Case No. 2007-00074

NORTHERN KENTUCKY WATER DISTRICT

TAYLOR MILL TREATMENT PLANT

BIDDING REQUIREMENTS AND CONTRACT DOCUMENTS

for the construction of the

BACKWASH TREATMENT SYSTEM

Volume 1 of 1

Bidding Requirements, Contract Forms, Conditions of the Contract and Division 1 to Division 16

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Ron Lovan, President/CEO

Northern Kentucky Water District Board of Commissioners:

Joe Koester, Chairperson
Andrew Collins, Secretary
Fred Maeke, Jr., Treasurer
Frank Jackson, Commissioner
Pat Sommerkamp, Commissioner
Doug Wagner, Commissioner

Charles Pangburn, Attorney

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CH2M HILL

Cincinnati, Ohio

December 26, 2006

Project No. 332885

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END OF SECTION

PART 1

BIDDING REQUIREMENTS

INVITATION TO BID

Sealed Bids for construction of Taylor Mill Treatment Plant Backwash Treatment System, addressed to Ms. Amy Kramer, P.O. Box 18640, 2835 Crescent Springs Road, Erlanger, Kentucky 41018, will be received at the office of the Northern Kentucky Water District, Kenton County, State of Kentucky (Owner), until 2:00 p.m., local time, on the 16th day of January, 2007. Any Bids received after the specified time will not be considered.

Bids will then be publicly opened and read.

The Project contemplated consists of the addition of new Backwash Treatment Building and backwash treatment equipment. Building shall be one-story masonry building. Project includes necessary piping, electrical, instrumentation, and other appurtenances for the backwash treatment system, including SCADA system and sludge handling system improvements.

Bidding Documents may be examined in Owner's office, Northern Kentucky Water District, 2835 Crescent Springs Road, Erlanger, Kentucky 41018 or at Engineer's office, CH2M HILL, 300 E-Business Way, Suite 400, Cincinnati, Ohio 45241. Bidding Documents may be obtained from the Engineer's office upon payment (check or money order only made out to "CH2M HILL INC.") of $100.00 for each set of documents consisting of 1/2 size plans and specifications, unless otherwise noted. Bidding documents will be shipped by regular mail at a cost of $10.00 per set and at a cost of $25.00 per set for overnight delivery. Full size plans are available at $50.00 plus shipping costs listed above. Copies of the Geotechnical Report are available at a cost of $25.00 plus shipping costs listed above. Return of the documents is not required, and the amount paid for the documents is nonrefundable.

Send requests for Bidding Documents to the attention of Mr. Frank Duran at the office of the Engineer.

Each Bid must be submitted on the prescribed Bid Form and accompanied by Bid security as prescribed in the Instructions to Bidders, payable to the OWNER in an amount not less than 10 percent of the amount Bid.

The Successful Bidder will be required to furnish the additional bond(s) prescribed in the Bidding Documents.

Bidders are not required to be prequalified by the Owner to perform the type and size of Work contemplated herein.

Bidders will be required to pay prevailing wage rates as established by the Department of Workplace Standards.

Award of the Contract will be in accordance with Article, Evaluation of Bids and Award of Contract, specified in the Instructions to Bidders.

The Successful Bidder will be required to furnish a Construction Performance Bond and a Construction Payment Bond as security for the faithful performance and the payment of all bills and obligations arising from the performance of the Contract.

CONTRACTOR and all Subcontractors will be required to conform to the labor standards set forth in the Contract Documents.

OWNER reserves the right to reject any or all Bids, including without limitation the right to reject any or all nonconforming, nonresponsive, incomplete, unbalanced, or conditional Bids, and to reject the Bid of any Bidder if OWNER believes that it would not be in the best interest of OWNER to make an award to that Bidder. OWNER also reserves the right to waive informalities.

OWNER reserves the right to negotiate with the apparent successful Bidder to such an extent as may be determined by Owner.

If the Contract is to be awarded, OWNER will give the Successful Bidder a Notice of Award within the number of days set forth in the Bid Form.

For information concerning the proposed Work, contact Mr. Frank Duran, CH2M HILL, telephone: 513-489-0779, fax: 513-489-0807.

For an appointment to visit the Site, contact Ms. Amy Kramer, Northern Kentucky Water District, telephone: 859-426-2734, fax: 859-578-7893. 72 hours prior notice is required to arrange for a site visit.

Minority Bidders are encouraged to bid.

Dated this December day of 26, 2006.

The Northern Kentucky Water District

By Ms. Bari Joslyn, Vice President
Water Quality and Production

INSTRUCTIONS TO BIDDERS

1. DEFINED TERMS

1.1. Terms used in these Instructions to Bidders have the meanings assigned to them in the General Conditions and Supplementary Conditions. Additional terms used in these Instructions to Bidders have the meanings indicated below:

1.1.1. *Issuing Office*—The office from which the Bidding Documents are to be issued and where the Bidding procedures are to be administered.

1.1.2. *Apparent Low Bidder*—That Bidder whose Bids as offered in the Bid Form represents the lowest total as determined by the Base Bid.

1.1.3. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner (on the basis of Owner's evaluation as herein provided) makes an award.

1.1.4. Base Bid:

1.1.4.1. Base Bid—Includes Bid for the Lump Sum Work plus extended total for Unit Price Work.

1.1.4.2. No consideration of additive or deductive alternates or deductions for award of multiple schedules or other credits shall be made in determining the Base Bid.

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 Invitation to Bid may be obtained from the Issuing Office.

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 use of incomplete sets of Bidding Documents.

2.3. Drawings bound in the Bidding Documents are photographic reductions of original tracings. Amount of reduction is indicated by a note or scale bar on Drawing. Full-size Drawings may be obtained from Engineer at cost of reproduction and handling, plus postage for mailing (if mailing is requested). Drawings will only be made available to firms listed as having complete sets of Bidding Documents. No return of full-size Drawings is required, and no refund will be made.

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

3. QUALIFICATIONS OF BIDDERS

3.1. In order to perform public work, Bidder and its Subcontractors, prior to award of Contract, shall hold or obtain such licenses as required by State Statutes, and federal and local Laws and Regulations.

3.2. To demonstrate Bidder's qualifications to perform the Work, within 5 days of Owner's request, Bidder shall submit written evidence such as financial data, previous experience, present commitments, and such other data as may be requested.

4. EXAMINATION OF BIDDING DOCUMENTS, OTHER RELATED DATA, AND SITE

4.1. Subsurface and Physical Conditions:

4.1.1. The Supplementary Conditions identify:

4.1.1.1. Those reports of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Bidding Documents.

4.1.1.2. Those drawings of physical conditions in or relating to existing surface and subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Bidding Documents.

4.1.2. Copies of reports and drawings referenced will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.02 of the General Conditions has been identified and established in Paragraph 4.02 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, or information contained in such reports or shown or indicated in such drawings. Costs associated with making available copies of reports and drawings shall be borne by Bidder.

4.2. Underground Facilities:

4.2.1. 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:

4.3.1. The Supplementary Conditions identify those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that Engineer has used in preparing the Bidding Documents.

4.3.2. Copies of reports and drawings referenced will be made available by Owner to any Bidder on request. Those reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Bidder is entitled to rely as provided in Paragraph 4.06 of the General Conditions has been identified and established in Paragraph 4.06 of the Supplementary Conditions. Bidder is responsible for any interpretation or conclusion Bidder draws from any "technical data" or any other data, interpretations, opinions, or information contained in such reports or shown or indicated in such drawings. Costs associated with making available copies of reports and drawings shall be borne by Bidder.

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 conditions appear in Paragraphs 4.02 through 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 request, Owner will provide each 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 the General Requirements for identification of the general nature of other work that is to be performed at the Site by Owner or others (such as utilities and other prime contractors) that relates to the Work 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

4.7. It is responsibility of each Bidder before submitting a Bid to:

4.7.1. Examine and carefully study the Bidding Documents, other related data identified in the Bidding Documents, and any Addenda.

4.7.2. Visit the Site to become familiar with and satisfy Bidder as to the general, local, and Site conditions that may affect cost, progress, and performance of the Work.

4.7.3. Become familiar with and satisfy Bidder as to all federal, state, and local Laws and Regulations that may affect cost, progress, and performance of the Work.

4.7.4. Carefully study all:

4.7.4.1. Reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions.

4.7.4.2. Reports and drawings of Hazardous Environmental Conditions at the Site which have been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions.

4.7.5. Obtain and carefully study (or accept consequences of not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto.

4.7.6. 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) set forth in the Bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.

4.7.7. 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.

4.7.8. 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.

4.7.9. 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.

4.7.10. Determine Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance of the Work.

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

5. SITE AND OTHER AREAS

5.1. 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.

6. INTERPRETATIONS AND ADDENDA

6.1. 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 the office issuing documents as having received the Bidding Documents. Questions received less than 7 days prior to the date for opening of Bids may not be answered. Only questions answered by Addenda will be binding. Oral and other interpretations or clarifications will be without legal effect.

6.2. Addenda may also be issued to clarify, correct, or change the Bidding Documents as deemed advisable by Owner or Engineer.

7. BID SECURITY

7.1. Bid shall be accompanied by Bid security made payable to Owner in an amount of 10 percent of Bidder's maximum Bid price and in the form of a certified check or bank money order or a penal Bid Bond (on the attached form), issued by a surety meeting the requirements of Paragraph 5.01 and Paragraph 5.02 of the General Conditions.

7.2. 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 the time period specified in Article 22, Signing of Agreement, Owner may annul the Notice of Award and the Bid security of that Bidder will be forfeited. Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by

Owner until the earlier of the 7th day after the Effective Date of the Agreement or the number of days specified for all Bids to remain subject to acceptance in Article 19, Bids to Remain Subject to Acceptance, whereupon Bid security furnished by such Bidders will be returned.

8. CONTRACT TIMES

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

9. LIQUIDATED DAMAGES

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

10. SUBSTITUTE AND "OR-EQUAL" ITEMS

10.1. 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.

11. SUBCONTRACTORS, SUPPLIERS, AND OTHERS

11.1. 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, apparent Successful Bidder, and any other Bidder so requested, shall with the Bid, 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.

11.2. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute in which case apparent Successful Bidder shall submit an acceptable substitute. Bidder's Bid price will be increased (or decreased) by the difference in cost occasioned by such substitution, and Owner may consider such price adjustment in evaluating Bids and making the Contract award without an increase in Bid.

11.3. 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 General Conditions Paragraph 6.06.B.

11.4. Contractor shall not be required to employ any Subcontractor, Supplier, individual, or entity against whom Contractor has reasonable objection.

12. EMPLOYMENT REQUIREMENTS

12.1. In order to be awarded the Contract, Successful Bidder will be required to comply with KRS 45.600 regarding affirmative action.

13. WAGE RATES

13.1. The Work under these Bidding Documents is to be paid for by public funds; therefore, minimum prevailing wage rates published by Kentucky Department of Labor. Refer to Paragraph 6.09.D of the Supplementary Conditions for more information.

14. PREPARATION OF BID

14.1. The Bid Form and other attachments are included with the Bidding Documents. No substitution of forms will be allowed.

14.2. All blanks on the Bid Form shall be completed by typing or printing with black ink and the Bid 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 or the words "No Bid," "No Change," or "Not Applicable" entered.

14.3. 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 below the signature.

14.4. 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 below the signature.

14.5. 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 shall be shown below the signature.

