLTAGE MARKERS
- A. Markers for Conduits - Use factory pre-printed self-adhesive vinyl, self-adhesive vinyl cloth, or vinyl snap-around type markers.
 - B. Markers for Boxes and Equipment Enclosures - Use factory pre-printed self-adhesive vinyl or self-adhesive vinyl cloth type markers.
 - C. Minimum Size
 1. Markers for Equipment - 1-1/8 by 4-1/2 inches (29 by 110 mm).
 2. Markers for Conduits - As recommended by manufacturer for conduit size to be identified.

3. Markers for Pull Boxes - 1-1/8 by 4-1/2 inches (29 by 110 mm).
4. Markers for Junction Boxes - 1/2 by 2-1/4 inches (13 by 57 mm).

D. Legend

1. Markers for Voltage Identification - Highest voltage present.
2. Markers for System Identification
 - a. Emergency Power System - Text "EMERGENCY".

E. Color - Black text on orange background unless otherwise indicated.

2.05. UNDERGROUND WARNING TAPE

- A. Materials - Use foil-backed detectable type polyethylene tape suitable for direct burial, unless otherwise indicated.
- B. Foil-backed Detectable Type Tape - 3 inches (76 mm) wide, with minimum thickness of 5 mil (0.1 mm), unless otherwise required for proper detection.
- C. Legend - Type of service, continuously repeated over full length of tape.
- D. Color
 1. Tape for Buried Power Lines - Black text on red background.
 2. Tape for Buried Communication, Alarm, and Signal Lines - Black text on orange background.

2.06. FLOOR MARKING TAPE

- A. Floor Marking Tape for Equipment Working Clearance Identification - Self-adhesive vinyl or polyester tape with over laminate, 3 inches (76 mm) wide, with alternating black and white stripes. Provide floor marking tape for all electrical distribution (panelboards, motor control centers, switchboards, etc.)

2.07. WARNING SIGNS AND LABELS

- A. Comply with ANSI Z535.2 or ANSI Z535.4 as applicable.
- B. Warning Signs
 1. Materials
 - a. Indoor Dry, Clean Locations - Use factory pre-printed rigid plastic or self-adhesive vinyl signs.
 - b. Outdoor Locations - Use factory pre-printed rigid aluminum signs.
 2. Rigid Signs - Provide four mounting holes at corners for mechanical fasteners.

3. Minimum Size - 7 by 10 inches (178 by 254 mm) unless otherwise indicated.

C. Warning Labels

1. Materials - Use factory pre-printed or machine-printed self-adhesive polyester or self-adhesive vinyl labels; UV, chemical, water, heat, and abrasion resistant; produced using materials recognized to UL 969.
2. Machine-Printed Labels - Use thermal transfer process printing machines and accessories recommended by label manufacturer.
3. Minimum Size - 2 by 4 inches (51 mm by 102 mm) unless otherwise indicated.

PART 3 EXECUTION

3.01. PREPARATION

- A. Clean surfaces to receive adhesive products according to manufacturer's instructions.

3.02. INSTALLATION

- A. Install products in accordance with manufacturer's instructions.
- B. Install identification products to be plainly visible for examination, adjustment, servicing, and maintenance. Unless otherwise indicated, locate products as follows:
1. Surface-Mounted Equipment - Enclosure front.
 2. Flush-Mounted Equipment - Inside of equipment door.
 3. Free-Standing Equipment - Enclosure front; also enclosure rear for equipment with rear access.
 4. Elevated Equipment - Legible from the floor or working platform.
 5. Branch Devices - Adjacent to device.
 6. Interior Components - Legible from the point of access.
 7. Conduits - Legible from the floor.
 8. Boxes - Outside face of cover.
 9. Conductors and Cables - Legible from the point of access.
 10. Devices - Outside face of cover.
- C. Install identification products centered, level, and parallel with lines of item being identified.

- D. Secure nameplates to exterior surfaces of enclosures using stainless steel screws and to interior surfaces using self-adhesive backing or epoxy cement.
- 1. Do not use adhesives on exterior surfaces except where substrate cannot be penetrated.
- E. Install self-adhesive labels and markers to achieve maximum adhesion, with no bubbles or wrinkles and edges properly sealed.
- F. Install underground warning tape above buried lines with one tape per trench at 3 inches (75 mm) below finished grade.
- G. Secure rigid signs using stainless steel screws.
- H. Mark all handwritten text, where permitted, to be neat and legible.

3.03. FIELD QUALITY CONTROL

- A. Replace self-adhesive labels and markers that exhibit bubbles, wrinkles, curling or other signs of improper adhesion.

END OF SECTION

SECTION 16200
ELECTRICAL FIRESTOPPING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Firestopping materials.
- B. Firestopping of all penetrations, openings, and interruptions to fire rated assemblies, whether indicated on drawings or not, including but not limited to piping, tubing, and similar utilities passing through or penetrating fire rated walls and floor assemblies.

1.02. RELATED SECTIONS

- A. Refer to "Code Compliance Drawings" for location of fire rated assemblies (coordinate with the architect). At a minimum all corridor walls and all floors between stories have a 1-hour rating. Final requirements to be closely coordinated with the Architect.

1.03. REFERENCES

- A. ASTM International
 - 1. ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials.
 - 2. ASTM E119 - Standard Test Methods for Fire Tests of Building Construction and Materials.
 - 3. ASTM E814 - Standard Test Method for Fire Tests of Through-Penetration Fire Stops.
- B. National Fire Protection Association
 - 1. NFPA 70 - National Electrical Code.
- C. Underwriters Laboratories Inc.
 - 1. UL 263 - Fire Tests of Building Construction and Materials.
 - 2. UL 723 - Tests for Surface Burning Characteristics of Building Materials.
 - 3. UL 1479 - Fire Tests of Through-Penetration Firestops.
 - 4. UL - Fire Resistance Directory.

1.04. FIRE-STOP SYSTEM PERFORMANCE REQUIREMENTS

- A. General - For penetrations through fire resistance-rated constructions, including both empty openings and openings containing penetrating items, provide through-penetration firestop systems that are produced and installed to resist spread of fire according to requirements indicated, resist passage of smoke and other gases, and maintain original fire resistance rating of construction penetrated.

1. Fire resistance-rated walls including fire walls, fire partitions, fire barriers and smoke barriers.
2. Fire-resistance-rated horizontal assemblies including floors and ceiling membranes of roof/ceiling assemblies.

1.05. SUBMITTALS

- A. Product Data - For each type of product indicated.
- B. Shop Drawings - For each through-penetration firestop system, show each type of construction condition penetrated, relationships to adjoining construction, and type of penetrating item. Include firestop design designation of qualified testing and inspecting agency that evidences compliance with requirements for each condition indicated. Submit UL Standard detail for each penetration type proposed.

1.06. QUALITY ASSURANCE

- A. Fire Testing - Provide firestopping assemblies of designs which provide the specified fire ratings when tested in accordance with methods indicated.
 1. Listing in the current-year classification or certification books of UL will be considered as constituting an acceptable test report.

1.07. ENVIRONMENTAL REQUIREMENTS

- A. Comply with firestopping manufacturer's recommendations for temperature and conditions during and after installation. Maintain minimum temperature before, during, and for three days after installation of materials.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Hilti.
- B. Nelson Fire Stop Products.
- C. Specified Technology.
- D. 3M Fire Protection Products.
- E. Approved equals meeting UL requirements.

2.02. MATERIALS

- A. Sealant Firestopping
 1. Intumescent firestop sealant designed to expand when exposed to fire.

2. Paintable.
 3. Fire Resistance - Up to four hours.
 4. Curing Time - 14 to 21 days.
 5. Elongation - 5 percent.
 6. Density - 1.5 g/cm³.
 7. Product - FS-ONE Intumescent Firestop Sealant manufactured by Hilti USA.
 8. Uses - Insulated and uninsulated metal pipes, with or without sleeve, jacketed cables, cable bundles, plastic pipes, sheet metal duct, and top of wall joints.
- B. Silicone Sealant Firestopping
1. Silicone-based firestop sealant that provides maximum movement in fire-rated joint applications and pipe penetrations.
 2. Not paintable/
 3. Fire Resistance - Up to four hours.
 4. Elongation - 25 percent.
 5. Product - CP 601S Elastomeric Firestop Sealant manufactured by Hilti USA.
 6. Uses - Joints in walls, floor to floor or fire compartments.
- C. Safing Insulation
1. Mineral-wool type insulation.
 2. Thickness - 1 to 1-1/2 inches.
 3. Density - 4 to 8 pcf.
 4. Product - THERMAFIBER Safing Insulation.
- D. Mechanical Systems with fillers. Uses - cable trays, bus duct.
- E. Sleeves - Provide sleeves in accordance with Installation requirements section.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify openings are ready to receive sleeves and firestopping materials proposed.

3.02. PREPARATION

- A. Surface Cleaning - Clean out openings immediately before installing through-penetration firestop systems to comply with firestop system manufacturer's written instructions and with the following requirements:
1. Remove from surfaces of opening substrates and from penetrating items foreign materials that could interfere with adhesion of through-penetration firestop systems.
 2. Clean opening substrates and penetrating items to produce clean, sound surfaces capable of developing optimum bond with through-penetration firestop systems. Remove loose particles remaining from cleaning operation.
 3. Remove laitance and form-release agents from concrete.
- B. Priming - Prime substrates where recommended in writing by through-penetration firestop system manufacturer using that manufacturer's recommended products and methods. Confine primers to areas of bond; do not allow spillage and migration onto exposed surfaces.

3.03. INSTALLATION

- A. General - Install materials in manner described in UL Detail and in accordance with manufacturer's instructions, completely closing openings.
- B. Installation
1. Install material at fire rated construction perimeters and openings containing penetrating sleeves, piping, ductwork, conduit and other items, requiring firestopping.
 2. Apply primer where recommended by manufacturer for type of firestopping material and substrate involved, and as required for compliance with required fire ratings.
 3. Apply firestopping material in sufficient thickness to achieve required fire and smoke rating, to uniform density and texture.
 4. Fire Rated Surface
 - a. Seal opening at floor, wall, partition, and roof as follows:
 - 1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - 2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - 3) Pack void with backing material.
 - 4) Seal ends of sleeve with UL listed fire resistive silicone compound to meet fire rating of structure penetrated.

- b. Where cable tray, conduit, wireway, and trough penetrates fire-rated surface, install firestopping product in accordance with manufacturer's instructions.
5. Non-Rated Surfaces
- a. Seal opening through non-fire rated wall, floor, ceiling, and roof opening as follows:
 - 1) Install sleeve through opening and extending beyond minimum of 1 inch on both sides of building element.
 - 2) Size sleeve allowing minimum of 1 inch void between sleeve and building element.
 - 3) Install type of firestopping material recommended by manufacturer.
 - b. Install floor plates or ceiling plate where conduit, penetrates non-fire rated surfaces in occupied spaces. Occupied spaces include rooms with finished ceilings and where penetration occurs below finished ceiling.
 - c. Exterior Wall Openings Below Grade - Assemble rubber links of mechanical seal to size of conduit and tighten in place, in accordance with manufacturer's instructions.
 - d. Interior Partitions - Seal pipe penetrations at telecommunication rooms and data rooms. Apply sealant to both sides of penetration to completely fill annular space between sleeve and conduit.
- C. Identification - Identify through-penetration firestop systems with preprinted metal or plastic labels. Attach labels permanently to surfaces adjacent to and within 6 inches of edge of the firestop systems so that labels will be visible to anyone seeking to remove penetrating items or firestop systems. Use mechanical fasteners for metal labels. For plastic labels, use self-adhering type with adhesives capable of permanently bonding labels to surfaces on which labels are placed and, in combination with label material, will result in partial destruction of label if removal is attempted. Include the following information on labels:
- 1. The words "Warning - Through-Penetration Fire-Stop System - Do Not Disturb. Notify Building Management of Any Damage."
 - 2. Date of installation.
 - 3. Through-penetration firestop system manufacturer's name.
- 3.04. CLEANING AND PROTECTION
- A. Clean off excess fill materials adjacent to openings as work progresses by methods and with cleaning materials that are approved in writing by through-penetration firestop system manufacturers and that do not damage materials in which openings occur.
 - B. Provide final protection and maintain conditions during and after installation that ensure that through-penetration firestop systems are without damage or deterioration at time of Substantial Completion. If, despite such protection, damage or deterioration occurs, cut out and remove damaged or

deteriorated through-penetration firestop systems immediately and install new materials to produce systems complying with specified requirements.

END OF SECTION

SECTION 16201
EQUIPMENT WIRING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Electrical connections to equipment.

1.02. RELATED REQUIREMENTS

- A. Section 16110 – CONDUIT
- B. Section 16120 - LOW VOLTAGE ELECTRICAL POWER CONDUCTORS AND CABLES
- C. Section 16130 – BOXES
- D. Section 16140 - WIRING DEVICES
- E. Section 16442 - ENCLOSED SWITCHES

1.03. REFERENCE STANDARDS

- A. NEMA WD 1 - General Color Requirements for Wiring Devices; 1999 (R 2010).
- B. NEMA WD 6 - Wiring Devices - Dimensional Specifications; 2012.
- C. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Obtain and review shop drawings, product data, manufacturer's wiring diagrams, and manufacturer's instructions for equipment furnished under other sections.
 - 2. Determine connection locations and requirements.
- B. Sequencing
 - 1. Install rough-in of electrical connections before installation of equipment is required.
 - 2. Make electrical connections before required start-up of equipment.

1.05. SUBMITTALS

- A. Product Data - Provide wiring device manufacturer's catalog information showing dimensions, configurations, and construction.

- B. Manufacturer's Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Products - Listed, classified, and labeled as suitable for the purpose intended.

PART 2 PRODUCTS

2.01. MATERIALS

- A. Cords and Caps - NEMA WD 6; match receptacle configuration at outlet provided for equipment.
 - 1. Colors - Conform to NEMA WD 1.
 - 2. Cord Construction - NFPA 70, Type SO, multiconductor flexible cord with identified equipment grounding conductor, suitable for use in damp locations.
 - 3. Size - Suitable for connected load of equipment, length of cord, and rating of branch circuit overcurrent protection.
- B. Disconnect Switches - As specified in Section 16442, Enclosed Switches, and in individual equipment sections.
- C. Flexible Conduit - As specified in Section 16110, Conduit.
- D. Wire and Cable - As specified in Section 16120, Low Voltage Electrical Power Conductors and Cables.
- E. Boxes - As specified in Section 16130, Boxes.

2.02. EQUIPMENT CONNECTIONS

- A. Provide as indicated on the Contract Drawings.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that equipment is ready for electrical connection, wiring, and energization.

3.02. ELECTRICAL CONNECTIONS

- A. Make electrical connections in accordance with equipment manufacturer's instructions.

- B. Make conduit connections to equipment using flexible conduit. Use liquidtight flexible conduit with watertight connectors in damp or wet locations.
- C. Connect heat producing equipment using wire and cable with insulation suitable for temperatures encountered.
- D. Provide receptacle outlet to accommodate connection with attachment plug.
- E. Provide cord and cap where field-supplied attachment plug is required.
- F. Install suitable strain-relief clamps and fittings for cord connections at outlet boxes and equipment connection boxes.
- G. Install disconnect switches, controllers, control stations, and control devices to complete equipment wiring requirements.
- H. Install terminal block jumpers to complete equipment wiring requirements.
- I. Install interconnecting conduit and wiring between devices and equipment to complete equipment wiring requirements.

END OF SECTION

SECTION 16250

EQUIPMENT FOR HAZARDOUS LOCATIONS

PART 1 GENERAL

1.01. RELATED WORK

- A. Basic materials and methods.

1.02. QUALITY CONTROL

- A. Product Quality Control

1. Manufacturers shall fabricate their products in such a manner that all criteria for appearance, fit and tolerances shall be complied with.
2. Each manufacturer shall carefully control his operations to ensure that the engineering, quality, safety and reliability of product are achieved.

1.03. SUBMITTALS

- A. Product Data - Submittals are required for the products contained within this section, including:
 1. List of materials to be used.
 2. Catalog cuts of all materials and equipment.

PART 2 PRODUCTS

2.01. MATERIALS

- A. Basic Electrical Materials - Those products such as conduit, wire, connectors, cable, support devices, fasteners, and similar devices, as required for work of this section are specified elsewhere.

2.02. GENERAL REQUIREMENTS

- A. Provide equipment, fittings and wiring indicated for installation within the tunnels or airshafts referenced on the Drawings, which are approved by the NEC for Class I, Divisions 1 and 2, Group D as specifically designed for this type of hazardous use.
- B. Engage at least five full threads on conduit connections to couplings and fitting hubs. Coat threads with sealing compound to make connections gastight. Sealing fittings shall be properly installed at all required locations in accordance with code regulations.
- C. All wiring methods to be in compliance with NEC Article 500.

2.03. CONDUIT SEAL-OFF FITTINGS

- A. Provide conduit seal-off fittings on conduit runs entering or leaving the areas referenced on the Drawings as being hazardous.
- B. Fittings shall conform to the classification as defined by the NEC Article 500 as being Class I, Divisions 1 and 2, Group D.
- C. Acceptable Manufacturers
 - 1. Crouse Hinds Type EYS.
 - 2. Russell Stoll.
 - 3. Appleton Electric Company.
 - 4. Approved equal.

2.04. CONDUIT UNIONS

- A. Conduit unions shall conform to Types UNF/UNY as manufactured by the Crouse-Hinds Company or equal. Contractor to install a union fitting within 6 inches of each required seal-off fitting. All requirements to be per NEC.

2.05. FLEXIBLE COUPLINGS

- A. Flexible couplings shall conform to Types ECLK/ECGJH as manufactured by the Crouse-Hinds Company or equal. Actual length of coupling shall be determined by job conditions.

2.06. EXPANSION JOINTS

- A. Expansion joints shall conform to Types UNF/UNY as manufactured by the Crouse-Hinds Company or equal.

2.07. JUNCTION BOXES

- A. Junction boxes for suspended type conduit runs shall conform to Type GUA as manufactured by the Crouse-Hinds Company or equal. Junction boxes for surface mounted conduit runs shall conform to Type GUJ as manufactured by the Crouse-Hinds Company or approved equal.

2.08. PULLBOXES

- A. Pullboxes shall conform to Type EXB as manufactured by the Appleton Electric company or equal. Body of each pullbox shall be provided with the proper size and number of drilled and tapped conduit openings. Size of each pullbox shall be as per installation and NEC requirements.

2.09. SWITCHES, RECEPTACLES, AND FITTINGS

- A. Such devices shall comply with the appropriate section. In addition, install said devices in the proper type of surface mounted enclosure.

1. Local Control Lighting Switch - Refer to appropriate section.
2. Standard-Type Receptacles - Provide receptacles rated 20 amps, 125 volt, 2 poles, 3 wires, and of the heavy duty delayed action, circuit breaking, and grounding type. Provide surface mounted, angle configuration design receptacles having a cover flap with the enclosure. Provide a matching male plug with each outlet.

B. Acceptable Manufacturers

1. Crouse-Hinds.
2. Russell Stoll.
3. Appleton Electric Company.
4. Or approved equal.

2.10. CORD CONNECTORS

- A. Cord connectors shall be sized accordingly and shall be suitable for passing a cord into a rigid conduit from a Class I, Divisions 1 and 2, Group D Hazardous environment. All cord connectors shall have a wire mesh strain relief mechanism.

PART 3 EXECUTION

3.01. INSPECTION

- A. Carefully investigate the structural and finish condition, as well as other construction work which may affect the work of this section. Arrange electrical work accordingly and furnish such fittings and apparatus as required to accommodate such conditions and to preserve access to other equipment, rooms, areas, etc.
- B. Prior to performance of work described above, make detailed drawings of proposed departures from original design due to field conditions or other cause, and submit for Engineer's approval.
- C. Inspect installed conduit and remove obstructions. Conduits shall be blown out and mandreled to remove dirt and debris as applicable.

3.02. PREPARATION

- A. Field Measurement - The Contract Drawings are generally indicative of the work, but due to their small scale, it is not possible to indicate all offsets, fittings, and apparatus required nor the minor structural obstructions that may be encountered.
- B. Obtain roughing-in dimensions of electrically operated equipment being installed in other construction work. Set conduit and boxes only after receiving approved dimensions and checking such equipment locations.

- C. Layout electrical work to suit actual field measurements and according to accepted trade standard practice. However, electrical installations shall conform to NEC 500 for wiring methods general requirements, and to all other applicable Articles of the NEC governing methods of wiring.

3.03. INSTALLATION

- A. Methods of Wiring - In general, fabricate conduit systems in accordance with accepted trade standard practice. The following installation requirements are in addition to requirements set forth in Articles 501 of the NEC, and are included to complement same.
 - 1. Cut conduits and raceways square and deburr cuts to the same degree as cuts made by the material manufacturer. Ream cuts of conduits per NEC requirements with openings not restricted more than cuts made by the material manufacturer.
 - 2. Consult conduit specification for additional information on requirements for conduit installation throughout the area.
 - 3. Wiring in Hazardous Locations as indicated on the Drawings shall conform to Article 501, Class I, Divisions 1 and 2, Group D hazardous locations of the NEC, as applicable, and to the following:
 - a. Use RMC conduit with threaded explosion proof joints, and explosionproof boxes and fittings at these locations. Make up threaded joints with at least five full threads engaged.
 - b. Seal conduit entering or leaving the hazardous areas with approved sealing fittings at the point where they enter or leave the hazardous area.
 - c. Splices and taps shall not be made in sealing conduits; (they are not acceptable design for such purpose); neither shall splices or taps in other conduits be covered by compound.
 - d. In order to remove the accumulation of water from the conduit system, grade the conduit away from the sealing fittings. Provide drain fittings at the lowest point in the system.
- B. Wiring - Install wiring in conduit (PVC Coated RGS), unless indicated otherwise on the Drawings and as specified.

3.04. ANCHOR AND FASTENER INSTALLATIONS

- A. Auxiliary Support Structure Fabrication - Insofar as possible, fit and shop assemble fabrications and make ready for field installation.
 - 1. Drill or punch holes as required for attachment of work and for bolted connections. Burned holes are not acceptable.
 - 2. Dress welds smooth and free of sharp edges and corners.
- B. Threaded Bolts - Draw threaded bolted connections uptight using 316 stainless steel lock washers to prevent bolt or nut loosening.

- C. Drilled-In Epoxy or Adhesive Anchor Installation - As specified.

END OF SECTION

SECTION 16301

UNDERGROUND ELECTRICAL WORK

PART 1 GENERAL

1.01. DESCRIPTION:

- A. Under this section, the Contractor shall furnish all labor, materials and equipment for underground electrical work, as shown on the plans, as specified, and/or directed.

1.02. REFERENCES:

- A. The publications listed below and their latest revisions form a part of this specification. Adhere to applicable sections of the following publications:
1. American National Standards Institute (ANSI) Publications.
 2. American Society for Testing and Materials (ASTM) Publications
 3. Institute of Electrical and Electronics Engineers (IEEE) Publications.
 4. National Fire Protection Association (NFPA) Publications:
 5. American Concrete Institute (ACI) Publications:
 6. Underwriters Laboratories (UL)
 7. National Electrical Manufacturer's Association (NEMA) Publications
- B. General Requirements - Section 16055, Basic Electrical Requirements, applies to this section with additions and modifications specified herein.
- C. Underground Service - Terminate underground service into buildings at a point 5 feet outside the building and projections thereof, except that service conductors shall be continuous to the interior terminating point indicated. Protect ends of underground conduit with threaded metal caps until connections are made.
- D. Submittals
1. Shop Drawings (S) or Manufacturer's Data (M)
 - a. Conduit (M).
 - b. Splice box (M).
 - c. Insulating tape (M).
 - d. Hand hole frame and cover (M).
 - e. Cable lubricants (M).

- f. Sealing materials for handhole joints (M).
2. Manufacturer's Instructions
 - a. Manufacturer's directions for use of ground megger with proposed method indicated.
 - b. Terminator manufacturer's installation instructions.
3. Certificates of Compliance.
4. Materials and Equipment - Provide manufacturer's statement certifying that the product supplied meets or exceeds contracts requirements.
 - a. Precast hand-holes and accessories.