14.6. A Bid by an individual shall show the Bidder's name and official address.

14.7. A Bid by a joint venture shall be executed by each joint venturer in the manner indicated on the Bid Form. The official address of the joint venture shall be shown below the signature.

14.8. All names shall be typed or printed in ink below the signatures.

14.9. The Bid shall contain an acknowledgement of receipt of all Addenda; the numbers of which shall be filled in on the Bid Form.

14.10. The address and telephone number for communications regarding the Bid shall be shown.

14.11. The Bid shall contain evidence of Bidder's authority and qualification to do business in the state where the Project is located or covenant to obtain such qualification prior to award of the Contract. Bidder's state contractors' license number and class, if any, shall also be shown on the Bid Form.

15. BASIS OF BID; COMPARISON OF BIDS

15.1. Lump Sum:

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

15.2. The Lump Sum Bid price shall include such amounts as the Bidder deems proper for overhead and profit on account of cash allowances, if any, named in the Contract Documents as provided in Paragraph 11.02 of the General Conditions.

16. SUBMISSION OF BID

16.1. Bid Form and attachments may be photocopied for submission of Bids.

16.2. A Bid shall be submitted no later than the date and time prescribed, and at the place, and in the manner set forth in the Invitation to Bid. Enclose Bid in an opaque sealed envelope, marked with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted) and name and address of Bidder and accompanied by the Bid security 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 marked on the outside with the notation "BID ENCLOSED."

17. MODIFICATION AND WITHDRAWAL OF BID

17.1. A Bid may be modified or withdrawn by an appropriate document duly executed in the manner that a Bid must be executed and delivered to the place where Bids are to be submitted prior to the date and time for the opening of Bids.

17.2. 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.

18. OPENING OF BIDS

18.1. Bids will be opened at the time and place indicated in the Invitation to Bid and unless obviously nonresponsive, read aloud publicly. An abstract of the amounts of the Base Bids and major alternates if any will be made available to Bidders within 14 days after the opening of Bids.

19. BIDS TO REMAIN SUBJECT TO ACCEPTANCE

19.1. 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.

20. EVALUATION OF BIDS AND AWARD OF CONTRACT

20.1. Owner reserves its right to reject any or all Bids, including without limitation nonconforming, nonresponsive, incomplete, 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 not be 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 apparent Successful Bidder.

20.2. 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.

20.3. 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.

20.4. In evaluating Bidders, Owner may 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 with the Bid.

20.5. Owner may conduct such investigations as Owner deems necessary to establish responsibility, qualifications, and financial ability of Bidders, proposed Subcontractors, Suppliers, and individuals, or entities to perform the Work in accordance with the Contract Documents.

20.6. If the Contract is to be awarded, Owner will award the Contract to Bidder whose Bid is in the best interests of the Project.

20.7. If the Contract is to be awarded, it will be awarded to the lowest Base Bid Bidder exclusive of any additive alternatives. Additive alternates will be considered after selection of lowest Base Bid Bidder. Each additive alternate will be considered and selected individually, or none selected, for inclusion in the Work.

21. CONTRACT SECURITY AND INSURANCE

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

22. SIGNING OF AGREEMENT

22.1. Successful Bidder will be required to submit a statement of intent to comply in full with all requirements of the Kentucky Civil Rights Act, and to submit data required by KRS 45.4560 to 45.640 upon being designated the Successful Bidder.

22.2. In addition to the above requirements, Successful Bidder will be required to submit a breakdown of their existing work, indicating the race, sex, age, position held, county and state of residence, and date of employment of each employee.

22.3. When Owner gives a Notice of Award to Successful Bidder, it shall be accompanied by required number of unsigned counterparts of the Agreement with the other Contract Documents that 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 15 days thereafter, Owner shall deliver one fully signed counterpart to Successful Bidder with a complete set of the Drawings with appropriate identification.

23. RETAINAGE

23.1. Provisions concerning retainage and Contractor's rights to deposit securities in lieu of retainage, if applicable, are set forth in the Agreement.

END OF SECTION

NOTE TO BIDDER: Use typewriter or BLACK ink for completing this Bid Form.

BID FORM
(STIPULATED PRICE BASIS)

1. BID RECIPIENT

1.1. This Bid is submitted to:

Owner: Northern Kentucky Water District

Address: P.O. Box 18640, 2835 Crescent Springs Road, Erlanger, Kentucky 41018

Project Identification: Taylor Mill Treatment Plant Backwash Treatment System

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.

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 90 days after the Bid opening, or for such longer period of time that Bidder may agree to in writing upon request of Owner.

3. BIDDER'S REPRESENTATIONS

3.1. In submitting this Bid, Bidder represents that:

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

Addendum No.	**Addendum Date**

(Bidder shall insert number of each Addendum received.)

3.1.2. 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.

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

3.1.4. Bidder has carefully studied all: i) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in Paragraph 4.02 of the Supplementary Conditions; and ii) reports and drawings of Hazardous Environmental Conditions that have been identified in Paragraph 4.06 of the Supplementary Conditions.

3.1.5. Bidder has obtained and carefully studied (or accepts the consequences for not doing so) all additional or supplementary examinations, investigations, explorations, tests, studies and data concerning conditions (surface, subsurface and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents to be employed by Bidder, and safety precautions and programs incident thereto.

3.1.6. 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) set forth in the Bid and within the times and in accordance with the other terms and conditions of the Bidding Documents.

3.1.7. Bidder is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Bidding Documents.

3.1.8. Bidder has correlated the information known to Bidder, information and observations obtained from visits to the Site, reports and drawings identified in the Bidding Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents.

3.1.9. 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.

3.1.10. 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.

3.1.11. Bidder will submit written evidence of its authority to do business in the state where the Project is located not later than the date of its execution of the Agreement.

4. FURTHER REPRESENTATIONS

4.1. Bidder further represents that:

4.1.1. This Bid is genuine and not made in the interest of or on behalf of any undisclosed individual or entity and is not submitted in conformity with any agreement or rules of any group, association, organization or corporation;

4.1.2. Bidder has not directly or indirectly induced or solicited any other Bidder to submit a false or sham Bid;

4.1.3. Bidder has not solicited or induced any individual or entity to refrain from bidding; and

4.1.4. Bidder has not sought by collusion to obtain for itself any advantage over any other Bidder or over Owner.

4.1.5. All required sales and use taxes are included in the stated Bid prices for the Work unless provision is made herein for the Bidder to separately itemize the estimated amount of sales tax.

5. PREVAILING WAGE

5.1. Not less than the prevailing hourly wage as determined by the Commissioner of Labor shall be paid to all laborers, workmen, and mechanics performing Work under the Agreement.

6. INSURANCE

6.1. Bidder further agrees that the Bid amount(s) stated herein includes specific consideration for the specified insurance coverages.

7. CONTRACT TIMES

7.1. Bidder agrees to accept Contract Times set forth in the Agreement Form.

8. SUBCONTRACTORS

8.1. Bidder agrees to submit, in accordance with the INSTRUCTIONS TO BIDDERS, a listing of subcontracting firms or businesses that will be awarded subcontracts for portions of Work listed in paragraph 6.06.B of the Supplementary Conditions.

8.2. Bidder further proposes, in the event Bidder is awarded the Contract, that the following firms or businesses will be awarded subcontracts:

8.2.1. Mechanical _____
Name

_____
Street City State Zip

8.2.2. Electrical _____
Name

_____
Street City State Zip

8.2.3. Instrumentation and Controls _____
Name

_____
Street City State Zip

9. EQUIPMENT

9.1. Bidder proposes, in the event Bidder is awarded the Contract, to provide equipment per the specifications and as manufactured by the following firms:

Spec Section	**Equipment**	**Manufacturer**
11229	Plate Settler Equipment	_____
11240	Peristaltic Pump	_____
11240	Diaphragm Pump	_____
11240	Dry Polymer Processing System	_____

Manufacturers listed shall be one of the named manufacturers in each respective specification section.

10. SALES AND USE TAXES

10.1. The Bidder agrees that all sales and use taxes are included in the stated Bid prices for the work, unless provision is made herein for the Bidder to separately itemize the estimated amount of sales tax.

11. BASIS OF BIDS

11.1. Bidder will complete the Work in accordance with the Contract Documents for the following price(s):

11.2. LUMP SUM BID PRICE

_____ Dollars
(words)

and _____ Cents $_____
(numerals)

11.3. Additive Alternate 1 for Replacement of Roofing System on Existing Sludge Building.

11.3.1. Bidder further proposes that if OWNER elects to include the construction of replacement roofing system on Existing Sludge Building as specified in Section 01010, Summary of Work, with necessary changes in construction as required to complete the Work with this addition, based on undersigned's own estimate of quantities and cost, the Contract Price will be increased in the amount of:

_____ Dollars
(words)

and _____ Cents $_____
(numerals)

11.4. Additive Alternate 2 for Construction of Dry Polymer Processing System.

11.4.1. Bidder further proposes that if OWNER elects to include the construction of the Dry Polymer Processing System as specified in Section 01010, Summary of Work, with necessary changes in construction as required to complete the Work with this addition, based on undersigned's own estimate of quantities and cost, the Contract Price will be increased in the amount of:

_____ Dollars
(words)

and _____ Cents $_____
(numerals)

12. TIME OF COMPLETION

12.1. Bidder agrees that the Work, and any Milestones specified in Section 01040, Coordination, will be substantially complete and will be completed and ready for final payment in accordance with Paragraph 14.07.B of the General Conditions on or before the dates or within the number of calendar days indicated in the Agreement.

12.2. Bidder accepts the provisions of the Agreement as to liquidated damages in the event of failure to complete the Work, and any specified Milestones, within the Contract Times.

13. SURETY

13.1. If Bidder is awarded a construction contract from this Bid, the surety who provides the Performance and Payment Bond(s) shall be:

_____ whose address is

_____

Street City State Zip

14. ATTACHMENTS TO THIS BID

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

14.1.1. Required Bid security in the form of Bid bond.

15. DEFINED TERMS

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

16. BID SUBMITTAL

16.1. This Bid submitted by:

If Bidder is:

An Individual

Name *(typed or printed)*: _____

By *(signature)*: _____

Doing business as: _____

A Partnership

Partnership Name: _____(SEAL)

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

Name *(typed or printed)*: _____

A Corporation

Corporation Name: _____(SEAL)

State of Incorporation: _____

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

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

Name *(typed or printed)*: _____

Title:_____(CORPORATE SEAL)

Attest: _____
(Signature of Corporate Secretary)

Date of Qualification to do business is: _____

A Joint Venture

Joint Venturer Name: _____(SEAL)

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

Name *(typed or printed)*: _____

Title:_____

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

Bidder's Business Address: _____

_____

Phone No.:_____ FAX No.:_____

BID SUBMITTED on _____, 20____

(State) Contractor's License No.:_____

Contractor's License Class (where applicable):_____

END OF SECTION

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):

Northern Kentucky Water District

P.O. Box 18640, 2835 Crescent Springs Road, Erlanger, Kentucky 41018

BID

Bid Due Date: January 16, 2007.
Project (Brief Description Including Location): Taylor Mill Treatment Plant, 608 Grand Avenue, Taylor Mill, Kentucky 41015. The Project contemplated consists of the addition of new Backwash Treatment Building and backwash treatment equipment. Building shall be one-story masonry building. Project includes necessary piping, electrical, instrumentation, and other appurtenances for the backwash treatment system, including SCADA system and sludge handling system improvements.

BOND

Bond Number:
Date (Not later than Bid due date):

Penal sum _____ _____
(Words) (Figures)

Surety and Bidder, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Bid Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

BIDDER	SURETY
_____(Seal)	_____(Seal)
Bidder's Name and Corporate Seal	Surety's Name and Corporate Seal
By: _____	By: _____
Signature and Title	Signature and Title (Attach Power of Attorney)
Attest: _____	Attest: _____
Signature and Title	Signature and Title

Note: Above addresses are to be used for giving required notice.

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 Surety's liability.

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 by 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.

END OF SECTION

NON COLLUSION AFFIDAVIT

STATE OF: _____)

COUNTY OF: _____) SS

_____, being first duly sworn, deposes

and says that he/she is the _____ of
(sole owner, a partner, president, secretary, etc.)

_____, the party making the foregoing bid; that such bid is genuine and not collusive or sham; that said bidder is not financially interested in, or otherwise affiliated in a business way with any other bidder on the same contract; that said bidder has not colluded, conspired, connived, or agreed, directly or indirectly, with any bidder or person, to put in a sham bid, or that such other person shall refrain from bidding, and has not in any manner directly or indirectly sought by agreement or collusion, or communication or conference, with any person, to fix the price or affidavit of any other bidder, or that of any other bidder, or to secure any advantage against Owner, or any person or persons interested in the proposed Contract; and that all statements contained in said bid are true; and further, that such bidder has not, directly or indirectly submitted this bid, or the contents thereof, or divulged information of data relative thereto to any association or to any member or agent thereof.

_____
AFFIANT

Sworn to and subscribed before me, a Notary Public in and for the above named

State and County, this _____ day of _____, 20 _____.

_____
NOTARY PUBLIC

END OF SECTION

PART 2

CONTRACT FORMS

AGREEMENT

THIS AGREEMENT is by and between Northern Kentucky Water District (Owner) and

_____

_____ (Contractor).

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

1. WORK

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

Addition of new Backwash Treatment Building and backwash treatment equipment. Building shall be one-story masonry building. Project includes necessary piping, electrical, instrumentation, and other appurtenances for the backwash treatment system, including SCADA system and sludge handling system improvements.

2. ENGINEER

2.1. The Project has been designed by CH2M HILL (Engineer), who is to act as Owner's representative, assume all duties and responsibilities, and have the rights and authority assigned to Engineer in the Contract Documents in connection with the completion of the Work in accordance with the Contract Documents.

3. CONTRACT TIMES

3.1. Time of the Essence: 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 this Agreement.

3.2. Days to Achieve Substantial Completion and Final Payment:

3.2.1. The Work shall be substantially completed within 330 days from the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within 360 days after the date when the Contract Times commence to run.

3.3. Liquidated Damages:

3.3.1. Contractor and Owner recognize that time is of the essence of this Agreement and that Owner will suffer financial loss if the Work is not completed within the times specified in Paragraph Contract Times 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 Seven Hundred and Fifty Dollars ($750.00) for each day that expires after the time specified herein for Substantial Completion until the Work is substantially complete.

3.3.2. 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 Five Hundred Dollars ($500.00) for each day that expires after the time specified herein for completion and readiness for final payment until the Work is completed and ready for final payment.

4. CONTRACT PRICE

4.1. Owner will pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds equal to the following:

4.1.1. For all Work other than Unit Price Work, a lump sum of :

_____ Dollars
(Words)

and _____ Cents $_____
(Words) (Figures)

5. PAYMENT PROCEDURES

5.1. Submittal and Processing of Payments: Contractor shall submit Applications for Payment in accordance with Article 14 of the General Conditions. Applications for Payment will be processed by Engineer as provided in the General Conditions.

5.2. Progress Payments and Retainage: Owner will make progress payments on account of the Contract Price on the basis of Contractor's Application for Payment on the date of each month as established in the preconstruction conference during performance of the Work as provided herein. 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.

5.2.1. 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:

5.2.1.1. Ninety percent of Work completed (with the balance being retainage). This amount may be reduced by the Owner in it sole and absolute discretion, if the project is substantially completed.

5.2.1.2. Ninety percent of cost of materials and equipment not incorporated in the Work (with the balance being retainage) but are delivered, suitable stored, and accompanied by documentation satisfactory to Owner as provided in paragraph 14.02.A.1 of the General Conditions. Retainage for stored materials and equipment will be released when the materials and equipment are incorporated in the Work.

5.2.1.3. All retainage will be paid to Contractor when the Work is completed and ready for final payment in accordance with paragraph 14.07.C of the General Conditions. Consent of the Surety shall be obtained before retainage is paid by Owner. Consent of the Surety, signed by an agent, must be accompanied by a certified copy of such agent's authority to act for the Surety.

5.3. Final Payment:

5.3.1. 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.

6. CONTRACTOR'S REPRESENTATIONS

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

6.1.1. Contractor has examined and carefully studied the Contract Documents and the other related data identified in the Bidding Documents.

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

6.1.3. 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.

6.1.4. 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 in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) which have been identified in the Supplementary Conditions as provided in Paragraph 4.02 of the General Conditions and (2) reports and drawings of a Hazardous Environmental Condition, if any, at the Site which has been identified in the Supplementary Conditions as provided in Paragraph 4.06 of the General Conditions.

6.1.5. Contractor has obtained and carefully studied (or assumes responsibility for doing so) all additional or supplementary examinations, investigations, explorations, tests, studies, and data concerning conditions (surface, subsurface, and Underground Facilities) at or contiguous to the Site which may affect cost, progress, or performance of the Work or which relate to any aspect of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents, and safety precautions and programs incident thereto.

6.1.6. Contractor does not consider that any further examinations, investigations, explorations, tests, studies, or data are necessary for the performance of the Work at the Contract Price, within the Contract Times, and in accordance with the other terms and conditions of the Contract Documents.

6.1.7. Contractor is aware of the general nature of work to be performed by Owner and others at the Site that relates to the Work as indicated in the Contract Documents.

6.1.8. Contractor has correlated the information known to Contractor, information and observations obtained from visits to the Site, reports and drawings identified in the Contract Documents, and all additional examinations, investigations, explorations, tests, studies, and data with the Contract Documents.

6.1.9. 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.

6.1.10. The Contract Documents are generally sufficient to indicate and convey understanding of all terms and conditions for performance and furnishing of the Work.

7. CONTRACT DOCUMENTS

7.1. Contents:

7.1.1. The Contract Documents, which are attached to this Agreement (except as expressly noted otherwise), consist of the following:

7.1.1.1. This Agreement (pages 1 to _____, inclusive).

7.1.1.2. Performance bond (pages _____ to _____, inclusive).

7.1.1.3. Payment bond (pages _____ to _____, inclusive).

7.1.1.4. General Conditions (pages _____ to _____, inclusive).

7.1.1.5. Supplementary Conditions (pages _____ to _____, inclusive).

7.1.1.6. Specifications as listed in the table of contents of the Project Manual.

7.1.1.7. Drawings consisting of ___ sheets with each sheet bearing the following general title: Taylor Mill Treatment Plant Backwash Treatment System.

7.1.1.8. Addenda (numbers _____ to _____, inclusive).

7.1.2. The Contract Documents also include the following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

7.1.2.1. Notice to Proceed (pages _____ to _____, inclusive).

7.1.2.2. Work Change Directives.

7.1.2.3. Change Order(s).

7.2. There are no Contract Documents other than those listed above in this Article.

7.3. The Contract Documents may only be amended, modified, or supplemented as provided in Paragraph 3.04 of the General Conditions.

8. COMPLIANCE WITH KENTUCKY LAW

8.1. Contractor represents and warrants that it has revealed to Owner any and all final determinations of a violation of KRS Chapters 136, 139, 141, 337, 338, 341 and 342 within the previous five years. Contractor further represents and warrants that it will remain in continuous compliance with the provisions of KRS Chapters 136, 139, 141, 337, 338, 341 and 342 for the duration of this Agreement. Contractor understands that

its failure to reveal a final determination of a violation or to comply with the above statutory requirements constitutes grounds for cancellation of the Agreement and for disqualification of Contractor from eligibility for any contracts for a period of two years.

9. EQUAL OPPORTUNITY

9.1. Unless exempted under KRS 45.590, during the performance of the Agreement, the Contractor agrees as follows:

9.2. The Contractor will not discriminate against any employee or applicant for employment because of race, color, religion, sex, age, or national origin;

9.3. The Contractor will take affirmative action in regard to employment, upgrading, demotion, transfer, recruitment, recruitment advertising, layoff, termination, rates of pay or other forms of compensation, and selection for training, so as to ensure that applicants are employed and that employees during employment are treated without regard to their race, color, religion, sex, age, or national origin; however, when layoffs occur, employees shall be laid off according to seniority with the youngest employee being laid off first. When employees are recalled, this shall be done in the reverse of the way employees were laid off.

9.4. The Contractor will state in all solicitations or advertisements for employees placed by or on behalf of the Contractor that all qualified applicants will receive consideration for employment without regard to race, color, religion, sex, age, or national origin.

9.5. The Contractor will post notices in conspicuous places, available to employees and applicants for employment, setting forth the provisions of the nondiscrimination clauses required by this section; and

9.6. The Contractor will send a notice to each labor union or representative of workers with which he has collective bargaining agreement or other contract or understanding advising the labor union or workers' representative of the Contractor's commitments under the nondiscrimination clauses.

10. MISCELLANEOUS

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

10.2. Successors and Assigns: 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.

10.3. Severability: 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 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.

10.4. Assignment of Contract:

10.4.1. No assignment by a party hereto of any rights under or interests in the Contract shall 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 shall release or discharge the assignor from any duty or responsibility under the Contract Documents.

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in triplicate. One counterpoint each has been delivered to Owner, Contractor, and Engineer. All portions of the Contract Documents have been signed or 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: _____

_____

By: _____

Title:_____

[CORPORATE SEAL]

Attest: _____

Title:_____

Address for giving notices:

_____

_____

(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.)

CONTRACTOR: _____

_____

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title:_____

Address for giving notices:

_____

_____

License No. _____
(Where applicable)

Agent for service or process: _____

_____

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

END OF SECTION

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):

Northern Kentucky Water District

P.O. Box 18640, 2835 Crescent Springs Road, Erlanger, Kentucky 41018

CONTRACT

Date:
Amount:
Description (Name and Location): Taylor Mill Treatment Plant, 608 Grand Avenue, Taylor Mill, Kentucky 41015. The Project contemplated consists of the addition of new Backwash Treatment Building and backwash treatment equipment. Building shall be one-story masonry building. Project includes necessary piping, electrical, instrumentation, and other appurtenances for the backwash treatment system, including SCADA system and sludge handling system improvements.

BOND

Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Performance Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

Attest: _____
Signature and Title

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 3.1.

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 10 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 3.1; 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;

2. Another contractor selected pursuant to Paragraph 4.3 to perform the Contract.

4. When Owner has satisfied the conditions of Paragraph 3, 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 6 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 4 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 4.4, 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 4.1, 4.2, or 4.3 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 a 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 or failure to act of Surety under Paragraph 4; 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 comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone Surety Agency or Broker Owner's Representative (engineer or other party)

END OF SECTION

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):

Northern Kentucky Water District

P.O. Box 18640, 2835 Crescent Springs Road, Erlanger, Kentucky 41018

CONTRACT

Date:
Amount:
Description (Name and Location): Taylor Mill Treatment Plant, 608 Grand Avenue, Taylor Mill, Kentucky 41015. The Project contemplated consists of the addition of new Backwash Treatment Building and backwash treatment equipment. Building shall be one-story masonry building. Project includes necessary piping, electrical, instrumentation, and other appurtenances for the backwash treatment system, including SCADA system and sludge handling system improvements.