PART 2 PRODUCTS

2.01. MATERIALS AND EQUIPMENT

- A. Provide materials and equipment listed by UL or approved by Factory Mutual (FM) system when such equipment is listed or approved.
 1. Conduit (also reference Section 16110, Conduit, for additional requirements) - Shall be as indicated on the Contract Drawings Raceway Schedule conforming to the following:
 - a. Rigid galvanized steel conduit and fittings shall conform to the requirements of UL 6 and UL 1242, for threaded type, respectively, and shall be coated with a polyvinyl chloride (PVC) sheath bonded to the galvanized exterior surface, nominal 40 mils thick, conforming to NEMA RN 1, Type A40, except that hardness shall be nominal 85 Shore A durometer, dielectric strength shall be minimum 400 volts per mil at 60 Hz, tensile strength shall be minimum 3,500 psi, and aging shall be minimum 1,000 hours in an Atlas Weatherometer.
 - b. Plastic conduit for direct burial shall be PVC conforming to NEMA TC 2 (conduit) and NEMA TC 3 (fittings). Type shall be as indicated on Contract Drawings.
 - c. Plastic Insulating Tape - UL 510.
 - d. Outlet boxes for use with rigid or flexible steel conduit shall be cast metal cadmium or zinc coated if of ferrous metal with gasketed closures and shall conform to UL 514A. Fittings for steel conduit and outlet boxes shall conform to UL 514B.
 - e. Refer to Section 16110, Conduit, for additional requirements/information.
 2. Wire and Cable
 - a. Wire and cable conductor sizes are designated by American Wire Gauge (AWG) and Thousands of Circular Mils (MCM). Conductor and conduit sizes indicated are for copper conductors, unless otherwise noted. Insulated conductors shall bear the date of manufacture imprinted on the wire insulation with other identification. Wire and cable manufactured more than 24 months before delivery to the job site shall not be used.

- b. Conductors rated 600 volts and less, including service entrances, shall conform to UL 854, Type USE-2 or THWN-2. Conductor size and number of conductors in each cable shall be as indicated. Cable shall be color coded. Conductor identification shall be provided within each enclosure where a tap, splice, or termination is made. Conductor identification shall be by color-coded insulated conductors, plastic-coated self-sticking printed markers, colored nylon cable ties and plates, or heat shrink type sleeves. Control circuit terminations shall be properly identified.
- c. Shielded control wire shall be direct burial rated, insulated twisted pair #16 copper conductors with braid or tape shields, number of pairs per cable as scheduled on the Contract Drawings.
- d. Pull Wire - Shall be plastic, having a minimum tensile strength of 200 lbs.
- e. Connectors and Terminals - Shall be designed and approved for use with the associated conductor material, and shall provide a uniform compression over the entire contact surface. Solderless terminal lugs shall be used on stranded conductors.
- f. Grounding and Bonding Equipment - UL 467. Ground rods shall be copperweld-type copper-clad steel with diameter adequate to permit driving to full length of the rod, but not less than 3/4 inch in diameter and 10 feet long unless otherwise indicated.
- g. Refer to additional specification sections for additional requirements/ information.

PART 3 EXECUTION

3.01. INSTALLATION

- A. Underground installation shall conform to ANSI C2 and NFPA 70 except as otherwise specified or indicated.
 - 1. Contractor Damage - The Contractor shall promptly repair any indicated utility lines or systems damaged by Contractor operations. Damage to lines or systems not indicated, which are caused by Contractor operations, shall be treated as "Changes" under the terms of the General Provisions of the contract. If the Contractor is advised in writing of the location of a non-indicated line or system, such notice shall provide that portion of the line or system with "indicated" status in determining liability for damages. In any event, the Contractor shall immediately notify the Engineer of any such damage.
 - 2. Underground Ducts Without Concrete Encasement - Conduits shall be per the Raceway Schedule on the Contract Drawings.
 - 3. The top of the conduit shall be not less than 24 inches below grade, shall have a minimum slope of 3 inches in each 100 feet away from buildings and toward manholes and other necessary drainage points, and shall run in straight lines except where a change of direction is necessary. As each conduit run is completed, a testing mandrel not less than 12 inches long with a diameter 1/4 inch less than the inside diameter of the conduit shall be drawn through each conduit, after which a stiff bristled brush shall be drawn through until the conduit is clear of earth, sand, or gravel particles. Conduit plugs shall then immediately be installed. Ensure a minimum 3 inch clearance from the conduit to each side of the trench. Grade the bottom of the trenches smooth; where rock, soft spots, or sharp edged materials are encountered, excavate

- the bottom for an additional 3 inches; fill with sand or earth, free from particles that would be retained on a 1/4-inch sieve; and tamp level with the original bottom.
4. Under roads and paved areas, install conduits in reinforced concrete encasement of rectangular cross section providing a minimum of 3 inch concrete cover around ducts. The concrete encasement shall extend at least 5 feet beyond the edges of paved areas and roads.
 5. Separate multiple conduits with a minimum concrete thickness of 2 inches, except that light and power conduits shall be separated from control, signal, and telephone conduits by a minimum distance of 3 inches. Stagger the joints of the conduits by rows and layers to strengthen the conduit assembly. Provide plastic duct spacers that interlock vertically and horizontally. Spacer assembly shall consist of base spacers, intermediate spacers, and top spacers to provide a completely enclosed and locked in conduit assembly. Install spacers per manufacturer's instructions, but provide a minimum of two spacer assemblies per 10 feet of conduit assembly.
 6. Ductbanks, except at conduit risers, with changes in direction of runs exceeding a total of 10 degrees, either vertical or horizontal, shall be accomplished by long sweep bends having a minimum radius of curvature of 25 feet; sweep bends may be composed of one or more curved or straight sections or combinations thereof. Manufactured bends shall have a minimum radius of 24 inches for use with conduits of less than 3 inches in diameter and a minimum radius of 36 inches for ducts of 3 inches in diameter and larger. Excavate trenches along straight lines.
 7. New conduit indicated as being unused or empty shall be provided with plugs on each end. Plugs shall contain a weep hole or screen to allow water drainage. Provide a plastic pull rope having 3 feet of slack at each end of unused or empty conduits.
 8. Underground Conduit for Service Into Buildings - Shall be rigid steel from the service equipment to a point 5 feet beyond the building and projections thereof. Protect the ends of the conduit by threaded metal caps or bushings; coat the threads with graphite grease or other coating. Clean and plug conduit until conductors are installed.
 9. Concrete for Electrical Requirements - Shall be composed of fine and coarse aggregate, Portland cement, and water proportioned and mixed to produce a plastic, workable mixture. Fine aggregate shall be of hard, dense, durable, clean, and uncoated sand. The coarse aggregate shall be 3/16 inch to 1 inch size. The fine and coarse aggregates shall not contain dirt, vegetable matter, soft fragments, or other deleterious substances. Water shall be fresh, clean, and free from salts, alkali, organic matter, and other impurities. Concrete shall be 3000 psi minimum ultimate 28-day compressive strength. Slump shall not exceed 4 inches. Retempering of concrete will not be permitted. Exposed, unformed concrete surfaces shall be given a smooth, wood float finish. Concrete shall be cured for a period of not less than seven days, and concrete made with high early strength Portland cement shall be repaired by patching honeycombed or otherwise defective areas with cement mortar as directed. Air entrain concrete exposed to weather using an air entraining admixture conforming to ASTM C260. Air content shall be between 4 and 6 percent.
 10. Buried Utility Warning and Identification Tape - Provide detectable aluminum foil plastic backed tape or detectable magnetic plastic tape manufactured specifically for warning and identification of buried cable and conduit. Tape shall be detectable by an electronic detection instrument. Provide tape in rolls, 2 inches minimum width, color coded for the utility involved

with warning and identification imprinted in bold black letters continuously and repeatedly over entire tape length. Warning and identification shall be "CAUTION BURIED ELECTRIC CABLE BELOW" or similar. Use permanent code and letter coloring unaffected by moisture and other substances contained in trench backfill material. Bury tape with the printed side up at a depth of 12 inches below the top surface of earth or the top surface of the subgrade under pavements.

11. Unpaved surfaces disturbed during the installation of duct or direct burial cable shall be restored to the original elevation and condition. Sod or topsoil shall be preserved carefully and replaced after the backfilling is completed. Replace damaged sod with sod of equal quality. Where the surface is disturbed in a newly seeded area, the disturbed surface shall be reseeded with the same quantity and formula of seed as that used in the original seeding.
12. Paving Repairs - Where trenches, pits, or other excavations are made in existing roadways and other areas of pavement where surface treatment of any kind exists, such surface treatment or pavement shall be restored to the same thickness and in the same kind as previously existed, except as otherwise specified, and to match and tie into the adjacent and surrounding existing surfaces in a neat and acceptable manner.
13. Cable Pulling - Test existing ducts with a mandrel and thoroughly swab out to remove foreign material before the pulling of cables. Cable lubricants shall be soapstone, graphite, or talc for rubber or plastic jacketed cables. Cable pulling tensions shall not exceed the maximum pulling tension recommended by the cable manufacturer. Do not exceed the specified cable bending radii when installing cable under any conditions, including turnups into switches, transformers, switchgear, switchboards, and other enclosures. Cable with tape shield shall have a bending radius not less than 12 times the overall diameter of the completed cable. Cable with wire shield shall have a bending radius not less than eight times the overall diameter of the completed cable. If basket grip type cable pulling devices are used to pull cable in place, cut off the section of cable under the grip before splicing and terminating.
14. Secondary cable runs, 600 volts and less, shall include an insulated copper equipment grounding conductor sized as required by the rating of the overcurrent device supplying the phase conductors.
15. Excavating, Backfilling, and Compacting - Excavate to depths indicated. If hard material is encountered, the provisions of the contract respecting an adjustment for changed conditions shall apply, subject to the requirements of notification thereunder being given. Hard material shall be defined as solid rock; firmly cemented unstratified masses; conglomerate deposits possessing the characteristics of solid rock not ordinarily removed without systematic drilling and blasting; or any boulder, masonry, or concrete (except pavement) exceeding 1/2 cubic yard in volume.
16. Excavated materials not required or suitable for backfill shall be removed from the project site. Provide sheeting and shoring as necessary for protection of work and safety of personnel. Remove water from excavation by pumping or other approved method.
17. Backfilling around structures shall consist of earth, loam, sand clay, or sand and gravel, free from large clods of earth or stones over 1 inch in size. Backfill materials shall be placed symmetrically on all sides in loose layers not more than 9 inches deep. Each layer shall be moistened, if necessary, and compacted with mechanical or hand tampers to 90 percent compaction.

18. Backfilling Around Hand-holes - Provide excavation and backfilling include minimum 6-inch gravel base under the handhole assembly with the gravel 3 to 4 inches wider than the sides of the handhole. (Internal bracing may be warranted for any manufacturer's underground enclosure if 95 percent compaction is required or if heavy vehicles are going to be present during construction and/or throughout the life of the enclosure. See manufacturer recommended practices and instruction including applicable sizes that would require internal bracing.)
19. Backfilling Trenches - Place backfill in layers not more than 6 inches thick, and compact each layer. Backfilling shall progress as rapidly as the construction, testing, and acceptance of the work permits. Backfill shall be free from roots, wood scrap material, and other vegetable matter and refuse. Compaction of backfill shall be to 90 percent of ASTM D698 density. The first layer shall be earth or sand, free from particles that would be retained on a 1/4-inch sieve and extending not less than 3 inches above the top of the conduit or cables. The succeeding layers shall be excavated material having stones no larger than would pass through a 4-inch ring. The backfill may be moistened. The backfill shall be level with the adjacent surface, except that in sodded areas, leave a space equal to the thickness of the sod.
20. Splices for 600 Volt Class Cables - Splices in underground systems shall be made only in accessible locations such as hand holes, using a compression connector on the conductor and by insulating and waterproofing by one of the following methods suitable for continuous submersion in water.
 - a. Cast-type splice insulation shall be provided by means of a molded casting process employing a thermosetting epoxy resin insulating material which shall be applied by a gravity poured method or by a pressure injected method. The component materials of the resin insulation shall be in a packaged form ready for convenient mixing without removing from the package. Do not allow the cables to be moved until after the splicing material has completely set.
 - b. Gravity poured method shall employ materials and equipment contained in an approved commercial splicing kit which includes a mold suitable for the cables to be spliced. When the mold is in place around the joined conductors, prepare and pour the resin mix into the mold. Do not allow cables to be moved until after the splicing materials have completely set.
21. Grounding - Noncurrent carrying metallic parts associated with electrical equipment shall have a maximum resistance to solid earth ground not exceeding values established within the IEEE Green Book: Where values are not listed within the IEEE Green Book, resistance to solid earth ground shall not exceed 25 ohms.
22. Grounding electrodes shall be cone pointed ground rods, driven full depth plus 6 inches, installed when indicated to provide an earth ground of the appropriate value for the equipment being grounded.
23. Grounding connections which are buried or otherwise normally inaccessible, and excepting specifically those connections for which access for periodic testing is required, shall be made by exothermic weld or compression connector. Exothermic welds shall be made strictly in accordance with the weld manufacturer's written recommendations. Welds which are "puffed up" or which show convex surfaces, indicating improper cleaning, are not acceptable. Mechanical connectors are not required at exothermic weldments. Compression connector

shall be the type which uses a hydraulic compression tool to provide the correct circumferential pressure. Tools and dies shall be as recommended by the manufacturer. An embossing die code or other standard method shall provide visible indication that a connector has been adequately compressed on the ground wire.

24. Grounding conductors shall be stranded bare copper conforming to ASTM B8, Class B, for sizes No. 6 AWG and larger, and shall be solid bare copper conforming to ASTM B1 for sizes No. 8 and smaller. Surge arresters shall be grounded to ground rods with No. 4 AWG.
25. Special Conditions - During the construction of duct banks located in streets, the streets shall remain open to traffic. Plan and execute the work to meet this condition.
26. Field Tests - As an exception to requirements that may be stated elsewhere in the Contract, notify the Engineer in writing at least five working days prior to each test. Furnish labor, equipment, and incidentals required for testing, except that the Owner will provide electric power required for the tests. Correct defects in the work provided by the Contractor and repeat tests until the work is in compliance with contract requirements. Show by demonstration in service that circuits and devices are in good operating condition. Tests shall be such that each item of control equipment will function not less than five times.
27. Distribution Conductors 600 Volt Class - After wiring is completed and connected ready for operation, but prior to placing systems in service and before any branch circuit breakers are closed, perform insulation resistance tests in all circuits. Measure the insulation resistance between conductors and between each conductor and ground. Use an instrument capable of making measurements at an applied potential of 500 volts. Take readings after the voltage has been applied for a minimum of 1 minute. The minimum insulation resistance for circuits of No. 12 AWG conductors shall be 1,000,000 ohms.
28. Ground Rods - Test ground rods for ground resistance value before any wire is connected. Perform ground resistance measurements in normally dry weather, not less than 48 hours after rainfall. Ground resistance shall also be measured for each piece of equipment to the ground electrode. Use a portable ground testing megger to test each ground or group of grounds. The instrument shall be equipped with a meter reading directly in ohms or fractions thereof to indicate the ground value of the ground electrode under test. Provide one copy of the ground megger manufacturer's directions, indicating the method to be used.
29. Compaction - Backfill shall be tested in accordance with ASTM D1556, one test per lift per 2,000 square feet.

END OF SECTION

SECTION 16442
ENCLOSED SWITCHES

PART 1 GENERAL

1.01. RELATED REQUIREMENTS

- A. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- B. Section 16191 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- C. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.
- D. Section 16060 - POWER SYSTEM ANALYSIS: Additional criteria for the selection of equipment and associated protective devices specified in this section.
- E. Section 16448 - FUSES

1.02. REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NEMA KS 1 - Heavy Duty Enclosed and Dead-Front Switches (600 Volts Maximum); 2013.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.
- G. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- H. UL 98 - Enclosed and Dead-Front Switches; Current Edition, Including All Revisions.
- I. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.

1.03. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate the work with other trades. Avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and within working clearances for electrical equipment required by NFPA 70.

2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Engineer of any conflicts with or deviations from the Contract Documents. Obtain direction before proceeding with work.

1.04. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for enclosed switches and other installed components and accessories.
- B. Field Quality Control Test Reports.
- C. Project Record Documents - Record actual locations of enclosed switches.
- D. Maintenance Data - Include information on replacement parts and recommended maintenance procedures and intervals.

1.05. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Maintain at the project site a copy of each referenced document that prescribes execution requirements.
- C. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years documented experience.

1.06. DELIVERY, STORAGE, AND HANDLING

- A. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- B. Handle carefully in accordance with manufacturer's written instructions to avoid damage to enclosed switch internal components, enclosure, and finish.

1.07. FIELD CONDITIONS

- A. Maintain ambient temperature between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C) during and after installation of enclosed switches.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Eaton Corporation - www.eaton.com.

- B. Source Limitations - Furnish enclosed switches and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02. ENCLOSED SAFETY SWITCHES

- A. Description - Quick-make, quick-break enclosed safety switches listed and labeled as complying with UL 98; heavy duty; ratings, configurations, and features as indicated on the Drawings.
- B. Provide products listed, classified, and labeled as suitable for the purpose intended.
- C. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude - Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature: Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- D. Horsepower Rating - Suitable for connected load.
- E. Voltage Rating - Suitable for circuit voltage.
- F. Short Circuit Current Rating
 - 1. Provide enclosed safety switches, when protected by the fuses or supply side overcurrent protective devices to be installed, with listed short circuit current rating not less than the available fault current at the installed location as indicated on the drawings.
 - 2. Minimum Ratings
 - a. Switches Protected by Class H Fuses - 100,000 rms symmetrical amperes.
 - b. Heavy Duty Single Throw Switches Protected by Class R, Class J, Class L, or Class T Fuses - 200,000 rms symmetrical amperes.
- G. Enclosed Safety Switches Used for Service Entrance - Listed and labeled as suitable for use as service equipment according to UL 869A.
- H. Provide with switch blade contact position that is visible when the cover is open.
- I. Fuse Clips for Fusible Switches - As required to accept fuses indicated.
 - 1. Where NEMA Class R fuses are installed, provide rejection feature to prevent installation of fuses other than Class R.
- J. Conductor Terminations - Suitable for use with the conductors to be installed.
- K. Provide insulated, groundable fully rated solid neutral assembly where a neutral connection is required, with a suitable lug for terminating each neutral conductor.

- L. Provide solidly bonded equipment ground bus in each enclosed safety switch, with a suitable lug for terminating each equipment grounding conductor.
- M. Enclosures - Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: As indicated on the Drawings.
 - 2. Finish for Painted Steel Enclosures - Manufacturer's standard, factory applied grey unless otherwise indicated.
- N. Provide safety interlock to prevent opening the cover with the switch in the On position with capability of overriding interlock for testing purposes.
- O. Heavy Duty Switches
 - 1. Comply with NEMA KS 1.
 - 2. Conductor Terminations
 - a. Lug Material - Aluminum, suitable for terminating aluminum or copper conductors.
 - 3. Provide externally operable handle with means for locking in the Off position, capable of accepting three padlocks.
- P. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Auxiliary Switch - SPDT switch suitable for connection to system indicated, with auxiliary contact operation before switch blades open and after switch blades close.
- Q. Contractor is responsible for providing all necessary mounting hardware/equipment. All mounting hardware/equipment to be provided as stainless steel.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings of the enclosed switches are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive enclosed safety switches.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Install products in accordance with manufacturer's instructions.

- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Provide required supports in accordance with Section 16191, Hangers and Supports For Electrical Systems.
- E. Install enclosed switches plumb.
- F. Except where indicated to be mounted adjacent to the equipment they supply, mount enclosed switches such that the highest position of the operating handle does not exceed 79 inches (2000 mm) above the floor or working platform.
- G. Provide grounding and bonding in accordance with Section 16100, Grounding and Bonding For Electrical Systems.
- H. Provide fuses complying with Section 16448, Fuses, for fusible switches as indicated or as required by equipment manufacturer's recommendations.
- I. Identify enclosed switches in accordance with Section 16196, Identification For Electrical Systems.
- J. Disconnect locations not always shown on plan. Contractor to install disconnect (safety switch) adjacent to unit, unless otherwise indicated. Installation to comply with NEC Article 110.26. Contractor is responsible for providing all necessary stainless steel mounting hardware/equipment. Coordinate final switch locations with Owner and Engineer prior to rough-in. Typical.

3.03. FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS, Section 7.5.1.1.
- C. Correct deficiencies and replace damaged or defective enclosed safety switches or associated components.

3.04. ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.

3.05. CLEANING

- A. Clean dirt and debris from switch enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 16448

FUSES

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Fuses.

1.02. RELATED REQUIREMENTS

- A. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS - Identification products and requirements.
- B. Section 16060 - POWER SYSTEM ANALYSIS: Additional criteria for the selection of protective devices specified in this section.
- C. Section 16442 - ENCLOSED SWITCHES - Fusible switches.

1.03. REFERENCE STANDARDS

- A. NEMA FU 1 - Low Voltage Cartridge Fuses; 2012.
- B. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- C. UL 248-1 - Low-Voltage Fuses - Part 1: General Requirements; Current Edition, Including All Revisions.
- D. UL 248-4 - Low-Voltage Fuses - Part 4: Class CC Fuses; Current Edition, Including All Revisions.
- E. UL 248-10 - Low-Voltage Fuses - Part 10: Class L Fuses; Current Edition, Including All Revisions.
- F. UL 248-12 - Low-Voltage Fuses - Part 12: Class R Fuses; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate fuse clips furnished in equipment provided under other sections for compatibility with indicated fuses.
 - a. Fusible Switches for Switchboards - See Section 16475, Switchboards.
 - b. Fusible Switches for Motor Control Centers - See Section 16486, Motor Control Centers.
 - c. Fusible Enclosed Switches - See Section 16442, Enclosed Switches.

- d. Fusible Switches for Enclosed Motor Controllers - See Section 16484, Enclosed Controllers.
2. Coordinate fuse requirements according to manufacturer's recommendations and nameplate data for actual equipment to be installed.
3. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard data sheets including voltage and current ratings, interrupting ratings, time-current curves, and current limitation curves.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Bussmann, a division of Eaton Corporation - www.cooperindustries.com.
- B. Littelfuse, Inc - www.littelfuse.com.

2.02. APPLICATIONS

- A. Service Entrance
 1. Fusible Switches up to 600 Amperes - Class RK5, time-delay.
 2. Fusible Switches Larger Than 600 Amperes - Class L, time-delay.
- B. Feeders
 1. Fusible Switches up to 600 Amperes - Class RK5, time-delay.
 2. Fusible Switches Larger Than 600 Amperes - Class L, time-delay.
- C. General Purpose Branch Circuits - Class RK1, time-delay.
- D. Individual Motor Branch Circuits - Class RK1, time-delay.
- E. In-Line Protection for Pole-Mounted Luminaires - Class CC, time-delay.

- F. Primary Protection for Control Transformers - Class CC, time-delay.

2.03. FUSES

- A. Provide products listed, classified, and labeled as suitable for the purpose intended.
- B. Unless specifically indicated to be excluded, provide fuses for all fusible equipment as required for a complete operating system.
- C. Provide fuses of the same type, rating, and manufacturer within the same switch.
- D. Comply with UL 248-1.
- E. Unless otherwise indicated, provide cartridge type fuses complying with NEMA FU 1, class and ratings as indicated.
- F. Voltage Rating - Suitable for circuit voltage.
- G. Class R Fuses - Comply with UL 248-12.
- H. Class L Fuses - Comply with UL 248-10.
- I. Class CC Fuses - Comply with UL 248-4.
- J. Selectivity - Where the requirement for selectivity is indicated, furnish products as required to achieve selective coordination.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that fuse ratings are consistent with circuit voltage and manufacturer's recommendations and nameplate data for equipment.
- B. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Do not install fuses until circuits are ready to be energized.
- B. Install fuses with label oriented such that manufacturer, type, and size are easily read.

END OF SECTION

SECTION 16449

SURGE PROTECTIVE DEVICES

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Surge protective devices for branch panelboard locations.

1.02. RELATED REQUIREMENTS

- A. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- B. Section 16470 - PANELBOARDS

1.03. ABBREVIATIONS AND ACRONYMS

- A. SPD - Surge Protective Device.
- B. TVSS - Transient Voltage Surge Suppression

1.04. REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- D. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- E. UL 1449 - Standard for Surge Protective Devices; Current Edition, Including All Revisions.

1.05. SUBMITTALS

- A. Product Data - Include detailed component information, voltage, surge current ratings, repetitive surge current capacity, voltage protection rating (VPR) for all protection modes, maximum continuous operating voltage (MCOV), nominal discharge current (I-n), short circuit current rating (SCCR), connection means including any required external overcurrent protection, enclosure ratings, outline and support point dimensions, weight, service condition requirements, and installed features.
- B. Certificates - Manufacturer's documentation of listing for compliance with the following standards:
 - 1. UL 1449.
- C. Operation and Maintenance Data - Include information on status indicators and recommended maintenance procedures and intervals.

- D. Warranty - Submit sample of manufacturer's warranty and documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Product Listing Organization Qualifications - An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07. WARRANTY

- A. Manufacturer's Warranty - Provide minimum five-year warranty covering repair or replacement of surge protective devices showing evidence of failure due to defective materials or workmanship.
- B. Exclude surge protective devices from any clause limiting warranty responsibility for acts of nature, including lightning, stated elsewhere.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Factory-installed, Internally Mounted Surge Protective Devices - Same as manufacturer of equipment containing surge protective device, to provide a complete listed assembly including SPD.

2.02. SURGE PROTECTIVE DEVICES - GENERAL REQUIREMENTS

- A. Description - Factory-assembled surge protective devices (SPDs) for 60 Hz service; listed, classified, and labeled as suitable for the purpose intended; system voltage as indicated on the Drawings.
- B. Protected Modes
 - 1. Wye Systems - L-N, L-G, N-G, L-L.
- C. UL 1449 Voltage Protection Ratings (VPRs)
 - 1. Equivalent to basis of design.
 - 2. 208Y/120V System Voltage - Not more than 1,000 V for L-N, L-G, and N-G modes and 1,200 V for L-L mode.
- D. UL 1449 Maximum Continuous Operating Voltage (MCOV) - Not less than 115 percent of nominal system voltage.
- E. Enclosure Environment Type per NEMA 250 - As indicated on the Drawings.
- F. Equipment Containing Factory-installed, Internally Mounted SPDs - Listed and labeled as a complete assembly including SPD.

1. Panelboards - See Section 16470, Panelboards.

2.03. SURGE PROTECTIVE DEVICES FOR BRANCH PANELBOARD LOCATIONS

- A. Unless otherwise indicated, provide factory-installed, internally mounted SPDs.
- B. List and label as complying with UL 1449, Type 1 or Type 2.
- C. Provide SPDs utilizing field-replaceable modular or non-modular protection circuits.
- D. Surge Current Rating - Not less than 80 kA per mode/160 kA per phase.
- E. UL 1449 Nominal Discharge Current (I-n) - 20 kA.
- F. UL 1449 Short Circuit Current Rating (SCCR) - Not less than the available fault current at the installed location as indicated on the Drawings.
- G. Diagnostics
 1. Protection Status Monitoring - Provide indicator lights to report the protection status.
 2. Alarm Notification - Provide indicator light and audible alarm to report alarm condition. Provide button to manually silence audible alarm.
 3. Remote Status Monitoring - Provide Form C dry-type contacts (normally open and normally closed) for remote annunciation of status.
- H. Provide surge rated integral disconnect switch for SPDs not connected to a dedicated circuit breaker or fused switch or not direct bus connected.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the service voltage and configuration marked on the SPD are consistent with the service voltage and configuration at the location to be installed.
- C. Verify that electrical equipment is ready to accept connection of the SPD and that installed overcurrent device is consistent with requirements of the Drawings and manufacturer's instructions.
- D. Verify system grounding and bonding is in accordance with Section 16100, Grounding and Bonding For Electrical Systems, including bonding of neutral and ground for service entrance and separately derived systems where applicable. Do not energize SPD until deficiencies have been corrected.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- D. Unless indicated otherwise, connect service entrance surge protective device on load side of service disconnect main overcurrent device.
- E. Provide conductors with minimum ampacity as indicated on the Drawings, as required by NFPA 70, and not less than manufacturer's recommended minimum conductor size.
- F. Install conductors between SPD and equipment terminations as short and straight as possible, not exceeding manufacturer's recommended maximum conductor length. Breaker locations may be reasonably rearranged in order to provide leads as short and straight as possible. Twist conductors together to reduce inductance.
- G. Do not energize SPD until bonding of neutral and ground for service entrance and separately derived systems is complete in accordance with Section 16100, Grounding and Bonding For Electrical Systems, where applicable. Replace SPDs damaged by improper or missing neutral-ground bond.
- H. Disconnect SPD prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPD connected.

3.03. FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Perform inspections and tests listed in NETA ATS Section 7.19.1.

3.04. CLEANING

- A. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 16470

PANELBOARDS

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Power distribution panelboards.
- B. Overcurrent protective devices for panelboards.

1.02. RELATED REQUIREMENTS

- A. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- B. Section 16191 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- C. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.
- D. Section 16060 - POWER SYSTEM ANALYSIS: Additional criteria for the selection and adjustment of equipment and associated protective devices specified in this section.
- E. Section 16449 - SURGE PROTECTIVE DEVICES

1.03. REFERENCE STANDARDS

- A. FS W-C-375 - Circuit Breakers, Molded Case; Branch Circuit and Service; Federal Specification; Revision E, 2013.
- B. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- C. NECA 407 - Standard for Installing and Maintaining Panelboards; 2009.
- D. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- E. NEMA PB 1 - Panelboards; 2011.
- F. NEMA PB 1.1 - General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less; 2013.
- G. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- H. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- I. UL 50 - Enclosures for Electrical Equipment, Non-Environmental Considerations; Current Edition, Including All Revisions.

- J. UL 50E - Enclosures for Electrical Equipment, Environmental Considerations; Current Edition, Including All Revisions.
- K. UL 67 - Panelboards; Current Edition, Including All Revisions.
- L. UL 489 - Molded-Case Circuit Breakers, Molded-Case Switches and Circuit Breaker Enclosures; Current Edition, Including All Revisions.
- M. UL 869A - Reference Standard for Service Equipment; Current Edition, Including All Revisions.
- N. UL 943 - Ground-Fault Circuit-Interrupters; Current Edition, Including All Revisions.
- O. UL 1053 - Ground-Fault Sensing and Relaying Equipment; Current Edition, Including All Revisions.
- P. UL 1699 - Arc-Fault Circuit-Interrupters; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances for electrical equipment required by NFPA 70.
2. Coordinate arrangement of electrical equipment with the dimensions and clearance requirements of the actual equipment to be installed.
3. Verify with manufacturer that conductor terminations are suitable for use with the conductors to be installed.
4. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for panelboards, enclosures, overcurrent protective devices, and other installed components and accessories.
- B. Shop Drawings - Indicate outline and support point dimensions, voltage, main bus ampacity, overcurrent protective device arrangement and sizes, short circuit current ratings, conduit entry locations, conductor terminal information, and installed features and accessories.
 1. Include dimensioned plan and elevation views of panelboards and adjacent equipment with all required clearances indicated.
 2. Include wiring diagrams showing all factory and field connections.
 3. Clearly indicate whether proposed short circuit current ratings are fully rated or, where acceptable, series rated systems.

- C. Source Quality Control Test Reports - Include reports for tests designated in NEMA PB 1 as routine tests.
- D. Field Quality Control Test Reports.
- E. Manufacturer's Installation Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, and installation of product.
- F. Project Record Documents - Record actual installed locations of panelboards and actual installed circuiting arrangements.
- G. Maintenance Data - Include information on replacement parts and recommended maintenance procedures and intervals.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store panelboards in accordance with manufacturer's instructions and NECA 407.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's written instructions to avoid damage to panelboard internal components, enclosure, and finish.

1.08. FIELD CONDITIONS

- A. Maintain ambient temperature within the following limits during and after installation of panelboards:
 - 1. Panelboards Containing Circuit Breakers - Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
 - 2. Panelboards Containing Fusible Switches - Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Eaton Corporation; Cutler-Hammer Products. - www.eaton.com.

- B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. Requests for substitutions shall be made a minimum of 10 days prior to bid date. Manufacturers' catalog data shall accompany each request. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees in order for substitute equipment to meet all applicable codes and design intent.
- C. Source Limitations - Furnish panelboards and associated components produced by the same manufacturer as the other electrical distribution equipment used for this project and obtained from a single supplier.

2.02. PANELBOARDS - GENERAL REQUIREMENTS

- A. Provide products listed, classified, and labeled as suitable for the purpose intended. Refer to the Contract Drawings for additional information.
- B. Unless otherwise indicated, provide products suitable for continuous operation under the following service conditions:
 - 1. Altitude - Less than 6,600 feet (2,000 m).
 - 2. Ambient Temperature
 - a. Panelboards Containing Circuit Breakers - Between 23 degrees F (-5 degrees C) and 104 degrees F (40 degrees C).
 - b. Panelboards Containing Fusible Switches - Between -22 degrees F (-30 degrees C) and 104 degrees F (40 degrees C).
- C. Short Circuit Current Rating - Provide panelboards with listed short circuit current rating not less than the available fault current at the installed location as indicated on the Drawings.
- D. Panelboards Used for Service Entrance - Listed and labeled as suitable for use as service equipment according to UL 869A.
- E. Mains - Configure for top or bottom incoming feed as indicated or as required for the installation.
- F. Branch Overcurrent Protective Devices - Replaceable without disturbing adjacent devices.
- G. Bussing - Sized in accordance with UL 67 temperature rise requirements.
 - 1. Provide fully rated neutral bus unless otherwise indicated, with a suitable lug for each feeder or branch circuit requiring a neutral connection.
 - 2. Provide solidly bonded equipment ground bus in each panelboard, with a suitable lug for each feeder and branch circuit equipment grounding conductor.
 - 3. Provide separate isolated/insulated ground bus where indicated or where isolated grounding conductors are provided.
- H. Conductor Terminations - Suitable for use with the conductors to be installed.

- I. Enclosures - Comply with NEMA 250, and list and label as complying with UL 50 and UL 50E.
 - 1. Environment Type per NEMA 250: As indicated on the drawings.
 - 2. Boxes - Galvanized steel unless otherwise indicated.
 - a. Provide wiring gutters sized to accommodate the conductors to be installed.
 - 3. Fronts
 - a. Fronts for Surface-Mounted Enclosures - Same dimensions as boxes.
 - b. Fronts for Flush-Mounted Enclosures - Overlap boxes on all sides to conceal rough opening.
 - c. Finish for Painted Steel Fronts - Manufacturer's standard grey unless otherwise indicated.
 - 4. Lockable Doors - All locks keyed alike unless otherwise indicated.
- J. Future Provisions - Prepare all unused spaces for future installation of devices including bussing, connectors, mounting hardware and all other required provisions.
- K. Surge Protective Devices - Where factory-installed, internally mounted surge protective devices are provided in accordance with Section 16449, Surge Protective Devices, list and label panelboards as a complete assembly including surge protective device.
- L. Ground Fault Protection - Where ground-fault protection is indicated, provide system listed and labeled as complying with UL 1053.
 - 1. Where electronic circuit breakers equipped with integral ground fault protection are used, provide separate neutral current sensor where applicable.
- M. Multi-Section Panelboards - Provide enclosures of the same height, with feed-through lugs or sub-feed lugs and feeders as indicated or as required to interconnect sections.
- N. Load centers are not acceptable unless specifically specified on the Contract Drawings.
- O. Provide the following features and accessories where indicated or where required to complete installation:
 - 1. Feed-through lugs.
 - 2. Sub-feed lugs.

2.03. POWER DISTRIBUTION PANELBOARDS

- A. Description - Panelboards complying with NEMA PB 1, power and feeder distribution type, circuit breaker type, and listed and labeled as complying with UL 67; ratings, configurations and features as indicated on the drawings.

B. Conductor Terminations

1. Main and Neutral Lug Material - Aluminum, suitable for terminating aluminum or copper conductors.
2. Main and Neutral Lug Type - Mechanical.

C. Bussing

1. Phase and Neutral Bus Material - Copper.
2. Ground Bus Material - Copper.

D. Circuit Breakers

1. Provide bolt-on type.
2. Provide thermal magnetic circuit breakers unless otherwise indicated.
3. Provide electronic trip circuit breakers where indicated.

E. Enclosures

1. Provide surface-mounted enclosures unless otherwise indicated.
2. Fronts - Provide door-in-door trim with hinged cover for access to load terminals and wiring gutters, and separate lockable hinged door with concealed hinges for access to overcurrent protective device handles without exposing live parts.
3. Provide clear plastic circuit directory holder mounted on inside of door.
 - a. Provide typed circuit directory for all proposed panelboards and panelboards in which have had circuit modifications performed. Circuit directories to be labeled with equipment type (not the equipment tag) as indicated on the equipment connection schedule on the Contract Drawings. Coordinate final labeling requirements with the Engineer/Owner.

2.04. OVERCURRENT PROTECTIVE DEVICES

A. Molded Case Circuit Breakers

1. Description - Quick-make, quick-break, over center toggle, trip-free, trip-indicating circuit breakers listed and labeled as complying with UL 489, and complying with FS W-C-375 where applicable; ratings, configurations, and features as indicated on the Drawings.
2. Interrupting Capacity
 - a. Provide circuit breakers with interrupting capacity as required to provide the short circuit current rating as indicated on the Contract Drawings

- b. Fully Rated Systems - Provide circuit breakers with interrupting capacity not less than the short circuit current rating indicated.
3. Conductor Terminations
 - a. Lug Material - Aluminum, suitable for terminating aluminum or copper conductors.
4. Thermal Magnetic Circuit Breakers - For each pole, furnish thermal inverse time tripping element for overload protection and magnetic instantaneous tripping element for short circuit protection.
 - a. Provide field-adjustable magnetic instantaneous trip setting for circuit breaker frame sizes 225 amperes and larger.
5. Electronic Trip Circuit Breakers - Furnish solid state, microprocessor-based, true rms sensing trip units.
 - a. Provide the following field-adjustable trip response settings:
 - 1) Long time pickup, adjustable by replacing interchangeable trip unit or by setting dial.
 - 2) Long time delay.
 - 3) Short time pickup and delay.
 - 4) Instantaneous pickup.
 - 5) Ground fault pickup and delay where ground fault protection is indicated.
6. Multi-Pole Circuit Breakers - Furnish with common trip for all poles.
7. Provide the following circuit breaker types where indicated:
 - a. Ground Fault Circuit Interrupter (GFCI) Circuit Breakers - Listed as complying with UL 943, class A for protection of personnel.
 - b. Ground Fault Equipment Protection Circuit Breakers - Designed to trip at 30 mA for protection of equipment.
 - c. Arc-Fault Circuit Interrupter (AFCI) Circuit Breakers - Combination type listed as complying with UL 1699.
 - d. 100 Percent Rated Circuit Breakers - Listed for application within the panelboard where installed at 100 percent of the continuous current rating.
8. Provide listed switching duty rated circuit breakers with SWD marking where indicated.
9. Do not use handle ties in lieu of multi-pole circuit breakers.
10. Provide multi-pole circuit breakers for multi-wire branch circuits as required by NFPA 70.

11. Provide the following features and accessories where indicated or where required to complete installation:
 - a. Shunt Trip - Provide coil voltage as required for connection to indicated trip actuator.
 - b. Handle Pad-Lock Provision - For locking circuit breaker handle in Off position.

2.05. SOURCE QUALITY CONTROL

- A. Factory test panelboards according to NEMA PB 1.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of the panelboards and associated components are consistent with the indicated requirements.
- C. Verify that mounting surfaces are ready to receive panelboards.
- D. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Install panelboards in accordance with NECA 407 and NEMA PB 1.1.
- D. Arrange equipment to provide minimum clearances in accordance with manufacturer's instructions and NFPA 70.
- E. Provide required supports in accordance with Section 16191, Hangers and Supports For Electrical Systems.
- F. Install panelboards plumb.
- G. Mount panelboards such that the highest position of any operating handle for circuit breakers or switches does not exceed 79 inches (2000 mm) above the floor or working platform.
- H. Mount floor-mounted power distribution panelboards on properly sized 3 inch (80 mm) high concrete pad.
- I. Provide grounding and bonding in accordance with Section 16100, Grounding and Bonding For Electrical Systems.

1. Terminate branch circuit equipment grounding conductors on solidly bonded equipment ground bus only. Do not terminate on isolated/insulated ground bus.
 2. Terminate branch circuit isolated grounding conductors on isolated/insulated ground bus only. Do not terminate on solidly bonded equipment ground bus.
- J. Install all field-installed branch devices, components, and accessories.
- K. Set field-adjustable circuit breaker tripping function settings as determined by overcurrent protective device coordination study performed according to Section 16060, Power System Analysis.
- L. Set field-adjustable ground fault protection pickup and time delay settings as indicated.
- M. Provide filler plates to cover unused spaces in panelboards.
- N. Provide circuit breaker lock-on devices to prevent unauthorized personnel from de-energizing essential loads where indicated.
- O. Identify panelboards in accordance with Section 16196, Identification For Electrical Systems.

3.03. FIELD QUALITY CONTROL

- A. Inspect and test in accordance with NETA ATS, except Section 4.
- B. Molded Case Circuit Breakers - Perform inspections and tests listed in NETA ATS, Section 7.6.1.1 for all main circuit breakers and circuit breakers larger than 400 amperes. Tests listed as optional are not required.
- C. Test GFCI circuit breakers to verify proper operation.
- D. Test AFCI circuit breakers to verify proper operation.
- E. Procure services of a qualified manufacturer's representative to observe installation and assist in inspection, testing, and adjusting. Include manufacturer's reports with field quality control submittals.
- F. Correct deficiencies and replace damaged or defective panelboards or associated components.

3.04. ADJUSTING

- A. Adjust tightness of mechanical and electrical connections to manufacturer's recommended torque settings.
- B. Adjust alignment of panelboard fronts.
- C. Load Balancing - For each panelboard, rearrange circuits such that the difference between each measured steady state phase load does not exceed 20 percent and adjust circuit directories accordingly. Maintain proper phasing for multi-wire branch circuits.

3.05. CLEANING

- A. Clean dirt and debris from panelboard enclosures and components according to manufacturer's instructions.
- B. Repair scratched or marred exterior surfaces to match original factory finish.

END OF SECTION

SECTION 16497

TRANSFER SWITCHES

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Transfer switches for low voltage (600 V and less) applications and associated accessories.
 - 1. Automatic transfer switches.

1.02. RELATED REQUIREMENTS

- A. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- B. Section 16191 - HANGERS AND SUPPORTS FOR ELECTRICAL SYSTEMS
- C. Section 16196 - IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.

1.03. REFERENCE STANDARDS

- A. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- B. NEMA 250 - Enclosures for Electrical Equipment (1000 Volts Maximum); 2014.
- C. NEMA ICS 10 Part 1 - Industrial Control and Systems Part 1 - Electromechanical AC Transfer Switch Equipment; 2005.
- D. NETA ATS - Acceptance Testing Specifications for Electrical Power Equipment and Systems; 2013.
- E. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- F. UL 1008 - Transfer Switch Equipment; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Coordinate compatibility of transfer switch to be installed with owner's existing generator system (installed by Contractor as part of this contract).
 - 2. Coordinate the work with other trades to avoid placement of ductwork, piping, equipment, or other potential obstructions within the dedicated equipment spaces and working clearances required by NFPA 70.
 - 3. Coordinate arrangement of equipment with the dimensions and clearance requirements of the actual equipment to be installed.

4. Coordinate the work with placement of supports, anchors, etc. required for mounting.
5. Notify Engineer of any conflicts with or deviations from the contract documents. Obtain direction before proceeding with work.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets for each product, including ratings, configurations, dimensions, finishes, weights, service condition requirements, and installed features.
- B. Shop Drawings - Include dimensioned plan views and sections indicating locations of system components, required clearances, and field connection locations. Include system interconnection schematic diagrams showing all factory and field connections.
- C. Specimen Warranty - Submit sample of manufacturer's warranty.
- D. Source quality control test reports.
- E. Manufacturer's detailed field testing procedures.
- F. Field quality control test reports.
- G. Executed Warranty - Submit documentation of final executed warranty completed in Owner's name and registered with manufacturer.

1.06. QUALITY ASSURANCE

- A. Comply with the following:
 1. NFPA 70 (National Electrical Code).
- B. Product Listing Organization Qualifications - An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Receive, inspect, handle, and store transfer switches in accordance with manufacturer's instructions.
- B. Store in a clean, dry space. Maintain factory wrapping or provide an additional heavy canvas or heavy plastic cover to protect units from dirt, water, construction debris, and traffic.
- C. Handle carefully in accordance with manufacturer's instructions to avoid damage to transfer switch components, enclosure, and finish.

1.08. FIELD CONDITIONS

- A. Maintain field conditions within manufacturer's required service conditions during and after installation.

1.09. WARRANTY

- A. Provide minimum two-year manufacturer warranty covering repair or replacement due to defective materials or workmanship. Warranty shall cover all parts, labor, and travel expenses.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Transfer Switches Basis of Design – CATERPILLAR.
 - 1. Transfer switch to be service entrance rated as indicated on the Contract Drawings.
 - 2. Transfer switch to be compatible with owner's existing engine generator system. Contractor to field verify existing engine generator system prior to bid.
- B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees.

2.02. AUTOMATIC TRANSFER SWITCHES

- A. Interface with Other Work - Interface with owner's existing engine generators.
 - 1. Demonstrate to owner the complete operation of the transfer switch and generator system.
- B. Provide complete power transfer system consisting of all required equipment, conduit, boxes, wiring, supports, accessories, system programming, etc. as necessary for a complete operating system that provides the functional intent indicated.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Applications
 - 1. Utilize open transition transfer unless otherwise indicated or required.
 - 2. Neutral Switching (Single Phase, Three Wire and Three Phase, Four Wire Systems) - Unless otherwise indicated or required, provide solid (unswitched) neutral.
- E. Construction Type - Either "contactor type" (open contact) or "breaker type" (enclosed contact) transfer switches complying with specified requirements are acceptable.
- F. Ratings/Characteristics:
 - 1. Transfer Switch Type - As indicated on the Drawings.
 - 2. Transition Configuration - As indicated on the Drawings.
 - 3. Voltage - As indicated on the Drawings.
 - 4. Ampere Rating - As indicated on the Drawings.

5. Neutral Configuration - Solid neutral (unswitched), except as indicated.
 6. Load Served - As indicated on the Drawings.
 7. Primary Source - As indicated on the Drawings.
 8. Alternate Source - As indicated on the Drawings.
- G. Comply with NEMA ICS 10 Part 1, and list and label as complying with UL 1008 for the classification of the intended application (e.g. emergency, optional standby).
- H. Do not use double throw safety switches or other equipment not specifically designed for power transfer applications and listed as transfer switch equipment.
- I. Load Classification - Classified for total system load (any combination of motor, electric discharge lamp, resistive, and tungsten lamp loads with tungsten lamp loads not exceeding 30 percent of the continuous current rating) unless otherwise indicated or required.
- J. Switching Methods
1. Open Transition - Provide break-before-make transfer without a neutral position that is not connected to either source, and with interlocks to prevent simultaneous connection of the load to both sources.
 2. Obtain control power for transfer operation from line side of source to which the load is to be transferred.
- K. Service Conditions - Provide transfer switches suitable for continuous operation at indicated ratings under the service conditions at the installed location.
- L. Enclosures
1. Environment Type per NEMA 250: As indicated on the Drawings.
 2. Finish - Manufacturer's standard unless otherwise indicated.
- M. Short Circuit Current Rating
1. Withstand and Closing Rating - Provide transfer switches, when protected by the supply side overcurrent protective devices to be installed, with listed withstand and closing rating not less than the available fault current at the installed location as indicated on the drawings.
- N. Accessories/Miscellaneous
1. Description - Transfer switches with automatically initiated transfer between sources; electrically operated and mechanically held.
 2. Control Functions
 - a. Automatic mode.
 - b. Test Mode - Simulates failure of primary/normal source.