BOND

Bond Number:
Date (Not earlier than Contract Date):
Amount:
Modifications to this Bond Form:

Surety and Contractor, intending to be legally bound hereby, subject to the terms printed on the reverse side hereof, do each cause this Payment Bond to be duly executed on its behalf by its authorized officer, agent, or representative.

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

(Space is provided below for signatures of additional parties, if required.)

Attest: _____
Signature and Title

CONTRACTOR AS PRINCIPAL

Company:

Signature: _____(Seal)
Name and Title

SURETY

_____(Seal)
Surety's Name and Corporate Seal

By: _____
Signature and Title

(Attach Power of Attorney)

Attest: _____
Signature and Title

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 addresses 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 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 Construction Contract, whichever of (1) or (2) first occurs. If the provisions of this paragraph are void or prohibited by law, the minimum period of limitation available to sureties as a defense in the jurisdiction of the suit shall be applicable.

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 comply with the other terms thereof.

FOR INFORMATION ONLY – Name, Address and Telephone Surety Agency or Broker: Owner's Representative (engineer or other party):

END OF SECTION

PART 3

CONDITIONS OF THE CONTRACT

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly By

ACEC
American Council of Engineering Companies

National Society of Professional Engineers
Professional Engineers in Private Practice

ASCE American Society of Civil Engineers

PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
a practice division of the
NATIONAL SOCIETY OF PROFESSIONAL ENGINEERS

AMERICAN COUNCIL OF ENGINEERING COMPANIES

AMERICAN SOCIETY OF CIVIL ENGINEERS

This document has been approved and endorsed by

The Associated General Contractors of America

Knowledge for Creating and Sustaining the Built Environment

Construction Specifications Institute

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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's 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.A 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. The General Requirements pertain to all sections 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 in connection with the Work.

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. *Related Entity* -- An officer, director, partner, employee, agent, consultant, or subcontractor.

37. *Resident Project Representative*--The authorized representative of Engineer who may be assigned to the Site or any part thereof.

38. *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.

39. *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.

40. *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.

41. *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.

42. *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.

43. *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.

44. *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.

45. *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.

46. *Successful Bidder*--The Bidder submitting a responsive Bid to whom Owner makes an award.

47. *Supplementary Conditions*--That part of the Contract Documents which amends or supplements these General Conditions.

48. *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 any Subcontractor.

49. *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.

50. *Unit Price Work*--Work to be paid for on the basis of unit prices.

51. *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.

52. *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 following words or terms are not defined but, when used in the Bidding Requirements or Contract Documents, have the following 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 requirements of and information in the Contract Documents and conformance with the design concept of the completed 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 which 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*

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.

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 may reasonably be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the intended 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, or Engineer, or any of, their Related Entities, 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 may discover 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 any provision of any Law or Regulation applicable to the performance of the Work or of any standard, specification, manual or code, or of any instruction of any Supplier, 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 knew or reasonably should have known 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, code, or instruction (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 or other individual or entity performing or furnishing all of the Work under a direct or indirect contract with Contractor, 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 Engineer's consultants, including electronic media editions; or

2. reuse any of 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 adaption by Engineer.

B. The prohibition 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. Copies of data furnished by Owner or Engineer to Contractor or 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 of explorations and tests of subsurface conditions at or contiguous to the Site that Engineer has used in preparing the Contract Documents; and

2. those drawings of physical conditions in or relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that Engineer has used in preparing the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general 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 Related Entities 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 at or contiguous to the Site 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, Owner and Engineer, and any of their Related Entities 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.

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; 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:* Reference is made to the Supplementary Conditions for the identification of those reports and drawings relating to a Hazardous Environmental Condition identified at the Site, if any, that have been utilized by the Engineer in the preparation of the Contract Documents.

B. *Limited Reliance by Contractor on Technical Data Authorized:* Contractor may rely upon the general 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 Related Entities 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.

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 to Contractor written notice: (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, 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, 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 current 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 must be accompanied by a certified copy of the agent's authority to act.

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 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 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.

5.04 *Contractor's Liability Insurance*

A. Contractor shall purchase and maintain such liability and other 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, include as additional insured (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, 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 completed operations insurance;

4. include contractual liability insurance covering Contractor's indemnity obligations under Paragraphs 6.11 and 6.20;

5. 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);

6. 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

7. with respect to completed operations insurance, and any insurance coverage written on a claims-made basis, remain in effect for at least two years after final payment.

a. 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, 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 an insured or additional insured;

2. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, false work, 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 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 additional insured to whom a certificate of insurance has been issued.

B. Owner shall purchase and maintain such boiler and machinery 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, 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 an insured or additional insured.

C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained in accordance with 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 additional insured 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 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 to be listed as insureds or additional insureds (and the officers, directors, 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 additional insureds thereunder. Owner and Contractor waive all rights against each other and their respective officers, directors, 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 to be listed as insured or additional insured (and the officers, directors, 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, 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, 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 insureds, 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. The superintendent will be Contractor's representative at the Site and shall have authority to act on behalf of Contractor. All communications given to or received from the superintendent shall be binding on Contractor.

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,

3) it has a proven record of performance and availability of responsive service; and

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 that 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 in 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 or not 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 or not 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;

4) and 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 either a Change Order for a substitute or 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 item so proposed or submitted by Contractor, Contractor shall reimburse Owner for the charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the 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 an additional insured 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, and Engineer,, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or additional insureds (and the officers, directors, 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, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, 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 primary 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, 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. 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. 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 , 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).

D. 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 acceptable 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:* Contractor shall also submit Samples to Engineer for review and approval in accordance with the acceptable Schedule of Submittals.

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 determined and verified:

a. all field measurements, quantities, dimensions, specified performance and design criteria, installation requirements, materials, catalog numbers, and similar information with respect thereto;

b. the suitability of all materials with respect to intended use, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work;

c. all information relative to Contractor's responsibilities for means, methods, techniques, sequences, and procedures of construction, and safety precautions and programs incident thereto; and

d. shall also have 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.

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 Drawing's 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 Related Entities 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, 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 respective consultants, agents, officers, directors, partners, or employees 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, 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 via 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, a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and shall 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 their work and will only cut or alter their 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 actions or inactions.

C. Contractor shall be liable to Owner and any other contractor for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's 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 in respect of 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 in or relating to existing surface or subsurface structures at or contiguous to the Site that have been utilized by Engineer in preparing the Contract Documents.

8.06 *Insurance*

A. Owner's responsibilities, if any, in 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 in 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. If and to the extent Owner has agreed to furnish Contractor reasonable evidence that financial arrangements have been made to satisfy Owner's obligations under the Contract Documents, Owner's responsibility in respect thereof will be as set forth in the Supplementary Conditions.

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 and will not be changed without written consent of Owner and Engineer.

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 believe 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.

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.B.

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 notice 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) is required by the provisions of any bond to be given to a surety, 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 Time 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 include only the following items, and shall not include any of the costs itemized in Paragraph 11.01.B.

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 at the Site. 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, 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, expresses, 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, expediters, 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 and 11.01.B.

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 Paragraph 12.01.C.2.a 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 the Related Entities of each of them 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. All 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, inspecting, and testing. Contractor shall provide them proper and safe conditions for such access and advise them of Contractor's Site 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 said 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, it must, if requested by Engineer, be uncovered 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 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 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 therefore 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 on the Site 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, to the results of any subsequent tests called for in the Contract Documents, to a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and to 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. that 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 corrects to Owner's satisfaction the reasons for such action.

3. If it is subsequently determined 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.

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 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 will certify to Owner and Engineer that such part of the Work is substantially complete and request Engineer to issue a certificate of Substantial Completion 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.7;

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 or Owner's property might in any way be responsible 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 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 their 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 and other provisions of the Contract Documents as indicated below. All provisions that are not so amended or supplemented remain in full force and effect.

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

SC-1.01. Add the following language at the end of Paragraph 1.01.A.45:

> Substantial Completion is further defined as (i) that degree of completion of the Project's operating facilities or systems sufficient to provide Owner the full time, uninterrupted, and continuous beneficial operation of the Work; and (ii) all required functional, performance and acceptance or startup testing has been successfully demonstrated for all components, devices, equipment, and instrumentation and control to the satisfaction of Engineer in accordance with the requirements of the Specifications.

SC-1.01. Add the following new paragraph immediately after Paragraph 1.01.A.52:

> 1.01.A.53. *Specialist*—The term Specialist refers to a person, partnership, firm, or corporation of established reputation (or if newly organized, whose personnel have previously established a reputation in the same field), which is regularly engaged in, and which maintains a regular force of workers skilled in either (as applicable) manufacturing or fabricating items required by the Contract Documents, or otherwise performing Work required by the Contract Documents. Where the Specifications require the installation by a Specialist, that term shall also be deemed to mean either the manufacturer of the item, a person, partnership, firm, or corporation licensed by the manufacturer, or a person, partnership, firm, or corporation who will perform the Work under the manufacturer's direct supervision.

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

> Five sets of Contract Documents and full-size Drawings will be furnished to the contractor without charge. Owner will furnish to Contractor additional copies of the Contract Documents and copies of full-size Drawings upon request at the cost of reproduction.

SC-2.03. Delete the third sentence of Paragraph 2.03.A in its entirety.

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

> 3.01.D. Sections of Division 1, General Requirements, govern the execution of the Work of all sections of the Specifications.

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

4.02.A. No reports of explorations or tests of subsurface conditions at or contiguous to the Site are known to the Owner or Engineer.

SC-4.02. Add the following new paragraph(s) immediately after THE NEW Paragraph 4.02.A:

4.02.B. In preparation of Drawings and Specifications, Engineer or Related Entities relied upon the following reports of explorations and tests of subsurface conditions at the Site:

4.02.B.1. Report dated October 12, 2006 prepared by Thelen Associates, 1398 Cox Avenue, Erlanger, Kentucky 41018, entitled "Geotechnical Exploration Sludge Building Addition".

4.02.C. In preparation of Drawings and Specifications, Engineer or Related Entities relied upon the following drawings of physical conditions in or relating to existing surface and subsurface structures (except Underground Facilities) which are at or contiguous to the Site:

4.02.C.1. Drawings dated November of 1997 prepared by CH2M HILL, Cincinnati, Ohio, entitled "Taylor Mill Plant Chemical Building, Clarifier, and Clearwell Improvements".

4.02.C.2 Drawings dated September of 2003 prepared by Black & Veatch, Cincinnati, Ohio, entitled "Taylor Mill WTP Filter to Waste System".

4.02.C.3 Drawings dated June of 1987 prepared by Burgess and Niple, Cincinnati, Ohio, entitled "Taylor Mill WTP Sludge Dewatering Facilities".