- c. Voltage and Frequency Sensing
 - 1) Undervoltage sensing for each phase of primary/normal source; adjustable dropout/pickup settings.
 - 2) Undervoltage sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - 3) Underfrequency sensing for alternate/emergency source; adjustable dropout/pickup settings.
 - d. Outputs
 - 1) Contacts for engine start/shutdown (except where direct generator communication interface is provided).
 - 2) Auxiliary contacts; one set(s) for each switch position.
 - e. Adjustable Time Delays
 - 1) Engine generator start time delay; delays engine start signal to override momentary primary/normal source failures.
 - 2) Transfer to alternate/emergency source time delay.
 - 3) Retransfer to primary/normal source time delay.
 - 4) Engine generator cooldown time delay; delays engine shutdown following retransfer to primary/normal source to permit generator to run unloaded for cooldown period.
 - f. In-Phase Monitor (Open Transition Transfer Switches) - Monitors phase angle difference between sources for initiating in-phase transfer.
 - g. Engine Exerciser - Provides programmable scheduled exercising of engine generator selectable with or without transfer to load; provides memory retention during power outage.
 - 1) Contractor to program the generator system to automatically test once per week for 15 minutes or manufacturers recommended minimum test time. Coordinate scheduled weekly test time with the owner.
3. Status Indications
- a. Connected to alternate/emergency source.
 - b. Connected to primary/normal source.
 - c. Alternate/emergency source available.
4. Other Features

- a. Event log.
 - b. Communications Capability - Compatible with system indicated. Provide all accessories necessary for proper interface.
5. Automatic Sequence of Operations
- a. Upon failure of primary/normal source for a programmable time period (engine generator start time delay), initiate starting of engine generator where applicable.
 - b. When alternate/emergency source is available, transfer load to alternate/emergency source after programmable time delay.
 - c. When primary/normal source has been restored, retransfer to primary/normal source after a programmable time delay. Bypass time delay if alternate/emergency source fails and primary/normal source is available.
 - d. Where applicable, initiate shutdown of engine generator after programmable engine cooldown time delay.

2.03. SOURCE QUALITY CONTROL

- A. Perform production tests on transfer switches at factory to verify operation and performance characteristics prior to shipment. Include certified test report with submittals.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that the ratings and configurations of transfer switches are consistent with the indicated requirements.
- C. Verify that rough-ins for field connections are in the proper locations.
- D. Verify that mounting surfaces are ready to receive transfer switches.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02. INSTALLATION

- A. Perform work in accordance with NECA 1 (general workmanship).
- B. Install products in accordance with manufacturer's instructions.
- C. Arrange equipment to provide minimum clearances and required maintenance access.
- D. Provide required support and attachment in accordance with Section 16191, Hangers and Supports For Electrical Systems.

- E. Transfer switches to be installed plumb and level.
- F. Provide grounding and bonding in accordance with Section 16100, Grounding and Bonding For Electrical Systems.
- G. Identify transfer switches and associated system wiring in accordance with Section 16196, Identification For Electrical Systems.
- H. Time delay Emergency-to-Normal is recommended to be 15 minutes, but no less than 2 minutes to allow for supply system stabilization upon system restoration.

3.03. FIELD QUALITY CONTROL

- A. Provide services of a manufacturer's authorized representative to observe installation and assist in inspection and testing. Include manufacturer's detailed testing procedures and field reports with submittals.
 - 1. Perform load test in accordance with NFPA 110 (1.5 hour building load test followed by 2 hour full load test). Contractor to supply a load bank and cabling as necessary in order to perform the full load test on the owner's existing generator system.
- B. Prepare and start system in accordance with manufacturer's instructions.
- C. Automatic Transfer Switches
 - 1. Inspect and test in accordance with NETA ATS, except Section 4.
 - 2. Perform inspections and tests listed in NETA ATS, Section 7.22.3. The control wiring insulation-resistance tests listed as optional are not required.
 - a. Disconnect surge protective devices (SPDs) prior to performing any high potential testing. Replace SPDs damaged by performing high potential testing with SPDs connected.
- D. Correct defective work, adjust for proper operation, and retest until entire system complies with Contract Documents.
- E. Submit detailed reports indicating inspection and testing results and corrective actions taken.
- F. Contractor to program the generator system to automatically test once per week for 15 minutes or manufacturers recommended minimum test time. Coordinate scheduled weekly test time with the owner.

3.04. CLEANING

- A. Clean exposed surfaces to remove dirt, paint, or other foreign material and restore to match original factory finish.

3.05. CLOSEOUT ACTIVITIES

- A. Demonstration - Demonstrate proper operation of transfer switches to Owner, and correct deficiencies or make adjustments as directed.

- B. Training - Train Owner's personnel on operation, adjustment, and maintenance of transfer switches.
 - 1. Use operation and maintenance manual as training reference, supplemented with additional training materials as required.
 - 2. Provide minimum of four hours of training.
 - 3. Instructor - Manufacturer's authorized representative.
 - 4. Location - At project site.

- C. After successful acceptance test and just prior to Substantial Completion, Contractor is to fill fuel storage tank of engine generator.

3.06. PROTECTION

- A. Protect installed transfer switches from subsequent construction operations.

END OF SECTION

SECTION 16501
INTERIOR LIGHTING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Interior luminaires.
- B. Emergency lighting units.
- C. Exit signs.
- D. Ballasts and drivers.
- E. Lamps.
- F. Luminaire accessories.

1.02. RELATED REQUIREMENTS

- A. Section 16130 - BOXES.
- B. Section 16196 – IDENTIFICATION FOR ELECTRICAL SYSTEMS: Identification products and requirements.
- C. Section 16140 - WIRING DEVICES: Manual wall switches and wall dimmers.
- D. Section 16250 - EQUIPMENT FOR HAZARDOUS LOCATIONS
- E. Section 16502 - EXTERIOR LIGHTING

1.03. REFERENCE STANDARDS

- A. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- B. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- C. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- D. NECA/IESNA 500 - Standard for Installing Indoor Commercial Lighting Systems; 2006.
- E. NECA/IESNA 502 - Standard for Installing Industrial Lighting Systems; 2006.
- F. NEMA LE 4 - Recessed Luminaires, Ceiling Compatibility; 2012.
- G. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.

- H. NFPA 101 - Life Safety Code; 2015.
- I. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.
- J. UL 924 - Emergency Lighting and Power Equipment; Current Edition, Including All Revisions.
- K. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- L. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

A. Coordination

1. Coordinate the installation of luminaires with mounting surfaces installed under other sections or by others. Coordinate the work with placement of supports, anchors, etc. required for mounting. Coordinate compatibility of luminaires and associated trims with mounting surfaces at installed locations.
2. Coordinate the placement of luminaires with structural members, ductwork, piping, equipment, diffusers, fire suppression system components, and other potential conflicts installed under other sections or by others.
3. Coordinate the placement of exit signs with furniture, equipment, signage or other potential obstructions to visibility installed under other sections or by others.
4. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05. SUBMITTALS

- A. Product Data - Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, installed accessories, and ceiling compatibility; include model number nomenclature clearly marked with all proposed features.
 1. LED Luminaires - Include estimated useful life, calculated based on IES LM-80 test data.
 2. Ballasts - Include wiring diagrams and list of compatible lamp configurations.
 3. Lamps - Include rated life, color temperature, color rendering index (CRI), and initial and mean lumen output.
- B. Certificates for Dimming Ballasts - Manufacturer's documentation of compatibility with dimming controls to be installed.
- C. Field quality control reports.

- D. Operation and Maintenance Data - Instructions for each product including information on replacement parts.
 - E. Maintenance Materials - Furnish the following for Owner's use in maintenance of project.
 - 1. Extra Lenses and Louvers - 2 percent of total quantity installed for each type, but not less than one of each type where used.
 - 2. Extra Lamps - 2 percent of total quantity installed for each type, but not less than two of each type where used.
 - 3. Extra Ballasts - 2 percent of total quantity installed for each type, but not less than one of each type where used.
 - F. Project Record Documents - Record actual connections and locations of luminaires and any associated remote components.
- 1.06. QUALITY ASSURANCE
- A. Conform to requirements of NFPA 70.
 - B. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years documented experience.
 - C. Product Listing Organization Qualifications - An organization recognized by OSHA as a Nationally Recognized Testing Laboratory (NRTL) and acceptable to authorities having jurisdiction.
- 1.07. DELIVERY, STORAGE, AND PROTECTION
- A. Receive, handle, and store products according to NECA/IESNA 500 (commercial lighting), NECA/IESNA 502 (industrial lighting), and manufacturer's written instructions.
 - B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.
- 1.08. FIELD CONDITIONS
- A. Maintain field conditions within manufacturer's required service conditions during and after installation.
 - B. Where Contract Drawings call out a classified area all equipment, devices, and wiring methods to be suitable for this area per NEC. Refer to Contract Drawings for classified area locations and Section 16250, Equipment For Hazardous Locations, for additional information.
- 1.09. WARRANTY
- A. Provide three-year manufacturer warranty for all LED luminaires, including drivers.
 - B. Provide five-year pro-rata warranty for batteries for emergency lighting units.
 - C. Provide 10-year pro-rata warranty for batteries for self-powered exit signs.

PART 2 PRODUCTS

2.01. MANUFACTURERS - LUMINAIRES

- A. Cooper Lighting, a division of Cooper Industries or approved equal. www.cooperindustries.com.
- B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. Requests for substitutions shall be made a minimum of 10 days prior to bid date. Manufacturers' catalog data shall accompany each request. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees in order for substitute equipment to meet all applicable codes and design intent.
- C. Refer to luminaire schedule on Contract Drawings for additional information.

2.02. LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the Drawings or approved equal.

2.03. LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Hazardous (Classified) Location Luminaires - Listed and labeled as complying with UL 844 for the classification of the installed location.
- H. LED Luminaires
 - 1. Components - UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life - Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.

2.04. EMERGENCY LIGHTING UNITS

- A. Manufacturers
 - 1. Cooper Lighting, a division of Cooper Industries or approved equal www.cooperindustries.com.
- B. Description - Emergency lighting units complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
- C. Operation - Upon interruption of normal power source or brownout condition exceeding 20 percent voltage drop from nominal, solid-state control automatically switches connected lamps to integral battery power for minimum of 90 minutes of rated emergency illumination, and automatically recharges battery upon restoration of normal power source.
- D. Battery - Size battery to supply all connected lamps, including emergency remote heads where indicated.
- E. Diagnostics - Provide power status indicator light and accessible integral test switch to manually activate emergency operation.
- F. Provide low-voltage disconnect to prevent battery damage from deep discharge.
- G. Self-Diagnostics - Provide units that self-monitor functionality and automatically perform testing required by NFPA 101 where indicated; provide indicator light(s) to report test and diagnostic status.
- H. Where indicated, provide units with integral time delay to maintain emergency illumination for 15 minutes after restoration of normal power source.
- I. Accessories
 - 1. Provide compatible accessory mounting brackets where indicated or required to complete installation.
 - 2. Where indicated, provide emergency remote heads that are compatible with the emergency lighting unit they are connected to and suitable for the installed location.

2.05. EXIT SIGNS

- A. Manufacturers - Powered and Self-Luminous Signs
 - 1. Cooper Lighting, a division of Cooper Industries or approved equal. www.cooperindustries.com.
- B. Description - Exit signs and similar signs for special purpose applications such as area of refuge/rescue assistance.
- C. Description - Internally illuminated exit signs with LEDs unless otherwise indicated; complying with NFPA 101 and all applicable state and local codes, and listed and labeled as complying with UL 924.
 - 1. Number of Faces - Single or double as indicated or as required for the installed location.

2. Directional Arrows - As indicated or as required for the installed location.

2.06. BALLASTS AND DRIVERS

A. Manufacturers

1. Lutron Electronics Company, Inc; www.lutron.com/sle.
2. Osram Sylvania - www.sylvania.com.
3. Philips Lighting Electronics/Advance - www.advance.philips.com.

B. Ballasts/Drivers - General Requirements

1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
2. Minimum Efficiency/Efficacy - Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

C. Dimmable LED Drivers

1. Dimming Range - Continuous dimming from 100 percent to five percent relative light output unless dimming capability to lower level is indicated, without flicker.
2. Control Compatibility - Fully compatible with the dimming controls to be installed.

2.07. LAMPS

A. Manufacturers

1. General Electric Company/GE Lighting - www.gelighting.com.
2. Osram Sylvania - www.sylvania.com.
3. Philips Lighting Company - www.lighting.philips.com.
4. Manufacturer Limitations - Where possible, provide lamps produced by a single manufacturer.

B. Lamps - General Requirements

1. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
2. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
3. Minimum Efficiency - Provide lamps complying with all current applicable federal and state lamp efficiency standards.
4. Color Temperature Consistency - Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Engineer to be inconsistent in perceived color temperature.

2.08. ACCESSORIES

- A. Stems for Suspended Luminaires - Steel tubing, minimum 1/2-inch size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires - Zinc-plated steel, minimum 1/4-inch size, field-painted as directed.
- C. Provide accessory plaster frames for luminaires recessed in plaster ceilings.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02. PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03. INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 16130, Boxes, as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires securely, in a neat and workmanlike manner, as specified in NECA 500 (commercial lighting) and NECA 502 (industrial lighting).
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Install luminaires in locations as shown on the Contract Drawings or as close as possible to the locations shown with minor adjustments as required to avoid interferences.

- G. Suspended Ceiling-Mounted Luminaires
 - 1. Do not use ceiling tiles to bear weight of luminaires.
 - 2. Do not use ceiling support system to bear weight of luminaires unless ceiling support system is certified as suitable to do so.
 - 3. Secure surface-mounted and recessed luminaires to ceiling support channels or framing members or to building structure.
 - 4. Secure pendant-mounted luminaires to building structure.
 - 5. Secure lay-in luminaires to ceiling support channels using listed safety clips at four corners.
 - 6. In addition to ceiling support wires, provide two galvanized steel safety wire(s), minimum 12 gage, connected from opposing corners of each recessed luminaire to building structure.
 - 7. See appropriate Division 9 section where suspended grid ceiling is specified for additional requirements.
- H. Suspended Luminaires
 - 1. Unless otherwise indicated, specified mounting heights are to bottom of luminaire.
 - 2. Install using the suspension method indicated, with support lengths and accessories as required for specified mounting height.
 - 3. Provide minimum of two supports for each luminaire equal to or exceeding 4 feet nominal length, with no more than 4 feet (1.2 m) between supports.
- I. Wall-Mounted Luminaires - Unless otherwise indicated, specified mounting heights are to center of luminaire.
- J. Install accessories furnished with each luminaire.
- K. Bond products and metal accessories to branch circuit equipment grounding conductor.
- L. Emergency Lighting Units - Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- M. Exit Signs - Unless otherwise indicated, connect unit to unswitched power from same circuit feeding normal lighting in same room or area. Bypass local switches, contactors, or other lighting controls.
- N. Identify luminaires connected to emergency power system in accordance with Section 16196, Equipment For Hazardous Locations
- O. Install lamps in each luminaire.

3.04. FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.
- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Test self-powered exit signs and emergency lighting units to verify proper operation upon loss of normal power supply.
- D. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

3.05. ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.
- B. Aim and position adjustable emergency lighting unit lamps to achieve optimum illumination of egress path as required or as directed by Engineer or authority having jurisdiction.
- C. Exit Signs with Field-Selectable Directional Arrows - Set as indicated or as required to properly designate egress path as directed by Engineer or authority having jurisdiction.

3.06. CLEANING

- A. Clean surfaces according to NECA 500 (commercial lighting), NECA 502 (industrial lighting), and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07. CLOSEOUT ACTIVITIES

- A. Demonstration - Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed and clean luminaires.

3.08. PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 16502
EXTERIOR LIGHTING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Exterior luminaires.
- B. Ballasts.
- C. Lamps.
- D. Accessories.
- E. Luminaire accessories.

1.02. RELATED REQUIREMENTS

- A. Section 16100 - GROUNDING AND BONDING FOR ELECTRICAL SYSTEMS
- B. Section 16130 - BOXES
- C. Section 16140 - WIRING DEVICES: Receptacles for installation in poles.
- D. Section 16250 - EQUIPMENT FOR HAZARDOUS LOCATIONS
- E. Section 16448 - FUSES
- F. Section 16501 - INTERIOR LIGHTING

1.03. REFERENCE STANDARDS

- A. IEEE C2 - National Electrical Safety Code; 2012.
- B. IES LM-79 - Approved Method: Electrical and Photometric Measurements of Solid-State Lighting Products; 2008.
- C. IES LM-80 - Approved Method: Measuring Luminous Flux and Color Maintenance of LED Packages, Arrays, and Modules; Illuminating Engineering Society; 2015.
- D. NECA 1 - Standard for Good Workmanship in Electrical Construction; 2010.
- E. NECA/IESNA 501 - Standard for Installing Exterior Lighting Systems; 2006.
- F. NFPA 70 - National Electrical Code; Most Recent Edition Adopted by Authority Having Jurisdiction, Including All Applicable Amendments and Supplements.
- G. UL 844 - Luminaires for Use in Hazardous (Classified) Locations; Current Edition, Including All Revisions.

- H. UL 1598 - Luminaires; Current Edition, Including All Revisions.
- I. UL 8750 - Light Emitting Diode (LED) Equipment for Use in Lighting Products; Current Edition, Including All Revisions.

1.04. ADMINISTRATIVE REQUIREMENTS

- A. Coordination
 - 1. Notify Engineer of any conflicts or deviations from the contract documents to obtain direction prior to proceeding with work.

1.05. SUBMITTALS

- A. Shop Drawings - Indicate dimensions and components for each luminaire that is not a standard product of the manufacturer.
- B. Product Data - Provide manufacturer's standard catalog pages and data sheets including detailed information on luminaire construction, dimensions, ratings, finishes, mounting requirements, listings, service conditions, photometric performance, weight, effective projected area (EPA), and installed accessories; include model number nomenclature clearly marked with all proposed features.
 - 1. LED Luminaires - Include estimated useful life, calculated based on IES LM-80 test data.
- C. Manufacturer's Installation Instructions - Indicate application conditions and limitations of use stipulated by product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- D. Operation and Maintenance Data - Instructions for each product including information on replacement parts.
- E. Project Record Documents - Record actual connections and locations of pole foundations, luminaires, and any pull or junction boxes.

1.06. QUALITY ASSURANCE

- A. Conform to requirements of NFPA 70.
- B. Where Contract Drawings call out a classified area all equipment, devices, and wiring methods to be suitable for this area per NEC. Refer to Contract Drawings for classified area locations and Section 16250, Equipment For Hazardous Locations, for additional information.
- C. Manufacturer Qualifications - Company specializing in manufacturing the products specified in this section with minimum three years' documented experience.

1.07. DELIVERY, STORAGE, AND HANDLING

- A. Receive, handle, and store products according to NECA/IESNA 501 and manufacturer's written instructions.

- B. Keep products in original manufacturer's packaging and protect from damage until ready for installation.

1.08. WARRANTY

- A. Provide three year manufacturer warranty for all LED luminaires, including drivers.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. Cooper Lighting, a division of Cooper Industries or approved equal. www.cooperindustries.com.
- B. Products other than basis of design are subject to compliance with specified requirements and prior approval of Engineer. Requests for substitutions shall be made a minimum of 10 days prior to bid date. Manufacturers' catalog data shall accompany each request. By using products other than basis of design, Contractor accepts responsibility for costs associated with any necessary modifications to related work, including any design fees in order for substitute equipment to meet all applicable codes and design intent.
 - 1. Refer to luminaire schedules on the Contract Drawings for additional basis of design information.

2.02. LUMINAIRE TYPES

- A. Furnish products as indicated in luminaire schedule included on the Drawings or approved equal.

2.03. LUMINAIRES

- A. Provide products that comply with requirements of NFPA 70.
- B. Provide products that are listed and labeled as complying with UL 1598, where applicable.
- C. Provide products listed, classified, and labeled as suitable for the purpose intended.
- D. Unless otherwise indicated, provide complete luminaires including lamp(s) and all sockets, ballasts, reflectors, lenses, housings and other components required to position, energize and protect the lamp and distribute the light.
- E. Unless specifically indicated to be excluded, provide all required conduit, boxes, wiring, connectors, hardware, poles, foundations, supports, trims, accessories, etc. as necessary for a complete operating system.
- F. Provide products suitable to withstand normal handling, installation, and service without any damage, distortion, corrosion, fading, discoloring, etc.
- G. Provide luminaires listed and labeled as suitable for wet locations unless otherwise indicated.

- H. Hazardous (Classified) Location Luminaires - Listed and labeled as complying with UL 844 for the classification of the installed location.
- I. LED Luminaires
 - 1. Components - UL 8750 recognized or listed as applicable.
 - 2. Tested in accordance with IES LM-79 and IES LM-80.
 - 3. LED Estimated Useful Life - Minimum of 50,000 hours at 70 percent lumen maintenance, calculated based on IES LM-80 test data.
- J. Exposed Hardware - Stainless steel.

2.04. BALLASTS

- A. Ballasts/Drivers - General Requirements
 - 1. Provide ballasts containing no polychlorinated biphenyls (PCBs).
 - 2. Minimum Efficiency/Efficacy - Provide ballasts complying with all current applicable federal and state ballast efficiency/efficacy standards.

2.05. LAMPS

- A. Unless explicitly excluded, provide new, compatible, operable lamps in each luminaire.
- B. Verify compatibility of specified lamps with luminaires to be installed. Where lamps are not specified, provide lamps per luminaire manufacturer's recommendations.
- C. Minimum Efficiency - Provide lamps complying with all current applicable federal and state lamp efficiency standards.
- D. Color Temperature Consistency - Unless otherwise indicated, for each type of lamp furnish products which are consistent in perceived color temperature. Replace lamps that are determined by the Engineer to be inconsistent in perceived color temperature.

2.06. ACCESSORIES

- A. Stems for Suspended Luminaires - Steel tubing, minimum 1/2-inch size, factory finished to match luminaire or field-painted as directed.
- B. Threaded Rods for Suspended Luminaires - Zinc-plated steel, minimum 1/4-inch size, field-painted as directed.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that field measurements are as indicated.
- B. Verify that outlet boxes are installed in proper locations and at proper mounting heights and are properly sized to accommodate conductors in accordance with NFPA 70.
- C. Verify that suitable support frames are installed where required.
- D. Verify that branch circuit wiring installation is completed, tested, and ready for connection to luminaires.
- E. Verify that conditions are satisfactory for installation prior to starting work.

3.02. PREPARATION

- A. Provide extension rings to bring outlet boxes flush with finished surface.
- B. Clean dirt, debris, plaster, and other foreign materials from outlet boxes.

3.03. INSTALLATION

- A. Coordinate locations of outlet boxes provided under Section 16130, Boxes, as required for installation of luminaires provided under this section.
- B. Perform work in accordance with NECA 1 (general workmanship).
- C. Install products in accordance with manufacturer's instructions.
- D. Install luminaires in accordance with NECA/IESNA 501.
- E. Install luminaires plumb and square and aligned with building lines and with adjacent luminaires.
- F. Install luminaires in locations as shown on the Contract Drawings or as close as possible to the locations shown when necessary to make minor modifications to avoid interferences.
- G. Wall-Mounted Luminaires - Unless otherwise indicated, specified mounting heights are to center of luminaire.
- H. Install accessories furnished with each luminaire.
- I. Bond products and metal accessories to branch circuit equipment grounding conductor.
- J. Install lamps in each luminaire.

3.04. FIELD QUALITY CONTROL

- A. Inspect each product for damage and defects.

- B. Operate each luminaire after installation and connection to verify proper operation.
- C. Correct wiring deficiencies and repair or replace damaged or defective products. Repair or replace excessively noisy ballasts as determined by Engineer.

3.05. ADJUSTING

- A. Aim and position adjustable luminaires to achieve desired illumination as indicated or as directed by Engineer. Secure locking fittings in place.
- B. Luminaires with Field-Rotatable Optics - Position optics according to manufacturer's instructions to achieve lighting distribution as indicated or as directed by Engineer.

3.06. CLEANING

- A. Clean surfaces according to NECA/IESNA 501 and manufacturer's instructions to remove dirt, fingerprints, paint, or other foreign material and restore finishes to match original factory finish.

3.07. CLOSEOUT ACTIVITIES

- A. Demonstration - Demonstrate proper operation of luminaires to Engineer, and correct deficiencies or make adjustments as directed.
- B. Just prior to Substantial Completion, replace all lamps that have failed and clean luminaires.

3.08. PROTECTION

- A. Protect installed luminaires from subsequent construction operations.

END OF SECTION

SECTION 17000
INSTRUMENTATION

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. This section includes the general work description and requirements for instrumentation provided by this contract.

1.02. GENERAL REQUIREMENTS

- A. It is a requirement of this specification that all Division 17 specifications be provided by a single supplier. This supplier shall have total responsibility for the entire system performance and compatibility of this section, as well as all other Division 17 specifications.

1.03. RELATED SECTIONS

The specifications sections listed below are an integral part of this equipment specification and the Contractor shall be responsible for providing these sections to the equipment suppliers:

- A. Section 01300 - SUBMITTALS
- B. Section 01640 - EQUIPMENT-GENERAL
- C. All Division 16 specifications.
- D. All Division 17 specifications.