4.02.D. Copies of reports and drawings itemized in SC-4.02.B and SC-4.02.C that are not included with Bidding Documents may be examined at CH2M HILL, 300 E-Business Way, Suite 400, Cincinnati, Ohio 45241 or Northern Kentucky Water District, 2835 Crescent Springs Road, Erlanger, Kentucky 41018 during regular business hours. These reports and drawings are not part of the Contract Documents, but the "technical data" contained therein upon which Contractor may rely as identified and established above are incorporated therein by reference. Contractor is not entitled to rely upon other information and data utilized by Engineer and Related Entities in the preparation of Drawings and Specifications.

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

4.06.A. No reports or drawings related to Hazardous Environmental Conditions are known to Owner or Engineer.

SC-5.02. Add the following new paragraph immediately after Paragraph 5.02.A:

SC-5.02.B. Surety and insurance companies from which the bonds and insurance for this Project are purchased shall have an A.M. Best's rating of no less than A:VII, in addition to other requirements specified herein.

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

SC-5.03.C. Failure of Owner to demand such certificates or other evidence of full compliance with these insurance requirements or failure of Owner to identify a deficiency from evidence provided shall not be construed as a waiver of Contractor's obligation to maintain such insurance.

SC-5.03.D. By requiring such insurance and insurance limits herein, Owner does not represent that coverage and limits will necessarily be adequate to protect Contractor, and such coverage and limits shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

SC-5.04. Add the following language after Paragraph 5.04.B.1:

Include the following parties or entities as additional insured:

5.04.B.1.a. Northern Kentucky Water District, P.O. Box 18640, 2835 Crescent Springs Road, Erlanger, Kentucky 41018.

5.04.B.1.b. CH2M HILL, 300 E-Business Way, Suite 400, Cincinnati, Ohio 45241.

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

5.04.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:

5.04.C.1. Worker's Compensation and related coverages under Paragraphs 5.04.A.1 and 5.04.A.2 of the General Conditions:

5.04.C.1.a. State: Statutory.

5.04.C.1.b. Applicable Federal (e.g., Longshoreman's): Statutory.

5.04.C.1.c. Employer's Liability: $500,000.

5.04.C.2. Contractor's General Liability under Paragraphs 5.04.A.3 through 5.04.A.6 of the General Conditions shall include completed operations and product liability coverages and eliminate the exclusion with respect to property under the care, custody and control of Contractor:

5.04.C.2.a. General Aggregate	$1,000,000
5.04.C.2.b. Products - Completed Operations Aggregate	$1,000,000
5.04.C.2.c. Personal and Advertising Injury (per person/Organization)	$1,000,000
5.04.C.2.d. Each Occurrence (Bodily Injury and Property Damage)	$1,000,000

5.04.C.2.e. Property Damage liability insurance will provide Explosion, Collapse, and Underground coverages where applicable.

5.04.C.2.f. Excess or Umbrella Liability

1) General Aggregate	$4,000,000
2) Each Occurrence	$4,000,000

5.04.C.3. Automobile Liability under Paragraph 5.04.A.6:

5.04.C.3.a. Bodily Injury:

Each Person	$1,000,000
Each Accident	$1,000,000

5.04.C.3.b. Property Damage:

Each Accident	$1,000,000
5.04.C.3.c. Combined Single Limit of	$1,000,000

5.04.C.4. Contractual Liability coverage required by Paragraph 5.04.B.4 of the General Conditions shall provide coverage for not less than the following amounts:

5.04.C.4.a. Bodily Injury:

Each Accident	$1,000,000
Annual Aggregate	$1,000,000

5.04.C.4.b. Property Damage:

Each Accident	$1,000,000
Annual Aggregate	$1,000,000

SC-5.06. Delete Paragraph 5.06.A in its entirety and insert the following in its place:

5.06.A.Contractor shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof. Contractor shall be responsible for any deductible or self-insured retention.

5.06.A.1 This insurance shall:

5.06.A.1.a. include the interests of Owner, Contractor, Subcontractors, Engineer and any other individuals or entities identified herein, and the officers, directors, partners, employees, agents and other consultants and subcontractors of any of them each of whom is deemed to have an insurable interest and shall be listed as an insured or additional insured;

5.06.A.1.b. in addition to the individuals and entities specified, include as additional insureds, the following:

5.06.A.1.b.(1) Northern Kentucky Water District.

5.06.A.1.b.(2) CH2M HILL.

5.06.A.1.c. be written on a Builder's Risk "all-risk" or open peril or special causes of loss policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, false work, 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;

5.06.A.1.c.(1) In addition to the above listed perils, the property insurance shall include flood, landslide, sleet, snow, ice, freezing damage, mechanical or electrical breakdown/failure, boiler explosion, damage to electrical apparatus from electrical currents, and loss of occupancy or business interruption costs.

5.06.A.1.d. include expenses incurred in the repair or replacement of any insured property (including but not limited to fees and charges of engineers and architects);

5.06.A.1.e. 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;

5.06.A.1.f. allow for partial utilization of the Work by Owner;

5.06.A.1.g. include testing and startup; and

5.06.A.1.h. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other additional insured to whom a certificate of insurance has been issued.

5.06.A.2. The policies of insurance required to be purchased and maintained by Contractor in accordance with this Paragraph SC-5.06.A shall comply with the requirements of Paragraph 5.06.C of the General Conditions.

SC-5.06. Delete Paragraph 5.06.B in its entirety and insert the following in its place:

5.06.B. Boiler and machinery insurance is not required for this Project.

SC-5.06. Delete Paragraph 5.06.C in its entirety and insert the following in its place:

5.06.C. All the policies of insurance (and the certificates or other evidence thereof) required to be purchased and maintained by Contractor in accordance with Paragraphs 5.06.A and 5.06.B shall contain a provision or endorsement that the coverage afforded shall not be canceled or materially changed or renewal refused until at least 30 days' prior written notice has been given to Owner and to each other additional insured to whom a certificate of insurance has been issued and shall contain waiver provisions in accordance with Paragraph 5.07.

SC-5.06. Delete Paragraph 5.06.E in its entirety and insert the following in its place:

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

SC-5.07. Delete the last sentence of Paragraph 5.07.A in its entirety and insert the following in its place:

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 Contractor as trustee or otherwise payable under any policy so issued.

SC-5.08. Delete Paragraph 5.08.A in its entirety and insert the following in its place:

5.08.A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Contractor and made payable to Contractor as fiduciary for the insured, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Contractor 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.

SC-5.08. Delete Paragraph 5.08.B in its entirety and insert the following in its place:

5.08.B. Contractor 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 Contractor's exercise of this power. If such objection be made, Contractor 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, Contractor as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Contractor as fiduciary shall give bond for the proper performance of such duties.

SC-5.10. Add the following language to the end of Paragraph 5.10.A:

The property insurance shall contain no partial occupancy restriction for utilization of the Project by Owner for the purpose intended.

SC-6.02. Add the following language at the end of Paragraph 6.02.B:

In accordance with Kentucky Revised Statute 337.540, no laborer, worker, or mechanic shall be permitted to Work more than 8 hours in 1 day nor more than 40 hours in 1 week except in cases of emergency caused by fire, flood, or damage to life or property. Owner shall determine when an emergency exists. Any time worked in excess of 8 hours per day or 40 hours per week shall be paid at least 1-1/2 times the basic hourly rate.

SC-6.02. Add the following language to the end of Paragraph 6.02.B:

Contractor (and Subcontractor) regular working hours consist of 8 working hours within a 9-hour period between 7:00 a.m. and 6:00 p.m., on a regularly scheduled basis, excluding Sundays and holidays. Overtime work is work in excess of 40 hours per week.

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

6.02.C. Contractor shall reimburse Owner for Engineer's additional extraordinary costs for onsite personnel overtime work resulting from Contractor's overtime operations. Reimbursement shall be on the cost basis defined in Paragraph 14.02.D.4 of these Supplementary Conditions.

SC-6.05. Add the following language at the end of Paragraph 6.05.E:

Reimbursement rates for Engineer or Related Entities for evaluation of proposed substitutes shall be on the basis as established in Paragraph 14.02.D.4 of these Supplementary Conditions.

SC-6.06. Add the following language at the end of Paragraph 6.06.A:

Contractor shall perform a minimum of 25 percent of the onsite labor with its own employees.

SC-6.06. Add the following new paragraphs immediately after Paragraph 6.06.B:

6.06.B.1. The identity and acceptance of Subcontractors and Suppliers for the following portions of the Work is required in accordance with the requirements of the Instructions to Bidders:

6.06.B.1.a. Mechanical.

6.06.B.1.b. Electrical.

6.06.B.1.c. Instrumentation and Controls.

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

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

SC-6.07. Add the following new paragraphs immediately after Paragraph 6.07.B:

6.07.C. Contractor shall, at its sole expense, defend and pay all damages, fees, royalties, and costs awarded in any proceeding brought against Owner, its employees and Related Entities, in which it is claimed that the use of any treatment process, material, equipment, or parts thereof furnished constitutes an infringement of any patent or other proprietary information right, provided Contractor is promptly notified of the commencement of any such proceedings. Contractor's indemnity applies only when infringement occurs from the normal use for which such treatment process, material, or equipment were designed. Owner may, at its option, be represented at any such proceeding. If use is held in any such proceeding to constitute an infringement

and is enjoined, Contractor, at its expense, shall either procure for Owner the right to use such treatment process, material and equipment or manufacture and sell product generated from the use of the treatment process; or pay the costs for damages, fees, or royalties.

SC-6.08. Add the following new paragraphs immediately after Paragraph 6.08.A:

6.08.B. Owner has obtained and paid for the following construction permits and licenses:

6.08.B.1. Kentucky Division of Water.

6.08.B.2. General Building Permit from Northern Kentucky Area Planning Commission.

6.08.C. A copy of each permit is available at Owner's office. Contractor shall examine the permits and conform to the requirements contained therein, including the purchase of additional bonds or insurance as specified therein, and such requirements are hereby made a part of these Contract Documents as fully and completely as though the same were set forth herein. Failure to examine the permit(s) will not relieve Contractor from compliance with the requirements stated therein. Within 15 days after the date of signing the Agreement, Contractor shall confer with an agent of the permitting agency so that insurance requirements and similar matters can be arranged prior to the time set for that portion of the Work.

SC-6.09. Add the following new paragraph immediately after Paragraph 6.09.C:

6.09.D. While not intended to be inclusive of all Laws or Regulations for which Contractor may be responsible under Paragraph 6.09, the following Laws or Regulations are included as mandated by statute or for the convenience of Contractor:

6.09.D.1. Prevailing Wages: All laborers, workmen, and mechanics performing work under the Contract shall be paid not less than the prevailing hourly rate of wages as determined by the Commissioner of Workplace Standards.

6.09.D.2. Prevailing Wages: The Kentucky Prevailing Wage Determination Number CR-8-037, which sets for the required prevailing wage rates is bound at the end of this section. In the event it is found that any worker, employed by CONTRACTOR or any Subcontractor covered by the Agreement has been paid a rate of wages less than the prevailing wage required to be paid by the Agreement, OWNER may terminate CONTRACTOR's or Subcontractor's right to proceed with the Work, or such part of the Work as to which there has been a failure to pay required wages and to prosecute the Work to completion or otherwise. CONTRACTOR and its sureties shall be liable to OWNER for any excess costs occasioned thereby.

SC-6.10. Taxes. Add the following new paragraph immediately after Paragraph 6.10.A of the General Conditions:

B. Portions of this project may be exempt from taxes. It is the Contractor's responsibility to determine the exemptions for this.