1.04. REFERENCES

- A. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- B. NEMA ICS 3 - Industrial Systems.
- C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- D. NFPA 70 - National Electrical Code (NEC).
- E. NFPA 79 – NEC (Labeling).
- F. ISA - Standards 5.1 and 5.4.
- G. IEC 1131-3 – Programming Standards.

1.05. SHOP DRAWINGS

- A. All Division 17 specifications shall be submitted in one shop drawing. Requirements of individual specification sections shall be contained within a single section in the shopdrawing submittal. Indicate individual specification sections with a protruding tab. Submit material in the format and order as described in paragraph 1.05.B.2.

- B. Shop Drawing Submittal Format
1. Shop drawings shall be submitted in electronic format (i.e. pdf).
 2. Contents shall be organized accordingly.
 - a. Table of Contents – List of each section. Provide protruding tabs labeled with the pertinent heading for each section listed in the Table of Contents.
 - b. For each Division 17 specification section, provide the following within the respective sections
 - 1) Bill of Materials (BOM) for installed equipment, BOM for spare parts, and BOM for extra materials. Each BOM shall be grouped and identified separately.
 - 2) Equipment information satisfying specifications. Provide protruding tabs for each piece of equipment. Label each tab with the equipment manufacturer.
 - c. AutoCAD Drawings – Include title block, border, page numbers, and supplier job number. CD containing all Division 17 AutoCAD 2014, or higher, *.dwg files. Sheet/drawing titles shall utilize three lines in the title block and are subject to approval, and instructed change, by the Engineer.
 3. AutoCAD drawings shall be 11-inch by 17-inch.
 4. Shop drawings not containing the appropriate information or format will be returned without further review.
- C. Shop Drawing Submittal Contents - The following requirements pertain to all of Division 17 specifications and are intended to complement the requirements of Section 01640. Refer to individual Division 17 specifications for further requirements.
1. Detailed Bill of Materials in Microsoft Word 2013 table format, or Excel 2003, identifying component name, manufacturer, model number, and quantity supplied. Typical Bills of Materials are not acceptable.
 2. Descriptive lists of spare parts and extra materials provided in the same tabular format as the Bill of Materials. Lists shall be exclusive to the spare parts and extra materials requested by the specification section, hence separate from the Bill of Materials for installed equipment. Lists shall be intuitive and specifically created for this project.
 3. For individual equipment, submit information satisfying every item discussed in Part II of that specification section. Additionally, submit on all supporting accessories including, but not limited to, terminal blocks, surge and lightning suppression, UPSs, fuses, and cabling.
 4. AutoCAD 2014 or Higher Drawings - Provide loop and block diagrams. Symbols used and nomenclature shall be in accordance to ISA Standard 5.4. Diagrams shall be specific to the equipment submitted with the options and features specified or otherwise provided. The inclusion of options not specified or provided is unacceptable. Terminal points depicted shall be the terminal points provided with identical terminal point designations as the supplied equipment. Illustrate all available terminals that are not utilized.

5. Proposed nameplate wording. Scaled illustrations for each nameplate provided.
6. Manufacturer's literature and Web site printouts are independent of the above requests for information and, hence do not satisfy the above shop drawing requirements. All catalog cuts, Web site printouts, manufacturer's specifications, and drawings shall be clearly marked to allow identification of the specific products used. Cross-out all options and functions not supplied with the equipment.
7. Electrical power requirements, connection requirements, interconnecting cabling, and environmental limitations/restrictions.
8. Dimensions and weights of the equipment with the specified options.

1.06. OPERATION AND MAINTENANCE DATA

- A. The following requirements pertain to all of Division 17 specifications and are intended to complement the requirements of Section 01640 as well as individual Division 17 specifications.
- B. Submit under provisions of Sections 01600 and 01640.
- C. Provide complete sets electronic formatted Operation and Maintenance (O&M) Manuals. In addition to "As-Built" system drawings, the manuals shall include internal wiring diagrams and operating and maintenance literature for all components provided under Division 17. Utilize a Table of Contents listing major headings tabs and sub-major headings tabs. Provide tabs labeled with the pertinent heading for each item listed in the Table of Contents. Otherwise, utilize the same format as specified for shop drawing submittals.
- D. Submitted literature shall be in sufficient detail to facilitate the operation, removal, installation, programming and configuration, adjustment, calibration, testing, and maintenance of each component and/or instrument. Indicate application conditions and limitations of use stipulated by the product testing agency. Include instructions for storage, handling, protection, examination, preparation, installation, and starting of product.
- E. Provide a separate Section for the configuration settings for each instrument provided in Division 17. Provide a Table of Contents with tabs for each instrument. Label each with the equipment name and equipment designation. Indicate the value of all configuration parameters and setpoints, including those that are not utilized in the equipment's field configuration.
- F. Contractor shall review all submitted literature and cross out all options, functions, warranties, etc. not part of the supplied equipment.

1.07. PROJECT RECORD DOCUMENTS

- A. The following requirements pertain to all of Division 17 specifications and are intended to complement the requirements of Section 01640 as well as individual Division 17 specifications.
- B. Submit under provisions of Sections 01600, 01640, and 16055.
- C. Record actual locations of controller cabinets and input and output devices connected to system. Include interconnection wiring and cabling information, and terminal block layouts in controller cabinets.

1.08. DELIVERY, STORAGE, AND HANDLING

- A. Deliver, store, protect and handle products to site under provisions of Sections 01600, 01640, and 16055.
- B. Accept products on site in factory containers unless system is completely integrated into a pre-manufactured panel that has been factory tested. Inspect for damage.
- C. Store products in clean, dry area; maintain temperature to NEMA ICS 1 requirements.

1.09. COORDINATION

- A. Refer to Contract Drawings for designations and verify with Owner.
- B. Coordinate demonstration to Owner with the Contractor and the Owner.

PART 2 PRODUCTS

2.01. ACCESSORIES

- A. Nameplates
 - 1. Laminated plastic nameplates shall be provided for each instrument in Division 17.
 - 2. Nameplates shall have 5/16-inch high capital, white letters on black background machine engraved. Hang nameplates from process-mounted instruments via metallic chains. Nameplates shall be hung within 12 inches of the equipment.
 - 3. Final wording on nameplate shall be submitted during the shop drawing phase and approved by the Engineer.
 - 4. Nameplates shall be uniformly mounted and of identical form-factor for all equipment that nameplates are provided. Once a nameplate format has been selected, the format shall be utilized for all equipment throughout, thereby excluding providing original equipment manufacturer (OEM) nameplates.
 - 5. Where wire labeling is not conducive to nameplate tagging as specified above, such as in MCC compartments or inside the programmable logic controller (PLC) enclosure, provide wire labeling on computer printed, adhesive tape, and wraparound wiring. Printing that is capable of being rubbed off the wire label is not acceptable.
 - 6. Text on nameplates shall be as follows.
 - a. First Line – Equipment name. Equipment name shall as listed on the Contract Drawings and PLC input/output (I/O) lists.
 - b. Second Line – Equipment designation. Designation shall be in accordance with ISA Standards 5.1 and 5.4 as listed in the PLC I/O lists and on the Contract Drawings.
 - c. Third Line – Wiring destination. Indicate the destination of the wiring (i.e. SCP-ERPS).

- B. Lightning and Surge Protection
 - 1. Provide lightning and surge protection on the power supply of each instrument provided under Division 17.
 - 2. Provide lightning and surge protection on all analog input and output signal circuits that pass out of doors or are terminated to metallic piping that passes out of doors.
 - 3. Surge protection devices mounted on the analog output signal wiring of field-mounted transmitters shall be conduit-mounted utilizing a common chamber, three element, gas tube and clamp incoming transients to a level acceptable to the transmitter it is protecting. Manufacturer shall be Joslyn, Model 1669-01, or equal.
 - 4. Surge protection devices protecting analog circuits entering the PLC enclosure shall be din-rail mounted with removable terminal blocks on each side of the device with no interruption of the incoming signal by unplugging the surge protection device. Device shall possess the capability of discharging 1000 Amps evaluated on an 8x20- microsecond waveform. Device shall have an LED to indicate the unit is functioning properly. Surge protection device shall be manufactured by M-System Co, ModelMDP- 24-1, or equal.
- C. Wiring/Conduit/Mounting
- D. The Contractor shall provide all power wiring and conduit to each instrument specified in Division 17 in accordance with Section 16110, Conduit, and Section 16201, Equipment Wiring.
 - 1. The Contractor shall provide all signal wiring and conduit from the PLC to new and existing equipment as specified in the I/O list of Section 17100 and the Contract Documents.
 - 2. The Contractor shall provide all other wiring integral to supplied equipment to achieve the specified system performance as discussed individual Division 17 sections.
 - 3. The Contractor shall mount all equipment specified in Division 17 in locations discussed/shown in the Contract Documents.

PART 3 EXECUTION

3.01. EQUIPMENT MOUNTING

- A. All mounted equipment shall have sufficient clearance from other provided or existing obstructions (including walls, pipes, conduit, or other instruments) to facilitate removal, adjustment, inspection, and calibration of the installed device. Any device that is mounted without sufficient clearance to perform these functions with standard, manufacturer recommended tools shall be removed and remounted at no additional cost to the Owner.
- B. Rotate equipment heads as directed by the Engineer in the punch list for final completion.

END OF SECTION

SECTION 17010

CONTROL SYSTEMS INTEGRATOR (ADD-ALTERNATE)

PART 1 GENERAL

1.01. SUMMARY

- A. This section specifies the requirements of the Control Systems Integrator (CSI). The Contractor is required to subcontract a CSI with qualifications and a scope of work as specified herein.

1.02. SCOPE OF WORK

- A. The CSI shall provide testing and startup services to assist the Contractor with commissioning of the process control system and related instrumentation.
- B. PLC and Operator Interface Terminal (OIT) programming
- C. Termination and labeling of conductors as specified herein
- D. Division 17 - Complete responsibility for the provision of all Division 17 requirements, including equipment and services, as specified in the respective specification.
- E. Supply quantities of CSI field technician personnel as specified herein for the duration necessary for system installation, startup and commissioning of the new systems.
- F. Provide manufacturer's services for installation, configuration and testing of equipment where specified. Manufacturer's representatives who are not under direct employment of the equipment manufacturer are permitted only where specified in the Contract Documents.
- G. Take ownership of all equipment being furnished through the CSI. Coordinate efforts associated with manufacturer's technicians and representatives for services required during installation, configuration, calibration, startup and troubleshooting of equipment. Coordination shall occur in a timely fashion as to not delay the project schedule.
- H. Fabrication, configuration, testing, startup and implementation of the Process Control System (PCS), control panels, instrumentation and electrical equipment as specified herein and required to construct a highly available, efficient, reliable, and operable system.
- I. Conduct and coordinate CSI coordination meetings and attend progress meetings as specified herein.

1.03. CONTROL SYSTEMS INTEGRATOR QUALIFICATIONS

- A. The CSI shall be regularly engaged in the business of instrumentation and controls and shall be responsible for the supply, coordination, and installation of the equipment as specified herein.
- B. The CSI shall demonstrate the requisite resources of in-house staff, facilities and finances to complete the project in the schedule specified. These resources shall include personnel who are direct payroll employees of the CSI to engineer, design, implement, fabricate, stage, and test the entire integrated hardware and software system at the CSI's facilities. In-house personnel shall include all disciplines

associated with system manufacture, fabrication, and integration to include but not be limited to engineering, drafting, analog and digital control systems and wiring design, construction, wiring, labeling, software configuration, test/demonstration programming, project management, quality control, field engineering and training.

- C. The CSI shall maintain a UL 508 listed fabrication shop located at the CSI facility for the assembly of the various control panels, cabinets, consoles, instrument racks, enclosures, and wiring required for this project. This shop shall be available for inspection by the Engineer to observe quality control and workmanship. The CSI facilities shall include hardware and software owned by the CSI for development and support of any system software, testing, and demonstration equipment to be utilized on the project.
- D. Pre-Approved CSIs

Company	Location	Contact Person	Contact No.
AquaLogics Systems, Inc.	5 Dwight Park Drive Syracuse, NY 13209	Don Ballway	(315) 413-0400

1.04. DEFINITIONS

- A. Process Control System (PCS) - Network of one or more PLCs, PLC HMIs, and/or computers.
- B. Contract Documents - Comprised of both the Contract Drawings and Contract Specifications.
- C. Fieldbus Networks - Reference to a family of industrial network protocols. Fieldbus networks may include Foundation Fieldbus, Profibus, Profinet, Ethernet IP, Modbus TCP, Modbus Serial, Modbus 485, DH+, DeviceNet, ControlNet, and others.
- D. Resident Project Representative (RPR) - Onsite team that enforces the Contract Documents and witnesses most demonstrations. May, or may not, be the design Engineer.
- E. Contractor - Where used herein, refers to the Prime Contractor. The contractor to which this CSI is subcontracted.
- F. Project Team - Comprised of the Owner, Engineer, CSI, and Contractor.

1.05. CSI COORDINATION AND MEETING REQUIREMENTS

- A. The CSI shall collaborate with the Contractor in scheduling of all work.
- B. Schedule testing and demonstrations in writing with the Engineer and Owner at least two weeks in advance of the proposed date(s).
- C. The CSI shall perform the detailed integration and coordination of the control systems and instrumentation equipment furnished in accordance with this specification. Work shall be performed by the CSI's own staff and related equipment manufacturer's engineers where applicable, including submittal drawings, operations and maintenance manuals, record drawings, equipment testing, operational demonstrations, and other applicable documentation.
- D. Coordination with Process Mechanical Equipment Manufacturers

1. Coordinate with process mechanical equipment manufacturer's in order to obtain control system requirements and special control components. The CSI shall review and coordinate with the equipment manufacturer's submittals.
2. The Engineer and RPR are not required to supply information to the CSI that is available from within this project's contract, including supplier information, when the CSI is capable of obtaining such information directly.

E. Required Meetings

1. Pre-Submittal Review Meeting - The pre-submittal review meeting teleconference shall be held over 1, 2-hour meeting and shall be conducted within 30 workingdays of contract award. The pre-submittal review conference shall feature:
2. PLC and OIT Programming Review Workshops
 - a. Upon 25 percent completion of PLC program, schedule, coordinate, and host teleconference meetings with the Owner and Engineer to review progress, approach and address any questions or comments that the Owner and Engineer may have with regards to PLC programming, OIT programming, trending, security, and alarming.
 - b. Prior to startup of each PLC and OIT program, the CSI shall host a minimum of one training session to demonstrate process and alarm logic to the Owner and Engineer, utilizing a projection screen and projector. The CSI shall have as many meetings as necessary to demonstrate the PLC program in its entirety, these meetings may not occur on consecutive days. The CSI shall have multiple participants in these meetings that shall be capable of responding to detailed questions in regards to common mode failure scenario's (including loss of power, loss of communication and loss of signal), process control logic, alarm logic, Navigation of OIT screens, trending, security, process control, and alarming.

1.06. QUALITY ASSURANCE

- A. References - Materials and installation shall be in accordance with the latest revisions of the following codes, standards and specifications, except where more stringent requirements have been specified in the Contract Documents:
1. ANSI - American National Standards Institute
 2. ASME - The American Society of Mechanical Engineers
 3. ASTM - The American Society for Testing Materials
 4. NEMA - National Electric Manufacturers Association
 5. UL - Underwriters Laboratories, Inc.
 6. ISA - Instrument Society of America
 7. IEEE - Institute of Electrical and Electronic Engineers

8. NEC - National Electrical Code
- B. Quality Control
 1. All components shall be new and of the most current and proven design. All components shall be approved for the intended application and shall be installed and wired in accordance with the manufacturer's requirements.
 2. All new electrical equipment and control panels, and their components and materials shall be UL listed and labeled as a completed assembly.
 - C. This specification is designed to engage the CSI at key stages throughout the project so as to promote a formalized and repeatable process for quality control and quality assurance. CSI qualifications, submittals, meetings, workshops, coordination, and documents specified herein are designed to require more upfront planning, which is intended to align expectations of all stakeholders and to deliver the project in an efficient and effective manner that is cost effective and beneficial to all stakeholders.
- 1.07. SUBMITTALS
- A. Submittals shall be submitted in accordance with the individual Division 17 specification requirements.
 - B. Submittals shall include the following:
 1. CSI Qualifications Package - Submit within 15 days of the Notice to Proceed. Submittals sent to the Engineer from the CSI before the qualifications package is approved will be returned "Not Reviewed."
 2. Detailed Work Plan - Submit within 15 days of the Notice to Proceed. Submittals sent to the Engineer from the CSI before the detailed work plan is approved will be returned "Not Reviewed." In scheduling review time for the work plan, allocate time for three resubmittals before approval.
 3. Shop Drawings, Operations & Maintenance, and Project Record Documents - In scheduling review time for individual shop drawings, allocate time for a minimum of two resubmittals.
- 1.08. CSI QUALIFICATIONS PACKAGE
- A. The CSI shall submit a technical qualifications proposal along with the bid in accordance with the Instructions to Bidders.
 - B. Submit a CSI qualifications package for the proposed CSI for this project.
- 1.09. DETAILED WORK PLAN
- A. Submit an overall work plan that details tasks to be performed on this project in sufficient detail to demonstrate a complete understanding of the CSI's scope of work, interdependency of tasks and milestones, sequence of construction, and realistic duration of tasks.

1.10. SHOP DRAWINGS, OPERATIONS & MAINTENANCE, AND RECORD DOCUMENTS

A. Shop Drawings

1. Equipment shall only be ordered after shop drawings have been reviewed and approved by the Engineer. Equipment procured without Engineer approval may need to be uninstalled, returned, exchanged, and/or replaced at the Contractor's cost. Equipment ordered that does not address all the Engineer's shop drawing comments are subject to complete replacement, rather than refurbishment or modification, if modification of the supplied unit impacts aesthetics, intended functionality, schedule, or cost at the Engineer and Owner's option.
2. If deviations to the Contract Documents are proposed, the CSI shall submit a detailed description and explanation for each proposed deviation to the Contract Documents.

B. Shop drawing, operations & maintenance, and project record document requirements of Section 17000, Instrumentation, are intended to complement submittal requirements of individual specification sections. Refer to Section 17000, Instrumentation, for additional requirements and format in preparing individual section submittals.

C. Record Drawings

1. Submit complete and accurate record drawings reflecting all changes and modifications made during installation and testing of the equipment and systems.
2. Record drawings shall be submitted electronically on DVD or removable USB drive. Once the record drawings are reviewed by the Engineer, the CSI shall incorporate the Engineer's comments, and shall submit two copies of the electronic files for each record drawing shall be submitted on compact disks. Files shall be formatted in AutoCAD (.dwg) format. A list of drawing files with corresponding drawing titles shall be provided in electronic format. Record Drawings shall be provided after conditional acceptance of the facility is approved and shall include all field changes and design modifications made during construction.

PART 2 PRODUCTS

Not used.

PART 3 EXECUTION

3.01. GENERAL

- A. Furnish equipment, materials and appurtenances in accordance with the requirements of technical specifications listed in Divisions 16 and 17.
- B. Coordinate with equipment manufacturers as required to obtain information, submittals, materials and equipment from manufacturers, and shall provide information, submittals, materials and equipment to equipment manufacturers as required to execute the Work in accordance with the Contract Documents.
- C. Source Quality Control

1. The CSI shall conduct shop acceptance tests for control panels and systems prior to shipment. The factory acceptance test shall demonstrate that the equipment performs in accordance with the Contract Documents.
2. Each control panel furnished by the CSI shall be assembled and wired so that it functions as a complete system for the FAT. Inputs to the control panels from field instruments and devices may be simulated during the test. Control panels shall be fully assembled with all devices functional prior to Engineer arriving for shop testing. The Engineer reserves the right to postpone FAT if it is deemed that the control panels are not ready to be tested.
3. The FAT shall demonstrate the proper operation of the configuration and control logic of devices described or indicated on the Contract Drawings and specifications.

D. Incidental Discovery of Existing Issues

1. Upon incidental discovery of an existing issue, notify the Owner immediately in writing.
2. Existing issues may include, but are not limited to the following:
 - a. Code violations.
 - b. Defective equipment.
 - c. Compromised equipment.
 - d. Disabled interlocks.

3.02. FIELD TERMINATIONS AND LABELING

- A. Terminations - CSI shall terminate signal wiring to instrumentation, equipment, and field-side of control panel termination strips.
1. Electrical Contractor shall pull conductors and cables to termination points with sufficient excess cable to enable the CSI to label, organize, and terminate each conductor.
 2. Terminations shall be limited to signal wiring, 24 VDC and 120 VAC power and control circuits, such as analog signals, discrete signals, fieldbus networks, and control logic, but shall not include three-phase power or power higher than 120VAC. Scope of terminations include all equipment.
- B. Wire Labeling - Provide labeling of individual conductors terminated by the CSI.
1. Labels shall utilize a common format, appearance, and be installed with consistent and repeatable workmanship.
 2. Materials - Labels shall be comprised of a machine-printed polyester or polyvinyl film and utilize black text on a white background. Each label shall be a single adhesive film or shrink wrap tube. Combining multiple labels to comprise a single wire label is not acceptable.
 3. Method - Label conductors within 1 inch of each termination. Utilize the same, unique wire designation for the entire continuous segment of wire. All wire designations shall be a derivative

of the equipment's designation to which it is connected.

4. Timeliness - Wires must be labeled prior to termination and equipment may not be commissioned without permanent wire labels in-place. Wire labeling shall be a prerequisite of equipment startup.
- C. Nameplates - Provide nameplates for all Division 17 and Division 16 equipment in accordance with nameplate requirements in Section 17000, Instrumentation.

3.03. POINT-TO-POINT FIELD TESTING

A. Definitions

1. Equipment to be Tested - May include a PLC enclosure, control panel, or other device that requires point-to-point testing. It is the assembled panel that requires testing.
2. PLC I/O Lists - Tables located at the end of Section 17100, Programmable Logic Controller, that identify all the signals communicated to each plant PLC. I/O list does not identify signals communicated to Original Equipment Manufacturer (OEM) PLCs that are typically specified in Division 11 specifications.
3. DMM - Digital Multi Meter. Device cable of sensing current in milliamp with a resolution of at least 0.01 mA; sensing continuity; sensing resistance with a resolution of 1 Ohm; and able to source 4 to 20 mA analog signals at a minimum of 0, 25, 50, 75, and 100 percent spans.
4. Signal - Includes a PLC input and output, a hardwired circuit between two field-mounted devices or internal to a control panel, and a network signal like those available over Ethernet and fieldbus protocols.

B. Final Point-To-Point Testing

1. Purpose

- a. To verify all signals, instruments, and equipment are functional and completely ready to be commissioned by the programmer.
- b. It is expected there are no issues during this testing and that the final point-to-point testing proceeds quickly without interruption.
- c. To assess percent complete on contactor payment applications.
- d. To document when the testing was performed and by whom the testing was performed and witnessed.
- e. Successful demonstration thereof shall be a prerequisite for substantial completion for any single system.

2. Scope of Testing

- a. All signals specified in the I/O lists.

- b. All signals added during the shop drawing and/or construction phases.
 - c. All fieldbus and Ethernet networks.
 - d. All signals tested during intermediate point-to-point testing
3. Prerequisites to Commencing Final Point-To-Point Testing
- a. All checklists shall be prepopulated by the CSI and their completed form submitted to the RPR for review and approval.
 - b. Testing dates and planned sequence of testing has been submitted to RPR for review, approval, and scheduling.
 - c. Appropriate equipment vendors, CSI staff, and operations staff are advised and properly coordinated to signals to be demonstrated.
4. CSI shall expend all necessary labor required to demonstrate all signals.
5. Removal of a wire from a termination point within a previously tested circuit nullifies any previous testing of the circuit and necessitates retesting of the circuit following the complete point-to-point testing requirements in its entirety.
6. Method of Testing - to be performed as required by the intermediate point-to-point method of testing.
7. Final point-to-point testing shall not be considered complete until each signal has been successfully tested and items above are satisfied.

3.04. PLC TEST PROGRAMS

- A. Develop and provide test programs for the PLCs, and network devices internal to the PLC enclosure, as required to demonstrate functionality of the system hardware components and communications through the system networks.
- B. Test programs shall provide for the following tests:
 1. Factory Acceptance Testing of PLC Cabinets
 - a. Validate control panel wiring from each field wiring terminal block through the I/O modules and PLC.