SC-6.11. Add the following language to the end of Paragraph 6.11.A.1:

Contractor shall not enter upon nor use property not under Owner control until appropriate easements have been executed and a copy is on file at the Site.

SC-6.17. Add the following new paragraphs immediately after Paragraph 6.17.E.1:

6.17.E.2. Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than the number of submittals specified in Paragraph 14.02.D.4 of these Supplementary Conditions. Engineer will record time for reviewing subsequent submittals of Shop Drawings, samples or other items requiring approval and Contractor shall reimburse Owner for Engineer's charges for such time in accordance with Paragraph 14.02.D.4 of these Supplementary Conditions.

6.17.E.3. In the event that Contractor requests a substitution for a previously approved item, Contractor shall reimburse Owner for Engineer's charges for such time, unless the need for such substitution is beyond the control of Contractor.

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

9.03.B. Resident Project Representative (RPR) will be furnished by Engineer. The responsibilities, authority, and limitations of the RPR are limited to those of Engineer in accordance with Paragraph 9.09 and as set forth elsewhere in the Contract Documents and are further limited and described below. RPR may only be on site one day per week.

9.03.C. Responsibilities and Authority:

9.03.C.1. Schedules: Review and monitor Progress Schedule, Schedule of Submittals, and Schedule of Values prepared by Contractor and consult with Engineer concerning acceptability.

9.03.C.2. Conferences and Meetings: Conduct or attend meetings with Contractor, such as preconstruction conferences, progress meetings, Work conferences and other Project related meetings.

9.03.C.3. Liaison: (i) Serve as Engineer's liaison with Contractor, working principally through Contractor's superintendent and assist in understanding the intent of the Contract Documents; (ii) assist Engineer in serving as Owner's liaison with Contractor when Contractor's operations affect Owner's onsite operations; (iii) assist in obtaining from Owner additional details or information when required for proper execution of the Work.

9.03.C.4. Submittals: Receive Submittals that are furnished at the Site by Contractor, and notify Engineer of availability for examination. Advise Engineer and Contractor of the commencement of any Work or arrival of Products at Site, when recognized, requiring a Shop Drawing or Sample if the Submittal has not been approved by Engineer.

9.03.C.5. Review of Work, Rejection of defective Work, Inspections and Tests: (i) Conduct onsite observations of the Work in progress to assist Engineer in determining if the Work is in general proceeding in accordance with the Contract Documents; (ii) inform Engineer and Contractor whenever RPR believes that any Work is defective; (iii) advise Engineer whenever RPR believes that any Work will not produce a completed Project that conforms generally to the Contract Documents or will prejudice the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or whenever RPR believes Work should be uncovered for observation, or requires special testing, inspection, or approval; (iv) monitor that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate personnel, and that Contractor maintains adequate records thereof; (v) observe, record and report to Engineer appropriate details relative to the test procedures and startups; and (vi) accompany visiting inspectors representing public or other agencies having jurisdiction over the Project, record the results of these inspections and report to Engineer.

9.03.C.6. Interpretation of Contract Documents: Inform Engineer when clarifications and interpretations of the Contract Documents are needed and transmit to Contractor clarifications and interpretations as issued by Engineer.

9.03.C.7. Modifications: Consider and evaluate Contractor's suggestions for modifications in Drawings or Specifications and provide recommendations to Engineer; transmit to Contractor the decisions issued by Engineer.

9.03.C.8. Records: (i) Maintain at the Site files for correspondence, conference records, Submittals including Shop Drawings and Samples, reproductions of original Contract Documents including all Addenda, signed Agreement, Work Change Directives, Change Orders, Field Orders, additional Drawings issued after the Effective Date of the Agreement, Engineer's written clarifications and interpretations, progress reports, and other Project related documents; (ii) keep a diary or log book recording pertinent Site conditions, activities, decisions and events.

9.03.C.9. Reports: (i) Furnish Engineer periodic reports of progress of the Work and of Contractor's compliance with the Progress Schedule and Schedule of Submittals; (ii) consult with Engineer in advance of scheduled major tests, inspections or start of important phases of the Work; and (iii) assist in drafting proposed Change Orders, Work Change Directives, and Field Orders, obtain backup material from Contractor as appropriate.

9.03.C.10. Payment Requests: Review applications for payment with Contractor for compliance with the established procedure for their submission and forward with recommendations to Engineer, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed and materials and equipment delivered at the Site but not incorporated in the Work.

9.03.C.11. Certificates, Operation and Maintenance Manuals, Record Documents, and Site Records: During the course of the Work, monitor that these documents and other data required to be assembled, maintained, and furnished by Contractor are applicable to the items actually installed and in accordance with the Contract Documents, and have this material delivered to Engineer for review and forwarding to Owner prior to final payment for the Work.

9.03.C.12. Substantial Completion: (i) Conduct an inspection in the company of Engineer, Owner, and Contractor and prepare a list of items to be completed or corrected; (ii) submit to Engineer a list of observed items requiring completion or correction.

9.03.C.13. Completion: (i) Conduct final inspection in the company of Engineer, Owner and Contractor; and (ii) notify Contractor and Engineer in writing of all particulars in which this inspection reveals that the Work is incomplete or defective; and (iii) observe that all items on final list have been completed, corrected, or accepted by Owner and make recommendations to Engineer concerning acceptance.

9.03.D. Limitations of Authority: Resident Project Representative will not:

9.03.D.1. have authority to authorize any deviation from the Contract Documents or substitution of materials or equipment, unless authorized by Engineer; or

9.03.D.2. undertake any of the responsibilities of Contractor, Subcontractors, or Contractor's superintendent; or

9.03.D.3. accept Submittals from anyone other than Contractor; or

9.03.D.4. authorize Owner to occupy the Project in whole or in part; or

9.03.D.5. participate in specialized field or laboratory tests or inspections conducted by others except as specifically authorized by Engineer.

SC-10.01. Add the following new paragraph immediately after Paragraph 10.01.A:

10.01.A.1. In accordance with Kentucky Revised Statute 45A.120, when accepting a Change Order, Contractor shall certify that, to the best of its knowledge and belief, the data submitted is accurate, complete, and current for performing the additional work or supplying the additional materials.

SC-10.05. Delete Paragraphs 10.05.C through 10.05.E in their entirety and insert the following in their place and renumber Paragraph 10.05.F to read 10.05.D:

10.05.C. *Engineer's Action and Executive Negotiation*:

10.05.C.1. *Engineer's Action*:

10.05.C.1.a. Engineer will render a formal decision in writing within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any. Engineer's written decision on such Claim, dispute or other matter will be final and binding upon Owner and Contractor, unless within 10 days after issuance of Engineer's written decision, either party appeals the decision by giving the other party and Engineer written notice of request for executive negotiation.

10.05.C.1.b. In the event Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

10.05.C.2. E*xecutive Negotiation*:

10.05.C.2.a. Within 10 days of the delivery of notice of appeal to Engineer's written decision regarding Claim, dispute or other matter, senior representatives of at least Owner and Contractor, having authority to settle the dispute, and Engineer shall meet at a mutually acceptable time and place, and thereafter as often as they reasonably deem necessary, to exchange relevant information and to attempt to resolve the dispute.

10.05.C.2.b. In the event a mutually acceptable decision cannot be reached through executive negotiation within 20 days of the appealing party's notice, or mutually agreeable longer period, or if the party receiving such notice will not meet within 10 days, Owner or Contractor may make a written declaration, delivered to the other party and Engineer, that the executive negotiation is deemed unsuccessful and may initiate further dispute resolution measures in accordance with Article 16.

10.05.C.2.c. If no such dispute resolution procedures have been set forth in Article 16, a written notice of intention to further appeal from Engineer's written decision is delivered by Owner or Contractor to the other and to Engineer within 30 days after the date upon which the executive negotiation has been declared unsuccessful, or within 60 days after Substantial Completion, whichever is later (unless otherwise agreed in writing by Owner and Contractor), to exercise such rights or remedies as the appealing party may have with respect to such Claim, dispute, or other matter in accordance with applicable Laws and Regulations.

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

13.03.B. Contractor shall employ an independent testing laboratory or testing agency and shall be responsible for arranging and shall pay for all specified tests, inspections, and approvals required for Owner's and Engineer's acceptance of the Work at the Site except:

13.03.B.1. costs incurred in connection with tests or inspections pursuant to Paragraph 13.04 shall be paid for as provided in said paragraph; and

13.03.B.2. as otherwise specifically provided in the Contract Documents.

SC-13.03. Add the following language at the end of Paragraph 13.03.D:

Tests required by Contract Documents to be performed by Contractor that require test certificates be submitted to Owner or Engineer for acceptance shall be made by an independent testing laboratory or agency licensed or certified in accordance with Laws and Regulations and applicable state and local statutes. In the event state license or certification is not required, testing laboratories or agencies shall meet the following applicable requirements:

13.03.D.1. "Recommended Requirements for Independent Laboratory Qualification," published by the American Council of Independent Laboratories.

13.03.D.2. Basic requirements of ASTM E329, "Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction" as applicable.

13.03.D.3. Calibrate testing equipment at reasonable intervals by devices of accuracy traceable to either the National Institute of Standards and Technology or accepted values of natural physical constants.

SC-14.02. Delete Paragraph 14.02.C.1 in its entirety and insert the following in its place:

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

SC-14.02. Add the following new paragraph(s) immediately after Paragraph 14.02.D.3:

14.02.D.4. Items entitling Owner to retain set-offs from the amount recommended, including but not limited to:

14.02.D.4.a. Owner compensation to Engineer at an estimated average rate of $120 per each extra personnel hour for labor plus expenses, if applicable, because of the following Contractor-caused events:

14.02.D.4.a.(2). return visits to manufacturing facilities to witness factory testing or retesting;

14.02.D.4.a.(3). Submittal review in excess of two reviews by Engineer for substantially the same Submittal, in accordance with Paragraph 6.17.E of these Supplementary Conditions;

14.02.D.4.a.(4). evaluation of proposed substitutes and in making changes to Contract Documents occasioned thereby, in accordance with Paragraph 6.05. of these Supplementary Conditions;

14.02.D.4.a.(5). Overtime worked by Contractor necessitating Engineer, Related Entities, Resident Project Representative or Resident Project Representative's Site staff, if any, to work extraordinary overtime in accordance with Paragraph 6.02.C. of these Supplementary Conditions.

14.02.D.4.b. Liability for liquidated damages incurred by Contractor as set forth in the Agreement.

SC-15.03.A. Delete the first sentence of Paragraph 15.03.A in its entirety and insert the following in its place:

Upon 7 days written notice to Contractor and Engineer, Owner may, without cause and without prejudice to any other right or remedy of Owner, terminate the Contract or any portion of the Contract.

SC-16. Dispute Resolution. Delete Article 16 in its entirety and insert the following new article in its place:

ARTICLE 16 – DISPUTES

Arbitration will not be acceptable as a means for settling claims, disputes, and other matters.

SC-17.04. Survival of Obligations. Add the following new paragraph immediately after Paragraph 17.04.A.

B. Contractor shall obtain from all suppliers and manufacturers any and all warranties and guarantees of such supplies and manufacturers, whether or not specifically required by the Specifications, and shall assign such warranties and guarantees to Owner. With respect thereto, Contractor shall render reasonable assistance to Owner when required, in order to enable Owner to enforce such warranties and guarantees. The assignment of any warranties or guarantees shall not affect the Correction Period or any other provisions of these Contract Documents.