3.05. FIELD QUALITY CONTROL

- A. Installation
 1. The CSI shall provide onsite supervision and advice to the installing contractor to insure the equipment is installed in accordance with the specifications and the manufacturer's requirements.
 2. Control Wiring - Contractor shall include time to install/replace/provide additional control and

interlock components and wiring for each starter/VFD assembly or control panel as directed by the Engineer in the field. Modifications shall be performed as required to provide electrical interlocks and interface wiring to obtain a complete and operating control system.

3. CSI shall have two field technicians made available during the testing of equipment to assist with performing wiring and control modifications as required to interface with other field mounted equipment and control panels as directed by the Engineer.

B. Inspections and Field Calibrations

1. Any and all testing equipment required for this project shall be owned by the CSI so as to be immediately available for this project.
2. The use of specific equipment manufacturer's startup, calibration, and troubleshooting personnel to assist the CSI shall be provided.
3. Calibrate instrumentation and place each system into operation. The commissioning of each system shall include the overall calibration and tuning of all control loops and sequences to provide stable control of the process. The validity of all process inputs and outputs for each system shall be checked and corrected during the system commissioning. Final adjustment and calibration shall be performed for all equipment prior to initiation of final testing.

C. System Testing

1. Testing of each panel and/or system shall be scheduled, performed in an orderly sequence, and conducted in the presence of, and to the satisfaction of the Engineer. Testing shall be conducted for each component and system in accordance with the CSI's submitted plan that has been reviewed by the Engineer.
2. Testing shall include the operation of all hardware, software, process control logic and custom control features. (Testing of process control logic shall only be required for panels and components which have been configured and programmed by the CSI.)
3. Testing requirements described herein shall be performed as specified in the following sections:
 - a. Section 17000, Instrumentation.
 - b. Section 17100, Programmable Logic Controller.
 - c. Section 01660, Testing and Startup.
4. The following field tests and demonstrations shall be performed for each of the panels:
 - a. Intermediate point-to-point wiring verification.
 - b. Final point-to-point wiring and transmission verification.
 - c. Network communications testing and verification.

D. Field Testing Requirements

1. Demonstrate the control features of each panel and associated field mounted instrumentation and control equipment, to verify that each panel performs the required control functions and logic as shown on the Contract Drawings or as specified. Control features shall include relay energization, initiation of alarm conditions, resets, interlocks, set point activation, and other functions of the control panels.
2. Equipment shall be field demonstrated to operate satisfactorily in the presence of the Owner, and shall be conducted in accordance with the CSI's testing and demonstration plan that has been reviewed by the Engineer. Field demonstrations shall be performed after successful installation, calibration and testing of each control panel.
3. In addition to demonstrating the operation of standard control features, special control panel functions shall be demonstrated as specified for each panel as specified below.
4. The Contractor shall provide the necessary test equipment, process media, materials, supplies, and qualified test personnel to perform the field demonstrations as specified herein.
5. Field instrumentation control signals that are required to demonstrate the operation of associated control panels may be simulated upon approval of the Engineer.
6. In the event of failure of the field demonstration, the Contractor shall perform the necessary corrections and re-demonstrate, at his own cost and expense, the equipment as directed by the Engineer.
7. Demonstration requirements described herein shall be performed as specified in the following specification sections:
 - a. Section 17000, Instrumentation.
 - b. Section 17100, Programmable Logic Controller.
 - c. Section 01660, Testing and Startup.

E. Sequence of Testing and Demonstration - The CSI shall perform testing and demonstration in the following sequence:

1. Factory Acceptance Testing - Specified in Section 17100, Programmable Logic Controllers.
2. Instrumentation Calibration and Testing - Specified with the respective Division 17 section.
3. Instrumentation Demonstration - Specified with the respective Division 17 section.
4. Wireless I/O testing and verification.
5. Network Communications Testing and Verification.
6. Intermediate Point to Point I/O Wiring Verification - Specified in Section 17100, Programmable Logic Controllers.

- 7. Final Point to Point I/O Wiring and Transmission Verification - Specified in Section 17100, Programmable Logic Controllers.
- F. The CSI shall provide competent personnel to participate in the field testing as scheduled required below.
- G. The CSI shall provide competent personnel to participate in the testing and startup of the facility as scheduled below and as specified in Sections 01640, Equipment-General, and 01660, Testing and Startup.
- H. The CSI shall provide competent personnel to participate in the I/O testing as scheduled below.
- I. The CSI shall provide competent personnel to participate in startup and validation. This effort includes, but is not limited to, addressing how instrumentation was setup, terminations made, and identifying and investigating possible issues with wiring and equipment.
 - 1. The CSI shall respond immediately upon notification of an urgent matter, which may result in destruction or damage of a building, piece of equipment, or property.
 - 2. The CSI shall respond within 24 hours to all other matters.

3.06. CSI FIELD TECHNICIAN TABLE

Description	Number of CSI Field Technicians Required
Factory Acceptance Testing	1
Equipment Installation	1
Instrumentation Calibration and Testing	1
Instrumentation Demonstration	1
Final Point-to-Point Testing	1

END OF SECTION

SECTION 17100

PROGRAMMABLE LOGIC CONTROLLERS (PLC)

PART 1 GENERAL

1.01. SUMMARY

- A. The Contractor shall furnish and install the following PLC enclosures, complete with all necessary accessories and PLC programming software, wired to accommodate all inputs and outputs listed in the input/output (I/O) lists, ready to communicate via the specified medium(s), and ready to be programmed under Section 17101, PLC Programming. In short, this section includes:
 - 1. Programmable logic controllers.
 - 2. PLC power equipment and accessories.
 - 3. Uninterruptible power supplies (UPS).
 - 4. Surge suppression.
 - 5. DC power supplies.
 - 6. PLC enclosures.
 - 7. PLC communication architecture.
 - 8. PLC I/O lists.
- B. Contractor to provide one station control panel which shall include all OEM equipment specified within Division 11 and includes and conforms to all Division 17 specifications.

1.02. GENERAL REQUIREMENTS

- A. It is a requirement of this specification that all Division 17 specifications be provided by a single supplier. This supplier shall have total responsibility for the entire system performance and compatibility of this Section, as well as all other Division 17 specifications.
- B. For ease of identification, symbols for the various components of the metering system to be furnished and installed are given in Table 17100-1.

TABLE 17100-1

SCHEDULE OF TYPE I PROGRAMMABLE LOGIC CONTROLLERS

PLC Nameplate Designation	Nameplate Designation	Location
Tarbell Hill PS	SCP-THPS	Tarbell Hill PS

1.03. RELATED SECTIONS

The specifications sections listed below are an integral part of this equipment specification and the Contractor shall be responsible for providing these sections to the equipment suppliers:

- A. Section 01300 - SUBMITTALS
- B. Section 01600 - MATERIALS AND EQUIPMENT
- C. Section 01640 - EQUIPMENT-GENERAL
- D. Section 01700 - CLOSEOUT AND RECORD DOCUMENTS
- E. Section 16055 - BASIC ELECTRICAL REQUIREMENTS
- F. All Division 17 specifications.

1.04. REFERENCES

- A. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- B. NEMA ICS 3 - Industrial Systems.
- C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- D. NFPA 70 - National Electrical Code.
- E. NFPA 79 - Labeling.
- F. Instrumentation Society of America (ISA) - Standards 5.1 and 5.4.
- G. Industry Electric Code (IEC) – Article 1131.3, Programming Standards.
- H. Federal Communication Commission (FCC), Part 15.247.
- I. Underwriters Laboratories (UL) 508.

1.05. DEFINITIONS

- A. System Supplier – The party responsible for all of Division 17 specifications.
- B. UPS – Uninterruptible power supply.
- C. FCC – Federal Communications Commission.
- D. Yagi – An antenna used to communicate between one location and another location directly.
- E. Operator Interface Terminal (OIT) - Used to facilitate monitoring and/or control between an operator and the process, but is only designed to run software of the same manufacture as the OIT. It is not capable of running windows based programs or other manufacture software based packages because it uses a specific proprietary manufacturer operating system.

- F. Transceiver – A radio transmitter and receiver in a single housing.
- G. Spread Spectrum Radio – A radio that utilizes frequency hopping as a means for communicating with other spread spectrum radios. Due to the nature of frequency hopping, these radios are not subject to frequency licensing from the FCC. They are, however, subject to limitations of use and installation by the FCC.
- H. I/O Lists – See Contract Drawings

1.06. SUBMITTALS

- A. Shop Drawings – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General. The following submittal requirements are to complement the requirements and format set forth in Section 17000, Instrumentation. The following submittal material shall be submitted for the Engineer's review and approval prior to fabrication of any PLC enclosures. PLCs fabricated prior to the approval of these shop drawings are subject to alteration to conform with the approved shop drawings by the supplier at the supplier's cost.
 - 1. Using AutoCAD 2014, or higher, provide these drawings for each PLC in the following order. Label all components with manufacturer and complete model numbers on the drawings. Typical drawings are not acceptable.
 - a. Scaled enclosure layout drawings in 11-inch by 17-inch format, detailing locations of all components on the subpanel, door, and all other enclosure faces. Label each view as "Enclosure Door," "Enclosure Subpanel," "Enclosure Side," etc. Drawing shall display layout of completed assemblies, including, but not limited to, PLC backplane, PLC I/O modules, empty slots, radios, UPS, Ethernet switches, autodialers, terminal blocks, installed spare equipment, power supplies, power line isolators, surge suppression, grounding lugs, wireway, disconnect switches, fuses, control relays, acceptable regions for conduit penetrations of both AC and DC wiring separately, and external power. Illustrate handles, hasps, hinges, and dimensions of exterior mounted devices. Identify equipment manufacturer and model numbers by placing a number next to the piece of equipment on the drawing and cross-referencing with the Bill of Materials. In addition to the Bill of Materials cross-reference labeling, label PLC I/O modules on the drawing with the manufacturer's complete model numbers.
 - b. Elementary diagram drawings in 11-inch by 17-inch format, detailing all enclosure electrical components including, but not limited to, power line isolators, surge suppression, UPS, power supplies, fuses, duplex receptacles, indicating lights, switches, and control relays. Diagrams shall include terminal point designations, line reference numbers, and wire numbers. All wires shall maintain the same wire number for the entire contiguous segment of wire. Diagrams shall illustrate all network cabling and DC and AC electrical distribution. Drawing shall illustrate all available instrument terminations, both used and unused, and be labeled with the manufacturer's terminal point label as will be found on the installed instrument. Provide a legend on this sheet for all symbols and general notes used on this sheet and on the PLC I/O module detail drawings.
 - c. Scaled PLC I/O module detail drawings, in 11-inch by 17-inch format, for each card installed in the PLC backplane. Detail the wiring of all terminations on the PLC I/O module including, wiring of all I/O points and power. Illustrate all termination points for each

signal including termination points for terminal blocks, relays, etc. Identify each wires color and wire number. Utilize NFPA 79 standards to illustrate termination points: to an MCC, to a device terminal, to a control panel terminal, to fused blocks, to surge suppressor blocks, etc. Label each point on PLC I/O modules with the PLCs physical address. Utilize NFPA 79 standards for illustration of wiring: internal to the PLC enclosure, outside the PLC panel, and integral to a device. Progression of I/O modules detail drawings shall be in the order of the orientation of the I/O modules in the PLC backplane (e.g. Slots 1 and 2 on Sheet 7, Slots 3 and 4 on Sheet 8, etc.). Not more than two card details shall be shown on any one drawing. Each I/O module shall be labeled with the installed rack and slot number. Illustrate installed spare I/O modules, but it is not necessary to detail slot filler cards. Each drawing title shall have the following format:

Line 1: PLC Name (e.g. "Control Building, PLC-CB")

Line 2: Module Type (e.g. "Discrete Inputs," "Combo Module: AI, AO, DI, DO," etc.)

Line 3: Installed Rack and Slot (e.g. "Rack 1, Slots 3 and 4") Label all PLC I/O module termination points and I/O point description as shown on the PLC I/O lists. For I/O list points that lack certain information, create descriptions that are in accordance with ISA Standard 5.1. Each point description shall utilize the following format:

Line 1: Equipment Description (e.g. "RSP-6201," "Raw Sewage Pump 1," "Influent Wet Well Level Transmitter," etc.)

Line 2: Signal Description (e.g. "Run Indication," "Flow Indication," etc.)

Line 3: Signal Functional Designation (e.g. "YI-XXXX," "FI-XXXX," where "XXXX" is the instrument loop number.)

- d. Provide two copies of all the above specified AutoCAD *.dwg files on USB Thumb drive. Drawing files must be capable of being used by others and saved to the disk in *.dwg format.
2. Submit manufacturer information on all software.
 3. Calculations to substantiate sizing of each UPS. For each UPS, itemize all equipment drawing from the UPS and compare the respective current and power draws and to the manufacturer's rating of current draw for the specified amount of time.
 4. Unless the manufacturer is specifically named in these specifications, the following must be provided along with the manufacturer information for the proposed "or equals". Provide the following information for a minimum of 20 references for the Engineer to verify 7 of these installations: name and address of the client and location of installation, if different; name of the person in direct responsible charge; consulting design engineer; system programmer; details of the equipment; installation date; startup date; and full performance details. It is the sole responsibility of the Contractor to provide this information. Include all travel costs for Engineer to visit two of the referenced installations.
- B. Operation and Maintenance Manual – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General. The following submittal requirements are to complement the requirements and format set forth in Section 17000, Instrumentation. Substantial Completion for this section will not

be approved until the Engineer has approved Operation and Maintenance manuals.

1. Maintenance, troubleshooting, and replacement of PLC cards, racks, CPU, EEPROM, and all associated equipment.
 2. All "as built" AutoCAD *.dwg files on CD ROM and 11-inch by 17-inch printed hardcopies.
 3. Warranties – Provide the warranties for the PLC, cards, programming software, operator interface, and all other PLC enclosure equipment in a section entitled "Warranties." Equipment covered, dates of expiration, contacts and procedures to exercise each warranty, and limitations of warranty shall be explicitly noted. All warranty papers shall be completely filled out by the Contractor with all necessary serial and model numbers.
 4. One manufacturer-supplied programming manual for the supplied PLC(s).
- C. Project Record Documents – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General. The following submittal requirements are to complement the requirements and format set forth in Section 17000, Instrumentation.
1. Revise AutoCAD drawings of individual I/O cards to reflect all scaling. Coordinate with the PLC programmer for each points scaling.
 2. Update the Operation and Maintenance Manual AutoCAD, or higher, drawing hardcopies and USB Thumb drive with the as-built drawings.
 3. Updated AutoCAD drawings to indicate any changes made during installation or startup of the equipment provided under this section.
 4. Updated Bill of Materials reflecting any changes in manufacturers, models, or quantities.
 5. Updated Bill of Materials for spare parts supplied.

1.07. QUALIFICATIONS

- A. PLC Manufacturer - Company specializing in manufacturing the products specified in this section with minimum 10 years' documented experience, and with authorized service facilities within 250 miles of the project site. Field technicians dispatch sites (i.e., home residences, etc.) do not satiate this distance requirement.
- B. System Supplier – Company specializing in the fabrication of control panels incorporating PLCs.
1. System supplier shall have a minimum of five years of experience fabricating industrial and municipal control panels, with a minimum of three projects of equal or greater size as this project.
 2. Submit names and telephone numbers for a minimum of three similarly sized projects. Names and telephone numbers shall be for the project end users and design engineers.

1.08. DELIVERY, STORAGE, AND HANDLING

- A. Contractor is responsible for all costs associated with shipping.

- B. Contractor is responsible for preparing the assembled and programmed PLCs and associated equipment for shipping and shipping them to the project site.
- C. Deliver, store, protect, and handle products to the site under provisions of Sections 01600, Materials and Equipment; 01640, Equipment-General; and 16055, Basic Electrical Requirements.
 - 1. Shipping to all locations for all equipment provided under this section shall utilize accelerometer or 3-axis dye packets to indicate whether acceleration or deceleration of three times the force of gravity (3G) has been exceeded. If acceleration/ deceleration has been exceeded, Contractor shall pay for disassembly, damage repair, and reassembly of the shipped units. If any damage is apparent from inspection at time of delivery, Contractor is responsible for all costs involved in disassembly, damage repair, reassembly, and additional shipping back to the manufacturer's facility if deemed necessary by Engineer. Accelerometers shall be dye packet devices and shall not be reusable or resettable.
- D. Accept products on site in factory containers unless systems are completely integrated into a pre-manufactured panel that has been factory tested. Inspect for damage.
- E. Store products in clean, dry area; maintain temperature to NEMA ICS 1 requirements.

1.09. MAINTENANCE SERVICE

- A. Furnish manufacturer's, or designated authorized representative's, service and maintenance for PLCs a minimum of two years from date of Substantial Completion.
- B. Provide Owner with a toll-free phone number for technical information and assistance on the PLC and system programming or reimburse Owner for calls made due to system maintenance, debug, tuning, etc. requirement during the two-year warranty period.
- C. PLC Equipment Replacement During Construction – Contractor shall replace PLC components when directed to do so by the Programmer. Contractor shall provide all costs necessary to return components that are suspect of damage to the manufacturer for testing and are responsible for returning repaired modules and reinstalling in place of the temporary replacement module. When available, temporary replacement modules may be taken from uninstalled spare inventory. When the required temporary replacement modules are not available in the uninstalled spare inventory, Contractor shall obtain the necessary temporary replacement module(s) within 48 hours of directive by the Programmer.

1.10. COORDINATION

- A. Coordinate the compatibility of the power supplies and PLC cards with the new instrumentation, existing systems, and equipment. Coordination shall include, but not be limited to:
 - 1. Power supplies provide powered equipment with adequate voltage and amperage according to the connecting equipment manufacturer's recommendations.
- B. Refer to Contract Drawings for designations and verify with Owner.
- C. Coordinate PLC panel shop testing demonstration with the Owner and Engineer. Request for demonstration date shall be in writing no less than two weeks in advance of the proposed date.

1.11. RESOURCES AVAILABLE TO CONTRACTOR

- A. A radio signal strength survey was conducted in November 2017 by AquaLogics Systems, Inc. The survey included radio transmission send and receive signal strengths between the East River Pump Station and treatment facilities. Copies of this survey are available from the Engineer.
- B. East River Pump Station is to be setup/configured to be integrated into an overall future SCADA system.
- C. Install antenna to mounting stand as shown on plan. Antenna height to be 20'-0" above finished grade.

PART 2 PRODUCTS

2.01. PLC MANUFACTURERS

- A. For PLCs listed in Table 17100-1, provide the following type PLCs:
 - 1. ControlWave, Model Micro. No equal will be accepted.

2.02. PROGRAMMABLE LOGIC CONTROLLER (PLC)

- A. General Description
 - 1. Programmable controller manufactured to NEMA ICS 3 with component circuit boards manufactured to NEMA ICS 2.
 - 2. Rack-mounted design. Modular.
 - 3. Provide all terminal blocks, wiring arms.
 - 4. Ability to program through a compatible computer.
 - 5. Provide all power supplies, cabling, surge protection, input/output (I/O) racks, extensions, and ladder logic program to accommodate required I/O and system control as specified in previous sections.
 - 6. Programmable with software by the same manufacturer in strict accordance with IEC 1131-3 standards.
- B. Configuration
 - 1. Processor Unit - Include processor, power supply, EEPROM memory, input/output modules, and special modules required to communicate with other PLCs and other equipment designated to communicate digitally with the PLCs.
 - 2. PLC Module Capacity (for PLCs listed in Table 17100-1)
 - a. Backplanes or I/O racks shall have a minimum of 10 slots and the capability to support any I/O configuration utilizing all slots.

- b. Provide a minimum of five spare slots.
 - c. Provide covers for empty slots.
- C. Table 17100-1 PLC CPUs
- 1. Memory Size - Minimum 2MB of logic memory.
 - 2. Processing Speed – Final program scan time shall not exceed 5 milliseconds in any one PLC. In PLCs where the scan time exceeds this requirement, the CPU shall be replaced with a larger CPU at no additional cost to the Owner.
 - 3. Reserve Memory – Final program shall not exceed 65 percent of the available CPU program capacity. In PLCs where the program occupies more than this amount, the CPU shall be replaced with a larger CPU at no additional cost to the Owner.
 - 4. CPU microprocessor shall be by ARM
 - 5. CPU shall have a minimum of one communication port for 10Base T Ethernet and one serial communication ports for programming and interface with setpoint stations. Minimum baud-rate of the serial communication ports shall be up to 115.2kB. Ethernet port shall provide 10 MBS data transfer to the network, hence intermediary communication adapters that reduce this data transfer rate are not acceptable.
 - 6. PLC
 - a. All I/O modules for PLCs shall be of the same form-factor as the PLC CPU and shall plug into the PLC backplane (rack).
 - b. Use discrete I/O modules with a minimum of 8 and a maximum of 16 points each, 24VDC or 120VAC as required by I/O lists. Discrete outputs shall be isolated. All discrete input modules shall have the same number of points. All discrete output modules shall have the same number of points.
 - c. Use analog I/O cards with a maximum of 8 channels per card. Use voltage, current, or other analog arrangements as required by I/O lists. Analog I/O shall have minimum 12-bit resolution. All analog inputs and outputs shall be isolated. All analog modules shall have the same number of points.
 - d. Combination I/O modules are not acceptable.
 - 7. Installed Spare I/O - Provide the following installed spare I/O:
 - a. Provide a minimum of eight discrete inputs at each PLC.
 - b. Provide a minimum of eight discrete outputs at each PLC.
 - c. Provide a minimum of four analog inputs at each PLC.
 - d. Provide a minimum of four analog outputs at each PLC.

- e. Wire all installed spare points to terminal strips. These terminal blocks do not count toward installed spare terminal blocks.
 - f. Discrete outputs shall be isolated using an interposing relay. Provide relays for used and installed spare discrete outputs.
 - g. In PLC enclosures where signal isolators are used to isolate analog inputs or analog outputs, provide signal isolators for each installed spare analog I/O point.
8. Refer to I/O list for I/O points for each PLC enclosure.
- a. All I/O shall be wired to terminal strips. Where relays, intrinsically safe barriers and/or surge protection for I/O are required, wiring shall be from the I/O module to the relay, barrier, or surge protector to the terminal strip.
 - b. Provide intrinsically safe barriers for I/O originating in hazardous areas as indicated on the Contract Drawings. Installation and separation of wiring shall be in full accordance with the latest revision of the NEC.
 - c. Provide surge protection in accordance with Section 17000, Instrumentation. Surge protection shall be located on a separate DIN-rail from the terminal strips.
 - d. Provide loop and external power supplies for all field devices that require such power.
 - e. Provide 120 VAC power for all 120 VAC discrete outputs.
 - f. Provide 24 VDC power for all discrete inputs.

2.03. STRATEGIC WIRING OF I/O

- A. Wiring of I/O shall be planned such that the failure of any single PLC I/O module minimally affects an overall process.

2.04. ENCLOSURE

- A. All PLC enclosures shall be appropriately sized to accommodate all I/O modules, power supplies, communication equipment, etc. as specified within this section and as necessary to perform the required functions.
 - 1. Note, it is assumed that there will be one complete station control panel for the East River Pump Station which includes the radio/telemetry equipment as well as the OEM pump controls.
- B. Provide PLC and radio equipment for East River Pump Station in accordance with the requirements listed herein and in accordance with Sections 11303, Submersible Pumps; 11990, OEM Control Panels; and 17101, PLC Programming. Refer to Contract Drawings for locations and space available for the station control panel.
- C. Each enclosure shall have two ground busses, one for instrumentation cable shields and enclosure grounding and one for signal grounding.
- D. Provide grounding lugs for connection to the external grounding system.