END OF SECTION

PART 4

SPECIFICATIONS

SECTION 01010
SUMMARY OF WORK

PART 1 GENERAL

1.01 WORK COVERED BY CONTRACT DOCUMENTS

A. The completed Work will provide Owner with a Backwash Treatment System and includes the addition of a new Backwash Treatment Building and backwash treatment equipment. Building shall be one-story masonry building. Project includes necessary piping, electrical, instrumentation, and other appurtenances for the backwash treatment system, including SCADA system and sludge handling system improvements.

B. If accepted by the Owner, Work shall also include alternate bid item for replacement of roofing system on the Existing Sludge Building. Roofing system shall be as specified in Section 07550, Modified Bitumen Sheet Roofing, and associated specification sections.

C. If accepted by the Owner, Work shall also include alternate bid item for construction of a Dry Polymer Processing System, as specified in Section 11240, Chemical Feed Equipment, and associated specification sections. If alternate is not accepted, Contractor shall install water lines and electrical service to the proposed location of the Dry Polymer Processing System as part of the base bid Work.

1.02 WORK NOT COVERED BY CONTRACT DOCUMENTS

A. The Owner will retain others, during the construction period, to perform PLC programming work for the plant SCADA System to integrate the signals from the equipment control panel to the plant SCADA System and other SCADA system programming improvements.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01025
MEASUREMENT AND PAYMENT

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Schedule of Values: Submit on Contractor's standard form.
2. Schedule of Estimated Progress Payments:
   a. Submit with initially acceptable Schedule of Values.
   b. Submit adjustments thereto with Application for Payment.
3. Application for Payment.
4. Final Application for Payment.

1.02 SCHEDULE OF VALUES

A. Prepare a separate Schedule of Values for each schedule of the Work under the Agreement.

B. Upon request of Engineer, provide documentation to support the accuracy of the Schedule of Values.

C. Unit Price Work: Reflect unit price quantity and price breakdown from conformed Bid Form.

D. Lump Sum Work:

1. List bonds and insurance premiums, mobilization, demobilization, preliminary and detailed progress schedule preparation, equipment testing, facility startup, and contract closeout separately.

E. An unbalanced or front-end loaded schedule will not be acceptable.

F. Summation of the complete Schedule of Values representing all the Work shall equal the Contract Price.

1.03 APPLICATION FOR PAYMENT

A. Transmittal Summary Form: Attach one Summary Form with each detailed Application for Payment for each schedule and include Request for Payment of Materials and Equipment on Hand as applicable. Execute certification by authorized officer of Contractor.

B. Use detailed Application for Payment Form suitable to Engineer and/or provided by Owner.

C. Provide separate form for each schedule as applicable.

D. Include accepted Schedule of Values for each schedule or portion of lump sum Work and the unit price breakdown for the Work to be paid on a unit priced basis.

E. Include separate line item for each Change Order and Work Change Directive executed prior to date of submission. Provide further breakdown of such as requested by Engineer.

F. Preparation:

1. Round values to nearest dollar.
2. Submit Application for Payment, including a Transmittal Summary Form and detailed Application for Payment Form(s) for each schedule as applicable, a listing of materials on hand for each schedule as applicable, and such supporting data as may be requested by Engineer.

1.04 PAYMENT

A. Payment for all Lump Sum Work shown or specified in Contract Documents is included in the Contract Price. Payment will be based on a percentage complete basis for each line item of the accepted Schedule of Values.

B. Payment for Lump Sum Work covers all Work specified or shown in the Contract Documents.

1.05 NONPAYMENT FOR REJECTED OR UNUSED PRODUCTS

A. Payment will not be made for following:

1. Loading, hauling, and disposing of rejected material.
2. Quantities of material wasted or disposed of in manner not called for under Contract Documents.
3. Rejected loads of material, including material rejected after it has been placed by reason of failure of Contractor to conform to provisions of Contract Documents.
4. Material not unloaded from transporting vehicle.
5. Defective Work not accepted by Owner.
6. Material remaining on hand after completion of Work.

1.06 PARTIAL PAYMENT FOR STORED MATERIALS AND EQUIPMENT

A. Partial Payment: No partial payments will be made for materials and equipment delivered or stored unless Shop Drawings or preliminary operation and maintenance manuals are acceptable to Engineer.

B. Final Payment: Will be made only for products incorporated in Work; remaining products, for which partial payments have been made, shall revert to Contractor unless otherwise agreed, and partial payments made for those items will be deducted from final payment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01035
AMENDING AND SUPPLEMENTING CONTRACT DOCUMENTS

PART 1 GENERAL

1.01 PROPOSAL REQUESTS

A. Owner may, in anticipation of ordering an addition, deletion, or revision to the Work, request Contractor to prepare a detailed proposal of cost and times to perform contemplated change.

B. Proposal request will include reference number for tracking purposes and detailed description of and reason for proposed change, and such additional information as appropriate and as may be required for Contractor to accurately estimate cost and time impact on Project.

C. Proposal request is for information only; Contractor is neither authorized to execute proposed change nor to stop Work in progress as result of such request.

D. Contractor's written proposal shall be transmitted to Engineer promptly, but not later than 14 days after Contractor's receipt of Owner's written request. Proposal shall remain firm for a maximum period of 45 days after receipt by Engineer.

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

1.02 CLAIMS

A. Include, at a minimum:

1. Specific references including (i) Drawing numbers, (ii) Specification section and article/paragraph number, and (iii) Submittal type, Submittal number, date reviewed, Engineer's comment, as applicable, with appropriate attachments.
2. Stipulated facts and pertinent documents, including photographs and statements.
3. Interpretations relied upon.
4. Description of (i) nature and extent of Claim, (ii) who or what caused the situation, (iii) impact to the Work and work of others, and (iv) discussion of claimant's justification for requesting a change to price or times or both.
5. Estimated adjustment in price claimant believes it is entitled to with full documentation and justification.

6. Requested Change in Contract Times: Include at least (i) Progress Schedule documentation showing logic diagram for request, (ii) documentation that float times available for Work have been used, and (iii) revised activity logic with durations including sub-network logic revisions, duration changes, and other interrelated schedule impacts, as appropriate.
7. Documentation as may be necessary as set forth below for Work Change Directive, and as Engineer may otherwise require.

1.03 WORK CHANGE DIRECTIVES

A. Procedures:

1. Engineer will:
   a. Initiate, including a description of the Work involved and any attachments.
   b. Affix signature, demonstrating Engineer's recommendation.
   c. Transmit five copies to Owner for authorization.
2. Owner will:
   a. Affix signature, demonstrating approval of the changes involved.
   b. Return four copies to Engineer, who will retain one copy, send one copy to the Resident Project Representative or other field representative, and forward two copies to Contractor.
3. Upon completion of Work covered by the Work Change Directive or when final Contract Times and Contract Price is determined, Contractor shall submit documentation for inclusion in a Change Order.
4. Contractor's documentation shall include but not be limited to:
   a. Appropriately detailed records of Work performed to enable determination of value of the Work.
   b. Full information required to substantiate resulting change in Contract Times and Contract Price for Work. On request of Engineer, provide additional data necessary to support documentation.
   c. Support data for Work performed on a unit price or Cost of the Work basis with additional information such as:
      1) Dates Work was performed, and by whom.
      2) Time records, wage rates paid, and equipment rental rates.
      3) Invoices and receipts for materials, equipment, and subcontracts, all similarly documented.

B. Effective Date of Work Change Directive: Date of signature by Owner, unless otherwise indicated thereon.

1.04 CHANGE ORDERS

A. Procedure:

1. Engineer will prepare six copies of proposed Change Order and transmit such with Engineer's written recommendation and request to Contractor for signature.
2. Contractor shall, upon receipt, either: (i) promptly sign copies, retaining one for its file, and return remaining five copies to Engineer for Owner's signature, or (ii) return unsigned five copies with written justification for not executing Change Order.
3. Engineer will, upon receipt of Contractor signed copies, promptly forward Engineer's written recommendation and partially executed five copies for Owner's signature, or if Contractor fails to execute the Change Order, Engineer will promptly so notify Owner and transmit Contractor's justification to Owner.
4. Upon receipt of Contractor-executed Change Order, Owner will promptly either:
   a. Execute Change Order, retaining two copies for its file and returning three copies to Engineer, or
   b. Return to Engineer unsigned copies with written justification for not executing Change Order.
5. Upon receipt of Owner-executed Change Order, Engineer will transmit two copies to Contractor, one copy to Resident Project Representative or other field representative, and retain one copy, or if Owner fails to execute the Change Order, Engineer will promptly so notify Contractor and transmit Owner's justification to Contractor.
6. Upon receipt of Owner-executed Change Order, Contractor shall:
   a. Perform Work covered by Change Order.
   b. Revise Schedule of Values to adjust Contract Price and submit with next Application for Payment.
   c. Revise Progress Schedule to reflect changes in Contract Times, if any, and to adjust times for other items of Work affected by change.
   d. Enter changes in Project record documents after completion of change related Work.

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

1. Stipulated compensation (Contract Price or Contract Times, or both) set forth includes payment for (i) the Cost of the Work covered by the Change Order, (ii) Contractor's fee for overhead and profit, (iii) interruption of Progress Schedule, (iv) delay and impact, including cumulative impact, on other Work under the Contract Documents, and (v) extended overheads.

2. Change Order constitutes full mutual accord and satisfaction for the change to the Work;
3. Unless otherwise stated in the Change Order, all requirements of the original Contract Documents apply to the Work covered by the Change Order.

1.05 COST OF THE WORK

A. In determining the supplemental costs allowed in Paragraph 11.01.A.5 of the General Conditions for rental equipment and machinery, the following will apply.

B. Rental of construction equipment and machinery and the parts thereof having a replacement value in excess of $1,000, whether owned by Contractor or rented or leased from others, shall meet the following requirements:

1. Full rental costs for leased equipment shall not exceed rates listed in the Rental Rate Blue Book published by Primedia Information, Inc., San Jose, California, as adjusted to the regional area of the Project. Owned equipment costs shall not exceed the single shift rates established in the Contractors' Equipment Cost Guide (CECG) for Construction Equipment also published by Primedia Information, Inc. The most recent published edition in effect at commencement of actual equipment use shall be used.
2. Rates shall apply to equipment in good working condition. Equipment not in good condition, or larger than required, may be rejected by Engineer or accepted at reduced rates.
3. Leased Equipment: For equipment leased or rented in arm's length transactions from outside vendors, maximum rates shall be determined by the following actual usage/Blue Book Payment Category:
   a. Less than 8 hours: Hourly Rate.
   b. 8 or more hours but less than 7 days: Daily Rate.
   c. 7 or more days but less than 30 days: Weekly Rate.
   d. 30 days or more: Monthly Rate.
4. Arm's length rental and lease transactions are those in which the firm involved in the rental or lease of equipment is not associated with, owned by, have common management, directorship, facilities and/or stockholders with the firm renting the equipment.
5. Leased Equipment in Use: Actual equipment use time documented by Engineer shall be the basis that equipment was on and utilized at the Project Site. In addition to the leasing rate above, equipment operational costs shall be paid at the estimated hourly operating cost rate set forth in the Blue Book if not already included in the lease rate. Hours of operation shall be based upon actual equipment usage to the nearest quarter hour, as recorded by Engineer.