- E. Provide a Ground Fault Circuit Interrupter (GFCI), 15-amp duplex receptacle in each PLC enclosure. To be used as a service outlet with both outlets available.
- F. Provide three-point latching, gasketed, keyed locking handles. All PLC enclosures shall utilize the same cylinder lock and keys. Provide two keys per enclosure.
- G. Provide an LED light package in each enclosure. LED light shall utilize a manual light switch and terminal block. Light shall not energize automatically when door is opened. Light shall be Hoffman, Model LEDA1S35, or equal.
- H. Provide one externally mounted NEMA 4X rated RJ-45 Ethernet port with 120 VAC outlet. Manufacturer shall be GracePort, Model P-ES-M4RFIS or equal.
- I. Provide a large print pocket on interior face of the enclosure door(s). Where this cannot be accommodated due to windows and other control devices mounted on the door, the print pockets shall be mounted on the interior side of the control panels.
- J. Terminal Blocks
 - 1. Terminal blocks shall be DIN-rail mounted compression-screw type.
 - 2. Label via machine printed zack strips as supplied by the terminal block manufacturer. Zack strips shall be plastic labels specifically designed for the supplied terminal block. Zack strips shall be capable of being separated to label stand-alone terminal block, if necessary.
 - 3. Screwless terminal blocks are not acceptable.
 - 4. Provide installed spare terminal blocks to accommodate wiring of PLC I/O modules provided in empty slots. Of the remaining empty slots, estimate half will be 8-point analog cards and half will be 16-point discrete cards. Mount installed spare terminal blocks in a contiguous strip next to the utilized discrete input, output, analog input, or output strips.
 - 5. For discrete I/O, utilize single tier terminal blocks (Phoenix Contact, Model UK 5N, or equal). For analog I/O, utilize double tier terminal blocks with grounding foot (Phoenix Contact, Model SLKK 5, or equal).
- K. Fuse Blocks
 - 1. Provide individual fuses for each PLC module.
 - 2. Fuse blocks shall utilize slow or fast blow glass fuses as appropriate for the protected device.
 - 3. Fuse block shall have an LED that illuminates when the fuse has blown.
 - 4. Label via machine printed zack strips as supplied by the fuse block manufacturer. Zack strips shall be plastic labels specifically designed for the supplied fuse block. Zack strips shall be capable of being separated to label stand-alone fuse block, if necessary.
 - 5. Provide installed spare fuse blocks to accommodate wiring of additional PLC I/O modules. Estimate as is done for terminal blocks.

6. Fuse block manufacturer shall be Phoenix Contact, model UK5-HESI, or equal.
- L. Relays
1. Provide relays for all discrete outputs.
 2. Characteristics - Plug-in, spade terminal style with pilot light and retainer clip. All relays shall be DPDT rated 10A, minimum. DIN-rail mount relays.
 3. Manufacturer shall be Square D, Type KU, or equal.
- M. Wireway
1. Provide covers for all wireway.
 2. For all stand-alone enclosures, provide 3-inch width wireway, minimum.
 3. Size width and depth based on 50 percent of area fill. Check the applicable codes to verify fill.
- N. Enclosure Nameplates – Provide the following machine engraved nameplates permanently affixed to the front door of each PLC enclosure:
1. Short Circuit Current Rating (SCCR) – Calculate and display SCCR per UL508A Supplement SB. Contractor shall establish the SCCR of individual, relevant power circuit components; apply current limiting components to modify the SCCR in a portion of a circuit in the panel; and determine the overall SCCR of the panel. Submit itemized SCCR calculations with PLC shop drawings. On the nameplate, identify:
 - a. The panel builder company name and address.
 - b. Main supply voltage, phase, and frequency.
 - c. Electrical power full load current, largest motor FLA, and SCCR.
 - d. Enclosure type rating.
 - e. The lighting panel name (i.e., LP-1) and circuit breaker position (i.e., CB-15).
 2. Enclosure Nameplate – Nameplate as required by Table 17100-1.
- O. Install a laminated plastic card in the enclosure of each PLC provided under this contract detailing all procedures for restarting the PLC upon lockup, including reloading the PLC program when necessary.
- P. Install pertinent final I/O lists, elementary diagrams, and PLC card wiring diagrams in the enclosure of each PLC provided under this contract. Drawings shall be laminated and bound via a plastic zip strip through a metallic grommet in the upper left-hand corner of each drawing.

2.05. RADIO EQUIPMENT

- A. Radios shall be provided for the following areas:

1. East River Pump Station Control Panel (SCP-ERPS).
- B. 900 MHz Unlicensed Router, Frequency Hopping Spread Spectrum (FHSS).
- C. Configured with one unlicensed band radio.
- D. Technology - Point-to-point, point-to-multipoint.
- E. Operating Modes - Access point, Remote, Store and Forward.
- F. Data Rate - 1.25 Mbps/-95 dBm.
- G. Latency - Less than 5 msec one-way.
- H. Output Impedance - 50 ohms.
- I. Frequency Range - 902-928 MHz.
- J. Modulation - 2, 4 level GFSK, Dwell Time 10-300 msec.
- K. Cyber Security
 1. Tunneling - IPSec VPN compatible with Enterprise VPN concentrators.
 2. Firewall - Stateful Packet Inspection, Layer 2-4, Access Control Lists, NAT
 3. 90 Unlicensed Encryption - AES-CCM 128/256 bit with auto key rotation
 4. Authentication - RADIUS, PSK, EAP/TLS, PKI
 5. Certifications
 - a. x.509, SCEP, PEM, DER
 - b. FCC Part 15, IC
 - c. CSA Class I, Division 2, IEEE 1613
 - d. UL Listed
 6. Boot Security - Digitally signed firmware.
 7. Power Requirements
 - a. Voltage - 10-60 VDC
 - b. Maximum Power Consumption - 5.3W
 8. Operating Temperature - -40 degrees C to 70 degrees C

9. Humidity - 95 percent at 60 degrees C, non-condensing.
 10. DIN-rail mounted.
 11. Diecast aluminum housing.
- L. Manufacturer shall be Microwave Data Systems (MDS) Model Orbit.
- M. Provide radios for PLCs as shown on the Contract Drawings.

2.06. ANTENNAS

- A. General Description – Provide antennas and associated appurtenances as shown on the Contract Drawings for the following locations.
1. East River Pump Station Control Panel (SCP-ERPS)
- B. Each PLC/SCP shall communicate via a spread spectrum radio sending and receiving signals with the assistance of an antenna. Optimal communication requires (minimally) that each antenna have a straight line of transmission, free from natural obstruction, to other site antennas.
1. Note, the East River Pump Station will be integrated into an overall SCADA system in the future by others.
- C. Yagi (Directional) Antennas
1. Seven-element Yagi with a forward gain 10 dB, minimum.
 2. Front-to-Back Ratio – Greater than 20 dB.
 3. Feedpoint Method - Weatherproof gamma match for coaxial feedline.
 4. Polarization – Horizontal or vertical.
 5. Maximum Dimensions – 30 inches long by 12 inches wide.
 6. The internal balun, coax feed, and connector shall be sealed in a foam potting system to prevent moisture penetration.
 - a. Shall be constructed of aluminum rod and seamless drawn pipe, anodized for maximum reliability and corrosion resistance.
 - b. Manufacturer – Tessco Model 10108-2, 10108-3, or equal.
- D. Provide surge suppression at the input of the antenna cabling to the PLC. Surge suppressor shall be PolyPhaser, Bulkhead Arrestor, N/F.
- E. System supplier shall provide an antenna for each PLC as required to achieve the overall communications requirements of the system (refer to PLC communication system quality requirements). Antennas shall be directional (Yagi) as required and suitable for outdoor environments. Mounted antennas shall be of all-aluminum construction and rated to withstand at least 100 MPH winds

with 0.5-inch radial ice.

- F. Contractor shall provide masts on which to mount antennas. Particular attention shall be given to the correct installation of the antennas to give adequate protection from nearby lightning strikes.
- G. System supplier shall provide all mounting masts or poles as required to support the antennas at the elevations (not to exceed 30 above ground level unless justified to the Engineer) and orientations required. Masts and poles shall be suitable for outdoor environmental conditions, provide adequate support and protection for transmission lines, and be provided complete with all necessary mounting accessories.
- H. Provide TVSS at the input of the antenna cabling to the PLC.
- I. Cable
 - 1. Manufacturer – Tessco LCF78-50JAA7, or equal.
 - 2. Adequate lengths of low loss heliax cable shall be provided for connection to the antenna to the radio transceiver at each site. Involve manufacturer of PLC in sizing of cable length.
 - 3. Other Requirements
 - a. Impedance - 50 ohms.
 - b. Operating Temperature - -40 to 80 degrees C.
 - c. Gauge – 10 AWG.
 - d. Attenuation – 1.25 dB/100 feet, maximum.
 - 4. Transmission line shall be terminated only with connectors rated for the required service.
 - 5. Provide a lightning arrestor between the transceiver and coaxial cable.
 - 6. Installer is responsible for cable damage due to neglecting the manufacturer-stated bending radius.
- J. Installation
 - 1. Mount antennas as shown on the Contract Drawings.
 - 2. Provide 316 stainless steel mounting hardware including, but not limited to, nuts, bolts, washers, lock washers, and U-bolts. Mounting hardware shall be Rohn WM24D or equal.
 - 3. Where entering a structure/enclosure/building from out of doors, manage the cable into a drip loop. Where cabling enters structures from outside, provide a rubber boot with skirt to surround penetration by six times the penetration diameter. Fill gap between skirt and structure with appropriate adhesive. Shrinkwrap or use adhesive to permanently fix rubber boot to exterior exposed antenna cable for 6 inches outside penetration.
 - 4. Yagis Antennas – Mounted antenna shall be able to rotate 360 degrees free from obstruction.

Antenna shall be accessible, as future calibration of radio signal strength will require handling the antenna.

2.05. PLC HIGH-SPEED PEER-TO-PEER COMMUNICATION SYSTEMS (PLC NETWORK)

A. General

1. Communication shall be through Ethernet utilizing Modbus TCP protocol.
2. Minimum data communication speed shall be 10 megabits per second (MBPS).
3. PLC network topology shall be as shown on the Contract Drawings.

B. Copper Communication Cabling (CAT 6)

1. Furnish and install Ethernet cabling in conduit to connect networked PLCs, computers, industrial workstations, and wall-mounted Ethernet jacks to the networked Ethernet switches as shown in the Contract Drawings and in accordance with the project documents.
2. Specifications
 - a. Four-pair, 24 AWG cable. 100 percent overall foil shield bonded to jacket inner wall. Braided drain wire.
 - b. PVC jacket sequentially marked at 2-foot intervals.
 - c. Bonded pairs.
 - d. Color coded as follows: White with blue stripe, blue, white with orange stripe, orange, white with green stripe, green, white with brown strip, brown. White conductors must be striped.
 - e. Allowable pulling tension of 45 lbs.
 - f. Broadcasting quality of 270 MBPS, minimum.
 - g. In accordance with the TIA/EIA 568-B.2 Category 6 standard.
 - h. RJ-45 compatible.
 - i. Input impedance of 100 ± 15 ohms up to 100 MHz.
 - j. Documented and certified performance up to 250 MHz.
 - k. Sunlight and oil-resistant PVC jacket. Color Blue.
 - l. Manufactured by Belden, DataTuff 7953A, or equal.
 - m. Provide Belden R301604 Industrial Ethernet RJ45 plug kits or equal for all final terminations.

3. Ethernet Switches

- a. Provide DIN-rail mounted fast Ethernet switches for mounting in PLC enclosure.
- b. Provide a single switch with a minimum of 8-ports. Switch at minimum to include:
- c. Specifications
 - 1) Software Layer 2 Enhanced with Internet Group Multicast Protocol (IGMP) snooping enabled.
 - 2) Light source optimized to function with 50 micron/125 micron (core/cladding diameter) fiber optic cabling with duplex SC connectors.
 - 3) Fiber optic link budget (loss) no greater than 8.0 dB at 1300 nanometers over 0 to 5,000 meters.
 - 4) DIN-rail mounted, fanless design.
 - 5) Manufacturer-rated for industrial use, including temperatures of 0 to 60 degrees C, humidity 10 to 95 percent non-condensing, and a Mean Time Between Failures (MTBE) manufacturer rating greater than 40 years.
 - 6) IEC 60068-2-27 conformity for shock. Capable of withstanding 18 shocks at 15 g of 11 ms in duration.
 - 7) IEC 60068-2-6 conformity for vibration.
 - 8) EN 61000-4 conformity for immunity to electro-magnetic interference (EMI).
 - 9) Support 256 virtual Local Area Networks (VLANs)
 - 10) Removable terminal blocks with screw compression.
 - 11) Capable of being powered from redundant/dual DC power supply sources.
 - 12) LEDs for Link and Activity per port. Failure LED for switch.
 - 13) Capable of supporting a self-healing, fiber optic ring structure with a reconfiguration time less than 0.3 seconds.
 - 14) Device configuration and monitoring shall be achieved through a web-browser interface via the Ethernet TCP/IP protocol. The device shall include an embedded web server to access configuration and status pages. Ethernet switches that utilize separate configuration software packages are not acceptable.
 - 15) One Form C relay output contact, user-configurable to indicate startup failure, a broken ring segment, or other warning events.
- d. Manufacturers

- 1) Hirschmann, RS20 Series.
- 2) Allen-Bradley, Stratix 8000 Series.
- 3) Moxa Technologies, EDS 500 Series.
- 4) N-Tron equipment is not acceptable
- e. Completely compatible and optimized by the CSI for use with the supplied PC HMI (PLC OIT), PLC CPUs, and other networked equipment.

2.06. PLC ACCESSORIES

A. 24 VDC Power Supply

1. Provide a sufficient quantity of 24 VDC power supplies as necessary to power PLC equipment and instrumentation connected to the PLC.
2. Power supplies shall be manufactured by PULS, Phoenix Contact, Quint, Model DR Series, LAMDA Electronic, Acopian, or equal. Power supplies shall meet, or exceed, the following requirements.
 - a. UL 508 listed, CE approved.
 - b. DIN-rail mounted.
 - c. Removable, pluggable connections for input and output power.
 - d. Local output status indication light.
 - e. Overload Protection - Current limited to a preset value.
 - f. 89 percent efficient.
 - g. Output Voltage - 24 VDC +5 percent adjustable.
 - h. Temperature Range - -20 to 50 degrees C.
 - i. Mean lifetime of 500,000 hours.
 - j. Two-year warranty.
 - k. Ripple and Noise - 24 mV RMS, 200-mV peak to peak.
 - l. Accept input voltages of both 120 VAC and 240 VAC.
 - m. Fully enclosed, touch-safe.
 - n. Integral LEDs indicating DC Power On.
3. Power supplies shall be supplied in redundant pairs, with each pair provided with a redundancy

module of the same manufacturer as the power supplies and specifically designed for use as a redundancy module for the furnished power supplies. Redundancy module shall accept two independent inputs and provide one power source output. Redundancy module shall automatically decouple the standby power supply to remove the load from the standby power supply when the primary power supply is operational and functioning properly. Redundancy module shall provide dry contact outputs indicating the health of each power supply. The redundancy module shall have integral LEDs indicating the status of each power supply. Transition of power between the primary and standby power supply shall not affect continuity of power to any of the supplied loads.

B. I/O Signal Surge Suppressors

1. Provide I/O surge suppression for all discrete and analog signals terminating or originating out of doors or in other buildings and as specified in Section 17000, Instrumentation.
2. PLC Surge Suppressor– Metal Oxide Varistor (MOV) based surge suppression with an active tracking filter.
 - a. Provide one power protection device for each PLC enclosure.
 - b. Manufacturer – Emerson Network Power, Model Islatrol IE; or equal.
 - c. Minimum of 160 Joules protection between line-neutral, line-ground, and neutral-ground for a total of 480 Joules protection.
 - d. Response Time – Less than 1 nanosecond (in Normal mode).
 - e. 40kOhm surge capability on a 8x20 microsecond waveform.
 - f. UL1449 listed for safety and performance.
 - g. Manufactured by an ISO 9001 company.
 - h. Load side sine wave tracking circuitry.
 - i. Arrays of MOVs shall be located directly on the load side terminals and line side terminals to minimize response time.
 - j. Enclosure – Sand packed or epoxy filled.

C. Operator Interface Terminal

1. Provide setpoint stations as described below for the PLCs listed in Table 17100-1. For each setpoint station, provide cables necessary for communication with the PLC.
2. Height of centerline of setpoint station shall be between 4 feet 9 inches and 5 feet 0 inches above finished floor.
3. OITs shall be Red Lion, Model G315C210. No equal will be accepted.
4. OITs shall have the following characteristics:

- a. 1024 X 768 resolution with 32K colors.
- b. Each page shall be capable of containing up to 32 lines that can be accessed using up/down arrow keys
- c. Monitor and display up to 1024 alarms with the last 256 alarm events stored in alarm history
- d. 10 programmable keys and 3 front panel LED indicators.
- e. NEMA 4 indoor rating.
- f. Serial communication between setpoint station and PLCs shall be 100 percent compatible.
- g. Operating Temperature - 0 to 50 degrees C.
- h. Provide sufficient memory for a minimum of 10 screens.

2.07. PLC BATTERY BACKUP

A. Characteristics

1. No interruption (no transfer time for normal power to battery backup) of power to the RTU system.
2. Power Reserve Time at Full Power Draw - Eight hours, minimum. See paragraph 2.08.C below for power draw requirements. System supplier shall submit calculations to substantiate sizing.
3. Provide charging units.
4. Provide all necessary equipment to provide output of alarm as specified for RTU internal diagnostics in the I/O list.

B. RTU power supply shall be backed up by the battery backup. The required capacity of the battery backup shall be determined by the load requirements of the RTU and its peripherals. As a minimum, the battery backup shall maintain power to the entire panel, all communication devices and modules, all relays, all loop power supplies, all indicators, the RTU, and all RTU I/O that is powered from the panel, setpoint stations/HMIs, but not the heating/cooling system for the panel.

C. It is preferred that the battery backup be located in the same enclosure as the RTU, unless panel size or cooling requirements make it impractical. In that case, it shall be located on a wall shelf located above the RTU enclosure. Shelf shall be provided by the Contractor.

D. Provide one battery backup for each RTU.

2.08. UNINTERRUPTIBLE POWER SUPPLY (UPS)

A. Characteristics

1. Provide one online double conversion UPS for each PLC. Line Interactive, Offline- Standby,

Double Conversion On Demand, and Ferro-resonant technologies are not acceptable.

2. Minimum Watt Capacity - See paragraph 2.08.C below.
 3. Minimum Volt-ampere Capacity - See paragraph 2.08.C below.
 4. Four 120 volt, 5-15R, output receptacles, minimum.
 5. Alarms - Battery backup operation, low run time remaining, and overload.
 6. Automatic current and over-voltage output protection.
 7. Operating Input Voltage - 99 VAC - 138 VAC.
 8. No interruption (no transfer time for normal power to battery backup) of power to the PLC system.
 9. Efficiency - 95 percent.
 10. Brownout protection for input voltages of 88 VAC without the use of the batteries.
 11. Lightning and Surge Protection - ANSI/IEEE C62.41 Categories A and B with 0.3 to 0.7 percent.
 12. Radio Frequency Noise Isolation - 38 dB common mode, 47 dB normal mode.
 13. Power Reserve Time at Full Power Draw - One hour, minimum. See paragraph 2.08.C for power draw requirements. System supplier shall submit calculations to substantiate sizing.
- B. Manufacturer - Powerware, Model 9130, APC Smart-UPS Online, or equal.
- C. PLC power supply shall be backed up by the UPS. The required capacity of the UPS shall be determined by the load requirements of the PLC and its peripherals. As a minimum, the UPS shall maintain power to the entire panel, all communication devices and modules, all relays, all loop power supplies, all indicators, the PLC, and all PLC I/O that is powered from the panel, setpoint station, but not the heating/cooling system for the panel.
- D. It is preferred that the UPS be located in the same enclosure as the PLC, unless panel size or cooling requirements make it impractical. In that case, it shall be located on a wall shelf located above the PLC enclosure. Shelf shall be provided by the Contractor.

2.09. INTERNAL TEMPERATURE SENSOR

A. Characteristics

1. Provide one wall-mount temperature sensor for each PLC enclosure. Provide all mounting, power supplies and cable needed to connect the sensor to an analog input card on the PLC.
2. The temperature range shall be 0 to 135 degrees F.
3. The output shall be 4-20 mA.
4. The input power shall be 24 Vdc.

- B. Manufacturer – OMEGA EWS-TX or equal.

PART 3 EXECUTION

3.01. EXAMINATION

- A. Verify that surfaces are ready to receive work.
- B. Verify field measurements are as shown on Drawings.
- C. Verify that required utilities are available, in proper location, and ready for use.
- D. Beginning of installation means installer accepts conditions.
- E. Verify grounding of system.

3.02. PANEL FABRICATION

- A. Install in accordance with manufacturer's instructions.
- B. Wire Labeling
 - 1. All wiring shall be labeled within 1.0-inch of stripped sheathing.
 - 2. Wire label text shall be visible in its installed location without manual manipulation.
 - 3. Wire shall carry the same wire number for an entire contiguous segment.
 - 4. Wires shall be labeled via machine-generated print on polyester or polyvinyl film.
 - 5. In the event that labels begin to fall off or text begins to smudge, or otherwise begin to become illegible, within one year of panel delivery to the site, the Contractor shall remove all labels within the panel with new labels at the Contractor's own expense. In this case, the Engineer must approve replacement labels.
- C. Device Labeling - All subpanel-mounted devices shall be labeled.
 - 1. Devices that do not require external power (24 VDC or 120 VAC) shall be labeled via machine-generated print on polyester or polyvinyl film. Print shall not be capable of being washed off, smudged, or erased. Labeled components include, but are not limited to, individual terminal blocks, control relays, individual fuses, individual I/O surge suppressors, and grounding bars.
 - 2. Devices that require 24 VDC external power or 120 VAC shall be labeled via machine engraved plastic nameplates utilizing white text on black background. Nameplates shall be secured to the subpanel via permanent adhesives. Labeled components include, but are not limited to, disconnect switches, surge suppression, power supplies, PLC backplanes, circuit breakers, DIN-rail strips, radios, Ethernet switches, UPSs, and convenience receptacles.
 - 3. Exemptions – Individual PLC I/O modules only.

- D. Supplier-Fabricated Cabling – All cabling fabricated by the panel fabricator

3.03. SHOP TESTING

- A. To verify that all PLCs are ready for system programming, the system's integrator shall perform the following shop testing prior to shipment to the site:
1. Perform a test configuration on all PLC modules to verify that all PLC CPUs communicate with the associated I/O modules, including inter-rack communication.
 2. Perform a test configuration of all device servers to verify that the PLC communicates with a Modbus device connected to each device server.
 3. Install the battery backup, UPS, and power supplies, simulate all device outputs to the PLC, and verify that the signals are read properly at the PLC. As part of the testing of the UPS, fully charge the UPS battery and disconnect line power from the UPS and verify that:
 - a. "Power Loss" is sensed by the PLC when line power is disconnected.
 - b. Verify that when the UPS battery low that "Low UPS Battery" is sensed by the UPS.
 - c. Record the time it takes for the UPS battery to completely drain from full charge once line power is disconnected from the PLC panel.
 4. Point test all PLC I/O to verify that all I/O modules are correctly wired to the terminal strips and that the PLC I/O modules function properly. Testing shall be performed between terminal points on the I/O module to the terminal strip the electrician will terminate field wiring to.
 5. For PLC communicating via radio, load configuration programs in each PLC to establish communication synchronization.
 6. Leave all configuration programs in the PLC CPU.
 7. Perform testing to verify that the Ethernet communication between the PLCs is in accordance with the manufacturer's requirements.
- B. After all testing has been successfully completed, contact the Engineer to schedule an in-shop inspection by the Engineer. Contractor shall have the personnel that performed the testing present to perform random verification of the tests performed by the integrator.
- C. Submit a written report to the Engineer prior to scheduling Engineer's in-shop inspection.
- D. The Contractor shall furnish all instruments and a qualified engineer to properly perform all tests required.
- E. Factory acceptance testing shall not be approved and authorized for shipment from the fabricator's facility until PLC wiring diagrams are updated to reflect "As Fabricated" conditions and marked "As Built."

3.04. INSTALLATION

- A. Install in accordance with manufacturer's instructions.
- B. All electrical work performed in fabrication and installation of PLC systems shall be in full accordance with the requirements of the Division 16 Electrical Specifications.
- C. Contractor shall be responsible for all labor, effort, testing/troubleshooting, and costs associated with diagnosing and replacing OITs that are suspected of being defective as determined by the Engineer during construction.
- D. Terminate Category 6 cabling in accordance with TIA/EIA-568-B pin/pair assignments for 100-Ohm balanced twisted pair cabling (T568B), as follows:
 - 1. Pin 1 - White with orange stripe.
 - 2. Pin 2 - Orange solid.
 - 3. Pin 3 - White with green stripe.
 - 4. Pin 4 - Blue solid.
 - 5. Pin 5 - White with blue stripe.
 - 6. Pin 6 - Green solid.
 - 7. Pin 7 - White with brown stripe.
 - 8. Pin 8 - Brown solid.
- E. Ethernet Switch Configuration
 - 1. Program IP addresses into each switch using IP addresses supplied by the Owner.
 - 2. Configure parameters appropriate for an industrial control network including, but not limited to, enabling IGMP snooping and QoS.
 - 3. Configure Ethernet switches to function in a self-healing, redundant ring architecture.
 - 4. Advise Engineer of parameters available for the Ethernet switch's integral relay output contact and program as selected by the Engineer.
 - 5. Assist in troubleshooting network issues at the request of the Engineer.
 - 6. Configure Managed Ethernet Switches - Coordinate configuration of managed switch properties with the Owner and Engineer via shop drawings. Schedule a meeting with the Owner prior to in-field switch configuration to review switch configuration parameters and discuss intended managed switch function. Switch configuration shall occur before any Ethernet devices are put into service. Perform site visits for switch configuration to meet the sequence of construction. Switch configuration may include routing, development of up to three VLANs, configuration of IP addresses, traffic management, rules, and setup of switch management software of multiple

computers. Contractor shall take the lead on researching, collecting, and presenting all available configuration options.

7. Provide adequate put-up lengths on cable reels to make termination-to-termination runs without splices. Spliced cables are not acceptable.
- F. Radio Communication Requirements with Remote PLCs via Radio – The MTU shall communicate with each RTU located remotely, in regards to the water treatment facility, with a 92 percent hit rate of successful pollings within a 24-hour period for 5 consecutive days. Should this quality stipulation not be obtained one week after the last RTU is brought on-line, the system supplier shall provide replacement RTUs, labor, wiring, power, and all necessary supporting equipment, to be strategically placed and retransmitted from at their own expense until this stipulation is obtained during a 24-hour period for 5 consecutive days.
1. Note, the East River Pump Station will be integrated into an overall SCADA system in the future by others.

3.05. IDENTIFICATION

- A. Label each termination point on each end of the Category 6 cable. For example, each cable shall be labeled as "PLC-3/Port 6," "PLC-3A/Port 2," "Superintendent's Office Jack 1/Port3," etc.
- B. Tag each cable in junction boxes.
- C. Check cables and wires for proper identification numbering and color-coding.

3.06. CHECKOUT AND TESTING

- A. Upon receipt of Category 6 reels, perform pre-installation ("on the reel") measurements to verify attenuation, length and continuity. Record the results of all measurements and submit to the engineer. Cables that fail continuity or that have higher than specified attenuation shall be subject to rejection and shall be replaced at no additional cost to the Owner.
- B. Make the following tests after cable installation:
 1. Upon completion of the cable installation, perform 100 percent bi-directional end-to-end loss testing of cable runs between each port and switch.
- C. The calculated and measured values of the end to end shall be in accordance with Category 6 standards. In the event that any differences are in excess, implement troubleshooting techniques and methods to provide agreement. If the discrepancies cannot be reconciled, the cable installation shall be removed, replaced, and retested at no additional cost to the Owner.

3.07. SYSTEM PROGRAMMING

- A. The programmer shall provide all system programming to implement system description. The programmer shall modify all programming to meet the requirements of the Owner.
- B. The programmer shall provide additional programming services as required by Owner if system needs modification to function properly.

- C. Programmer shall provide for programming of an additional 25 points of I/O. If these services are not used a credit shall be provided to the Owner.
- D. The Contractor and programmer shall schedule system programming with the Owner. Upon request, the programmer shall visit the site within 24 hours of request.

3.08. MANUFACTURER'S OR SYSTEM INTEGRATOR'S FIELD SERVICES

- A. Provide a minimum of one, eight-hour day of on-site time for supervision of installation and hardware troubleshooting at Engineer's request. Written notification of the day required for troubleshooting and installation supervision will be sent to the Contractor 10 business days prior to the required day.

3.09. DEMONSTRATION AND OPERATION

- A. Provide systems demonstration under provisions of Sections 01600, Materials and Equipment, and 01640, Equipment-General.
- B. Demonstrate operation and programming of controller.
- C. Demonstration shall include, but not be limited to, the following:
 - 1. Demonstrate all alarms.
 - 2. Demonstrate changing of all setpoints.
 - 3. Demonstrate actions upon alarm.
 - 4. Demonstrate actions upon power loss.
 - 5. Demonstrate all control logic.

3.10. TRAINING

- A. Provide one, four-hour session of training to the operations staff.
- B. All procedures shall be as recommended by the respective equipment manufacturer.
- C. Procedures shall be physically performed rather than discussed in theory.

3.11. CERTIFICATION OF TESTING

- A. Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Owner. When the presence of such representative is so waived, certified results of the tests made and the results thereof shall be furnished by the Contractor.
- B. All tests shall be performed in the presence of the Owner. Written notice of all tests shall be given the Owner at least two weeks in advance.

3.12. TEST EQUIPMENT

- A. The Contractor shall furnish all instruments and a qualified engineer to properly perform all tests

required.

3.13. FACTORY-TRAINED SUPERVISION

- A. The Contractor shall include in his work the providing of necessary factory trained supervision to check over equipment for proper functioning before putting the equipment into operation as may be required by these specifications. This shall include establishing a simulated fault on checking out the coordination of the protective devices.
- B. Point-to-point test of all wiring.
- C. Functional test of all equipment, modes, alarms, controls.

END OF SECTION

SECTION 17101

PROGRAMMABLE LOGIC CONTROLLER (PLC) PROGRAMMING

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. Functional requirements for the programming of the PLCs and Operator Interface Terminals (OITs) specified under Section 17100, Programmable Logic Controllers.

1.02. RELATED SECTIONS

- A. The specifications sections listed below are an integral part of this equipment specification and the Contractor shall be responsible for providing these sections to the equipment suppliers:

1. Section 01300 - SUBMITTALS
2. Section 01640 - EQUIPMENT-GENERAL
3. Section 01700 - CLOSEOUT AND RECORD DOCUMENTS
4. All Division 11 specifications
5. All Division 17 specifications.

1.03. REFERENCES

- A. NEMA ICS 1 - General Standards for Industrial Control and Systems
- B. NEMA ICS 3 - Industrial Systems
- C. ISA - Standards 5.1 and 5.4
- D. IEC – 1131.3 Programming Standards

1.04. DEFINITIONS

- A. Input/Output Lists – Tables 17100-2. When references are made to the I/O lists, it is implicit that derived I/O, included in the “Functional Designation” column, shall be included.
- B. Physical I/O Point – An input or output wired to a PLC I/O module.
- C. Equipment Identification Number – Numbers developed by the Engineer to identify equipment in the field, in PLC programs, and in supervisory programs. Equipment Identification Numbers are shown on the PLC I/O lists in “Item No” and “Equipment Designation” columns. Equipment Identification Numbers are in accordance with ISA standards 5.1 and 5.4.
- D. Functional Designation – Column of the PLC I/O lists that identifies some of the PLC I/O registers required for each physical I/O point. Functional designations are in accordance with ISA standards 5.1

and 5.4. The functional designation shall always be identified in conjunction with the item number for each physical I/O point.

- E. I/O Type – A PLC register type. Referring to either an integer, floating point (or real), or digital register.

1.05. SUBMITTALS

- A. Shop Drawings – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General. The following submittal requirements are to complement the requirements and format set forth in Section 17000, Instrumentation.
1. Submit the name, address, and telephone number of the programmer. Submit the programmer's qualifications and experience along with the names, addresses, telephone numbers, and dates of a minimum of three clients for whom the proposed programmer has programmed the specified PLC with similar complexity to the work specified herein. Provide names, addresses, and phone numbers to contact these references.
- B. Operation and Maintenance Manual – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General. The following submittal requirements are to complement the requirements and format set forth in Section 17000, Instrumentation.
1. Printed PLC program bound with rigid front and back covers. Three-ring binders are not acceptable. Insert a Table of Contents outlining different files within the program, a discussion of the final operational sequence, and a final I/O list associating a PLC address to each input and output to the PLC. Printed program shall include all logic documentation. Provide tabbed pages for each item listed in the Table of Contents.
 2. Two copies of the fully documented program on CD-ROM including all custom created function block (DFB) logic.
- C. Project Record Documents – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General. The following submittal requirements are to complement the requirements and format set forth in Section 17000, Instrumentation.
1. Revise AutoCAD drawings of individual I/O cards to reflect all scaling.
 2. Provide a minimum of two printed copies of the final, debugged program for the PLCs. Printed copies shall be fully documented including, but not limited to, the following:
 - a. All equipment names referenced in a manner consistent with the equipment names in the Contract Documents.
 - b. All I/O points referenced in a manner consistent with the Contract Documents.
 - c. Rung number cross-references for contacts, coils, timers, etc.
 - d. Written description of actions performed by the program.
 - e. All logic used in custom function blocks (DFBs).

1.06. QUALIFICATIONS

- A. PLC and OIT Programmer - Company specializing in programming of PLCs and OITs furnished under Section 17100, PLC, with minimum 5 years' documented experience, and with offices within 300 miles of the project.

1.07. TRAINING

- A. Provide training at the Owner's facility for a minimum total time as specified below.
- B. Training shall consist of one day after startup.
- C. Training shall include the following:
 - 1. Basic system concepts and maintenance procedures for all hardware and software provided.
 - 2. Basic system concepts, troubleshooting, and maintenance procedures shall include:
 - a. Procedures for restarting and reloading PLC programs upon PLC failure.
 - b. Procedures for troubleshooting and replacement of I/O modules, CPUs, power supplies, communication modules, and other devices associated with the PLCs.
 - c. All installed PLC program capabilities.
 - d. Use of all password protected areas. Provide the Owner with all passwords.
- D. All training times are on-site times. All times referenced as "days" are eight hours.

1.08. COORDINATION

- A. Coordinate the compatibility of the hardware, software, and programming with the existing system and facility operation. Coordination shall include, but not be limited to:
 - 1. Programs effectively address all of the requirements of the system for control, display, and operation.
 - 2. Equipment will execute the programs to obtain the intended operation.
- B. Coordinate with equipment suppliers to verify that the appropriate signals and signal scaling are available to control the processes as specified.
- C. Make changes in programming to provide the intended operation.
- D. Coordinate demonstration to Owner with the Contractor, Owner, and Engineer. Request for demonstration date shall be in writing no less than two weeks in advance of the proposed date.
- E. Provide for a minimum of one, four-hour meeting with the Owner and Engineer at the Owner's facility to coordinate requirements for PLC programming. As a minimum, meetings shall cover:
 - 1. Operational sequences.

2. Setpoint station configuration.
 3. Sequence of construction.
- F. Coordinate I/O states accordingly:
1. Communicate whether I/O contacts to and from new and existing equipment are momentary or maintained.
- G. Obtain AutoCAD PLC I/O module drawings from the supplier of the PLC enclosure revision to indicate analog I/O scaling.

PART 2 PRODUCTS

2.01. SOFTWARE

- A. Shall be by the manufacturer of the provided PLC and support IEC 1131.3 programming standards. Provide one licensed copy of PLC programming software, and one licensed copy of the OIT programming software.

2.02. OWNERSHIP AND DELIVERY OF SOFTWARE PROGRAMS

- A. Software License Agreement (SLA) – Included with the cost of this specification section shall include all licensing fees and royalties (i.e., compensation) necessary for the Owner to possess, troubleshoot, maintain, append, and modify the PLC and HMI programs furnished with the system supplied herein. It is understood by the Owner that modification of these software programs by the Owner within the warranty period, without the written consent of the program supplier, may void the remainder of the product warranty.
- B. Interim Delivery of Programs – Furnish current-to-date electronic copies of PLC and/or HMI programs at the request of the Owner or an Owner's assignee.
- C. Final Delivery of Programs – At the time of Final Completion, furnish to the Owner two electronic copies of the completed programs on DVD-ROM. Furnish two replacement copies each time the program is modified thereafter. Utilize the date in the program revision number, i.e. a program modified on December 12th 2012, shall carry the revision number 12212012.
- D. All programs, as well as all aspects of the programs, shall be unlocked, unencrypted, and unprotected. Custom function blocks shall not be protected or hidden.

PART 3 EXECUTION

3.01. SPECIFIC PROGRAMMING REQUIREMENTS

- A. All programming shall be in accordance with the latest revision of IEC 1131-3 (PLC Programming Standards). All PLC programming shall be performed using the Structural Text Editor, not ladder logic or any other editors.

- B. Scale all inputs and outputs in units agreed upon with the Owner.
- C. Provide a list of all register addresses with register data content descriptions to the Owner and Engineer by the contract due date of PLC program completion. Submit in MicrosoftExcel format on a flash drive or compact disc.
- D. Where changes in PLC programming are necessary to prevent nuisance alarming or unintentional nuisance operation of equipment, the programmer shall perform the programming at no additional cost to the Owner.

3.02. PLC PROGRAM TAG FORMAT

- A. Group Individual I/O Types (Floating Point, Integer, Digital Registers) in Contiguous Address Ranges – Prior to developing control logic, quantify the number of each I/O type that will be required within each PLC and provide contiguous blocks of I/O addresses that will accommodate the known PLC addresses and 20-percent expansion. Do not, for example, assign an integer register in the middle of a discrete block of I/O or a real (floating point) register in the middle of a block of integer I/O.
- B. Equipment identification numbers and associated I/O addresses shall be consistent throughout the PLC system. For instance, if influent flow transmitter equipment designation is FIT-1000, the physical analog input should be FI_1000 and the high level alarm should be FAH_1000_AL, with an alarm enable bit of FAH_1000_AE, with a user-adjustable setpoint tag of FAH_1000_SP, with a running flow total of FQ_1000, with a daily flow total FQ_1000_Daily, with daily minimum of FI_1000_DLO, etc. Supervisory and PLC programs, operating, mechanical, and electrical documentation shall utilize the same equipment identification numbers.
- C. Utilize functional designations. A short list of commonly used functional designations is as follows and shall be used whenever possible:

AI_	Analyzer Indication	FAL_	Flow Alarm Low
AAL_	Analyzer Alarm Low	FQ_	Flow Totalization
AAH_	Analyzer Alarm High	IAH_	Current Alarm High
AALL_	Analyzer Alarm Low-Low	II_	Current (amps) Indication
AAHH_	Analyzer Alarm High-High	JA_	Power Alarm
FI_	Flow Indication	KQ_	Runtime Totalization
FAH_	Flow Alarm High	LI_	Level Indication
LAH_	Level Alarm High	VAH_	Vibration Alarm High
LAL_	Level Alarm Low	VAL_	Vibration Alarm Low
LQ_	Level Totalization	WI_	Weight Indication
OC_	Open/Stop Control	WAH_	Weight Alarm High
CC_	Close/Start Control	WAL_	Weight Alarm Low
PI_	Pressure Indication	WQ_	Weight Totalization
PAL_	Pressure Alarm Low	YI_	Run Indication
PAH_	Pressure Alarm High	YA_	Fail Indication

SI_	Speed Indication	YQ_	Start Counter
SC_	Speed Control	ZI_	Position Indication
TI_	Temp Indication	ZIO_	Position Indication Open
TAH_	Temp Alarm High	ZIC_	Position Indication Closed
TAL_	Temp Alarm Low	ZC_	Position Control
VI_	Vibration Indication		

- D. Utilize “modifiers” to tag names to further identify registers. A short list of commonly used modifiers is as follows and shall be used whenever possible:

_AL	Alarm bit (digital)	_DAVG	Daily average (real)
_SP	Setpoint (real)	_DAILY	Daily total (real)
_DLO	Daily low/minimum (real)	_AE	Alarm enable (digital)
_DHI	Daily high/maximum (real)	_AT	Alarm type (real)
_SEL	Alarm channel select (real)	_AUTO	Auto position (digital)
_HAND	Hand position (digital)	_OFF	Off position (digital)
_LOC	Local position (digital)	_REM	Remote position (digital)

1. Integers may be used to indicate multiple switch positions. When integers are used for this purpose, the tag shall be formatted as follows: HSI_XXXX_HOA, as in Hand Switch Indication, loop number XXXX, Hand-Off-Auto. For instance, if the switch is two-position “Local/Remote” switch the tag may be HSI_1000_LR.
 2. Do not use tag modifiers such as _SPH for “Setpoint High”.
- E. Alarming – Many derived datapoints will be required as the project is commissioned. Derive additional datapoints as requested by the Engineer or Owner during the construction phase. There is no limit to the quantity of derived datapoints that may be required.

3.03. TERMS USED

- A. AIT-Analyzer Indicating Transmitter (includes sensor).
- B. LIT – Level Indicating Transmitter (includes sensor).
- C. LT – Level Transducer.
- D. FIT – Flow Indicating Transmitter (includes sensor).
- E. CSP – Control Setpoint. These tags shall be used to control PLC logic.
- F. ASP – Alarm Setpoint. These tags shall be used to display an alarm when the threshold is reached.

3.04. SPECIFIC PROGRAMMING REQUIREMENTS

- A. PLC Diagnostics – As a minimum, for each PLC provide communication failure alarms, low memory battery alarms, PLC panel power loss alarms, and PLC uninterruptible power supply (UPS) battery low alarm. If the supplied PLC or UPS has additional diagnostics, provide programming to accommodate these additional indications or alarms.

3.05. PLC PROGRAMMER'S FIELD SERVICES

- A. In addition to time required for PLC program installation, provide a minimum of one four-hour day of on-site time for PLC program troubleshooting at Engineer's request. Written notification of the days required for troubleshooting and installation supervision will be sent to the Contractor 10 business days prior to the first required day.

3.06. ADDITIONAL PROGRAMMING SERVICES

- A. The programmer shall provide all system programming to implement system description.
- B. The programmer shall provide additional programming services as required by Engineer if system needs modification to function properly.
- C. Programmer shall provide for programming of an additional 25 points of physical I/O and the derived I/O associated with each physical point. Provide a credit to the Owner for programming services not utilized towards the additional 25 I/O points.
- D. The Contractor and programmer shall schedule system programming with the Owner. Upon request, the programmer shall visit the site within 24 hours of request.

END OF SECTION

SECTION 17375

LEVEL MEASUREMENT (SUSPENDED PRESSURE TRANSDUCER TYPE)

PART 1 GENERAL

1.01. SECTION INCLUDES

- A. The Contractor shall furnish and install, ready to operate, the following level sensing systems, complete with all necessary accessories to monitor level as indicated herein in compliance with the following specifications and as shown on the Contract Drawings.
 - 1. It is a requirement of this specification that the elements of the system be provided by a single supplier. This supplier shall have total responsibility for the equipment and services specified in this section, as well as all other Division 17 specifications.
 - 2. For ease of identification, designations for the various components of the metering systems to be furnished and installed are given below:

TABLE 17375-1

SCHEDULE OF SUSPENDED PRESSURE TRANSDUCERS

Service Nameplate Designation	Equipment Designation	Approximate Span	Output
Tarbell Hill Pump Station Wet Well Level	LT-6201	0-25	Liquid depth in feet

1.02. RELATED SECTIONS

- A. Section 01300 - SUBMITTALS
- B. Section 01600 - MATERIAL AND EQUIPMENT
- C. Section 01640 - EQUIPMENT-GENERAL
- D. Section 16055 - BASIC ELECTRICAL REQUIREMENTS
- E. Section 16110 - CONDUIT
- F. Section 16201 - EQUIPMENT WIRING
- G. All Division 17 Specifications

1.03. REFERENCES

- A. NEMA ICS 1 - General Standards for Industrial Control and Systems.
- B. NEMA ICS 3 - Industrial Systems.

- C. NEMA ICS 6 - Enclosures for Industrial Controls and Systems.
- D. NFPA 70 - National Electrical Code.

1.04. SUBMITTALS

- A. Shop Drawings – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General.
 - 1. Refer to Section 17000, Instrumentation, for shop drawing format and content.
 - 2. Scaled AutoCAD drawings illustrating the actual mounting locations for each transmitter. Indicate dimensions of mounting area, centerline of the transducer cable, distances from the centerline of the transducer cable and the walls, and any nearby obstructions. Indicate distance from transducer to floor.
- B. Operation and Maintenance Manual – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General.
 - 1. Refer to Section 17000, Instrumentation, for operation and maintenance manual format and content.
- C. Project Record Documents – Submit under provisions of Sections 01300, Submittals, and 01640, Equipment-General.
 - 1. Refer to Section 17000, Instrumentation, for project record documents format and content.

1.05. WARRANTY

- A. Two-year warranty covering the transmitter and transducer.

PART 2 PRODUCTS

2.01. MANUFACTURERS

- A. The suspended pressure transducer-type level sensing equipment shown in Table 17375-1 shall be the following or equal:
 - 1. Endress+Hauser, Model Waterpilot.
 - 2. Ametek, Model 575.
 - 3. KPSI Model 705.

2.02. EQUIPMENT DESIGN

- A. Pressure Sensors/Transducer
 - 1. Sensor shall be housed in a 316 stainless steel housing and shall be suspended less than 1 foot above the bottom of the wet well.

2. Sensor shall transmit pressure signals to the transmitter via flexible extension cable clad in polyethylene.
3. Sensor shall utilize solid-state diffused silicon sensor technology to translate pressure to a 4-20 mADC linear signal.
4. Sensor shall be compensated for atmospheric pressure by means of a capillary that leads from a Goretex filter in the transmitter housing directly to the sensor/transducer.
5. Stainless steel sensor housing shall have a removable cover with a set of perforations to protect the sensing port from damage.
6. Provide stainless steel cable to suspend the sensor and to provide tension relief.
7. All fasteners shall be 316 stainless steel or non-metallic.

B. Performance Requirements

1. The systems shall have a minimum accuracy of ± 0.1 percent of range.
2. Sensor shall not be subject to loss of accuracy due to immersion in wastewater sludge with concentrations up to 6 percent.
3. Response time not to exceed 600 ms.
4. Linearity – 0.2 percent of measurement range.
5. Turndown – 10:1.
6. Temperature Operating Range - -4 to 140 degrees F.
7. Power Requirements - 24 VDC.

2.03. ACCESSORIES

- A. Nameplates – Refer to Section 17000, Instrumentation. Wording of nameplate shall be as specified in Table 17375-1.
- B. Mounting Hardware – Provide stainless steel mounting hardware as necessary to mount equipment in locations as described in the Contract Documents.
- C. Cabling – Provide power, and signal, cable and conduit to locate transmitters in locations listed in Table 17375-1 and the Contract Documents according to Section 17000, Instrumentation.
- D. Lightning and Surge Protection – Provide lightning and surge protection for the equipment listed in Table 17375-1 in accordance with Section 17000, Instrumentation.
- E. Provide a 4-inch diameter perforated Schedule 80 PVC pipe to serve as a stilling well to reduce turbulence and lateral movement. Locate stilling well as detailed on the Contract Drawings. Transducer shall be secured by a minimum of six points about its diameter to eliminate all lateral movement.

Transducer shall be removable by pulling the suspension cable out of the stilling well from ground level while the stilling well remains in place in the wet well. Secure the stilling well to the wet well wall at three foot intervals. All straps used for attaching the stilling well to the side of the well shall be stainless steel. All fasteners shall be stainless steel epoxy-grouted type with stainless steel nuts.

2.04. CONTROLS

- A. All electrical equipment and wiring shall be in full conformance with Division 16, Electrical Specifications.
- B. Refer to Contract Drawings for wiring requirements.

PART 3 EXECUTION

3.01. INSTALLATION

- A. Install in accordance with manufacturer's requirements/suggestion.
- B. All electrical work performed in fabrication and installation of the transmitters shall be in full accordance with the requirements of the Division 16 specifications.
- C. Mount all equipment provided herein in accordance with Section 17000, Instrumentation.
- D. Verify the integrity of the wall to which the stilling well is mounted. If the wall exhibits corrosion or other disrepair, provide a sound mounting surface.

3.02. MANUFACTURER'S OR SYSTEM INTEGRATOR'S FIELD SERVICES

- A. Allow for a manufacturer authorized service representative to test equipment to demonstrate that:
 - 1. The transmitter and transducer are properly installed, properly calibrated, and is functioning as specified.
 - 2. Configuration and setpoints are not lost upon power loss. This shall be tested by disconnecting the transmitter from power for 30 minutes.
- B. Training – Provide one hour of instruction for four persons to be conducted at the project site with a manufacturer's representative. Notify the Engineer and Owner in writing a minimum of two weeks in advance. Training shall include calibration, troubleshooting, and maintenance.

3.03. CERTIFICATION OF TESTING

- A. Unless waived in writing by the Engineer, all tests shall be made in the presence of a duly authorized representative of the Owner. When the presence of such representative is so waived, certified results of the tests made and the results thereof shall be furnished by the Contractor.
- B. All tests shall be performed in the presence of the Owner. Written notice of all tests shall be given the Owner at least two weeks in advance.

END OF SECTION