6. Leased Equipment, When Idle (Standby): Idle or standby equipment is equipment onsite or in transit to and from the Work Site and necessary to perform the Work under the modification, but not in actual use. Idle equipment time, as documented by Engineer, shall be paid at the leasing rate determined above, excluding operational costs.
7. Owned and Other Equipment in Use: Equipment rates for owned equipment or equipment provided in other than arm's length transaction shall not exceed the single shift total hourly costs rate developed in accordance with the CECG and as modified herein for multiple shifts. This total hourly rate will be paid for each hour the equipment actually performs work. Hours of operation shall be based upon actual equipment usage as recorded by Engineer. This rate shall represent payment in full for Contractor's direct costs.
8. Owned and Other Equipment, When Idle (Standby): Equipment necessary to be onsite to perform the Work on single shift operations, but not utilized, shall be paid for at the ownership hourly expense rate developed in accordance with the CECG, provided its presence and necessity onsite has been documented by Engineer. Payment for idle time of portions of a normal workday, in conjunction with original contract Work, will not be allowed. In no event shall idle time claimed in a day for a particular piece of equipment exceed the normal Work or shift schedule established for the Project. It is agreed that this rate shall represent payment in full for Contractor's direct costs. When Engineer determines that the equipment is not needed to continuously remain at the Work Site, payment will be limited to actual hours in use.
9. Owned and Other Equipment, Multiple Shifts: For multiple shift operations, the CECG single shift total hourly costs rate shall apply to the operating equipment during the first shift. For subsequent shifts, up to 2 in a 24-hour day, operating rate shall be the sum of the total hourly CECG operating cost and 60 percent of the CECG ownership and overhaul expense. Payment for idle or standby time for second and third shifts shall be 20 percent of the CECG ownership and overhaul expense.
10. When necessary to obtain owned equipment from sources beyond the Project limits, the actual cost to transfer equipment to the Work Site and return it to its original location will be allowed as an additional item of expense. Move-in and move-out allowances will not be made for equipment brought to the Project if the equipment is also used on original Contract or related Work.
11. If the move-out destination is not to the original location, payment for move-out will not exceed payment for move-in.
12. If move is made by common carrier, the allowance will be the amount paid for the freight. If equipment is hauled with Contractor's own forces, rental will be allowed for the hauling unit plus the hauling unit operator's wage. If equipment is transferred under its own power, the rental will be

75 percent of the appropriate total hourly costs for the equipment, without attachments, plus the equipment operator's wage.

13. Charges for time utilized in servicing equipment to ready it for use prior to moving and similar charges will not be allowed.
14. When a breakdown occurs on any piece of owned equipment, payment shall cease for that equipment and any other owned equipment idled by the breakdown.
15. If any part of the Work is shut down by Owner, standby time will be paid during nonoperating hours if diversion of equipment to other Work is not practicable. Engineer reserves the right to cease standby time payment when an extended shutdown is anticipated.
16. If a rate has not been established in the CECG for owned equipment, Contractor may:
    a. If approved by Engineer, use the rate of the most similar model found, considering such characteristics as manufacturer, capacity, horsepower, age, and fuel type, or
    b. Request Primedia Information Inc. to furnish a written response for a rate on the equipment, which shall be presented to Engineer for approval; or
    c. Request Engineer to establish a rate.

1.06 FIELD ORDER

A. Engineer will issue Field Orders, with three copies to Contractor.

B. Effective date of the Field Order shall be the date of signature by Engineer, unless otherwise indicated thereon.

C. Contractor shall acknowledge receipt by signing and returning one copy to Engineer.

D. Field Orders will be incorporated into subsequent Change Orders, as a no-cost change to the Contract.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01040
COORDINATION

PART 1 GENERAL

1.01 RELATED WORK AT SITE

A. General:

1. Other work that is either directly or indirectly related to scheduled performance of the Work under these Contract Documents, may be performed at Site by others.
2. Coordinate the Work of these Contract Documents with work of others as specified in General Conditions.
3. Ongoing construction activities at the site by Others include the Taylor Mill Treatment Plant UV Disinfection project.

1.02 UTILITY NOTIFICATION AND COORDINATION

A. Coordinate the Work with various utilities within Project limits. Notify applicable utilities prior to commencing Work, if damage occurs, or if conflicts or emergencies arise during Work.

1.03 FACILITY OPERATIONS

A. Continuous operation of Owner's facilities is of critical importance. Schedule and conduct activities to enable existing facilities to operate continuously, unless otherwise specified.

B. Perform Work continuously during critical connections and changeovers, and as required to prevent interruption of Owner's operations.

C. When necessary, plan, design, and provide various temporary services, utilities, connections, temporary piping and heating, access, and similar items to maintain continuous operations of Owner's facility.

D. Do not close lines, open or close valves, or take other action which would affect the operation of existing systems, except as specifically required by the Contract Documents and after authorization by Owner and Engineer. Such authorization will be considered within 72 hours after receipt of Contractor's written request.

E. Process or Facility Shutdown:

1. The following may be shutdown at some time during the Work:
   a. Sludge handling system.
   b. Backwash disposal system.
   c. Plant SCADA control system.
2. Provide 72-hour advance written request for approval of need to shut down a process or facility to Owner and Engineer.
3. Power outages will be considered upon 72 hours written request to Owner and Engineer. Describe the reason, anticipated length of time, and areas affected by the outage. Provide temporary provisions for continuous power supply to critical facility components.
4. Maximum shutdown of any Owner process or facility shall be limited to 4 hours.

F. Install and maintain facilities required to keep Owner's sludge handling and backwash disposal process operations on line. Sequences other than those specified will be considered upon written request to Owner and Engineer, provided they afford equivalent continuity of operations.

G. Do not proceed with Work affecting a facility's operation without obtaining Owner's and Engineer's advance approval of the need for and duration of such Work.

H. Relocation of Existing Facilities:

1. During construction, it is expected that minor relocations of Work will be necessary.
2. Provide complete relocation of existing structures and Underground Facilities, including piping, utilities, equipment, structures, electrical conduit wiring, electrical duct bank, and other necessary items.
3. Use only new materials for relocated facility. Match materials of existing facility, unless otherwise shown or specified.
4. Perform relocations to minimize downtime of existing facilities.
5. Install new portions of existing facilities in their relocated position prior to removal of existing facilities, unless otherwise accepted by Engineer.

1.04 ADJACENT FACILITIES AND PROPERTIES

A. Examination:

1. After Effective Date of the Agreement and before Work at Site is started, Contractor, Engineer, and affected property owners and utility owners shall make a thorough examination of pre-existing conditions including existing buildings, structures, and other improvements in vicinity of Work, as applicable, which could be damaged by construction operations.

2. Periodic reexamination shall be jointly performed to include, but not limited to, cracks in structures, settlement, leakage, and similar conditions.

1.05 REFERENCE POINTS AND SURVEYS

A. Owner's Responsibilities:

1. Establish bench marks convenient to Work and at least every 500 feet on pipelines and roads.
2. Establish horizontal reference points or coordinate system with bench marks and reference points for Contractor's use as necessary to lay out Work.

B. Location and elevation of bench marks are shown on Drawings.

C. Contractor's Responsibilities:

1. Provide additional survey and layout required to layout the Work.
2. Notify Engineer at least 3 working days in advance of time when grade and line to be provided by Owner will be needed.
3. Check and establish exact location of existing facilities prior to construction of new facilities and any connections thereto.
4. In event of discrepancy in data or staking provided by Owner, request clarification before proceeding with Work.
5. Provide competent employee(s), tools, stakes, and other equipment and materials as Engineer may require to:
   a. Establish control points, lines, and easement boundaries.
   b. Check layout, survey, and measurement Work performed by others.
   c. Measure quantities for payment purposes.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 CUTTING, FITTING, AND PATCHING

A. Cut, fit, adjust, or patch Work and work of others, including excavation and backfill as required, to make Work complete.

B. Obtain prior written authorization of Engineer before commencing Work to cut or otherwise alter:

1. Structural or reinforcing steel, structural column or beam, elevated slab, trusses, or other structural member.
2. Weather- or moisture-resistant elements.

3. Efficiency, maintenance, or safety of element.
4. Work of others.

C. Refinish surfaces to provide an even finish.

1. Refinish continuous surfaces to nearest intersection.
2. Refinish entire assemblies.
3. Finish restored surfaces to such planes, shapes, and textures that no transition between existing work and Work is evident in finished surfaces.

D. Restore existing work, Underground Facilities, and surfaces that are to remain in completed Work including concrete-embedded piping, conduit, and other utilities as specified and as shown.

E. Make restorations with new materials and appropriate methods as specified for new Work of similar nature; if not specified, use recommended practice of manufacturer or appropriate trade association.

F. Fit Work airtight to pipes, sleeves, ducts, conduit, and other penetrations through surfaces and fill voids.

G. Remove specimens of installed Work for testing when requested by Engineer.

END OF SECTION

SECTION 01092
ABBREVIATIONS

PART 1 GENERAL

1.01 REFERENCE TO STANDARDS AND SPECIFICATIONS OF TECHNICAL SOCIETIES

A. Reference to standards and specifications of technical societies and reporting and resolving discrepancies associated therewith shall be as provided in Paragraph 3.02 of the General Conditions, and as may otherwise be required herein and in the individual Specification sections.

B. Work specified by reference to published standard or specification of government agency, technical association, trade association, professional society or institute, testing agency, or other organization shall meet requirements or surpass minimum standards of quality for materials and workmanship established by designated standard or specification.

C. Where so specified, products or workmanship shall also meet or exceed additional prescriptive or performance requirements included within Contract Documents to establish a higher or more stringent standard of quality than required by referenced standard.

D. Where two or more standards are specified to establish quality, product and workmanship shall meet or exceed requirements of most stringent.

E. Where both a standard and a brand name are specified for a product in Contract Documents, proprietary product named shall meet or exceed requirements of specified reference standard.

F. Copies of standards and specifications of technical societies:

1. Copies of applicable referenced standards have not been bound in these Contract Documents.
2. Where copies of standards are needed by Contractor, obtain a copy or copies directly from publication source and maintain in an orderly manner at the Site as Work Site records, available to Contractor's personnel, Subcontractors, Owner, and Engineer.

1.02 ABBREVIATIONS

A. Abbreviations for trade organizations and government agencies: Following is a list of construction industry organizations and government agencies to which references may be made in the Contract Documents, with abbreviations used.

1. AA Aluminum Association

2.	AABC	Associated Air Balance Council
3.	AAMA	American Architectural Manufacturers Association
4.	AASHTO	American Association of State Highway and Transportation Officials
5.	ABMA	American Bearing Manufacturers' Association
6.	ACI	American Concrete Institute
7.	AEIC	Association of Edison Illuminating Companies
8.	AGA	American Gas Association
9.	AGMA	American Gear Manufacturers' Association
10.	AI	Asphalt Institute
11.	AISC	American Institute of Steel Construction
12.	AISI	American Iron and Steel Institute
13.	AITC	American Institute of Timber Construction
14.	ALS	American Lumber Standards
15.	AMCA	Air Movement and Control Association
16.	ANSI	American National Standards Institute
17.	APA	APA – The Engineered Wood Association
18.	API	American Petroleum Institute
19.	APWA	American Public Works Association
20.	ARI	Air-Conditioning and Refrigeration Institute
21.	ASAE	American Society of Agricultural Engineers
22.	ASCE	American Society of Civil Engineers
23.	ASHRAE	American Society of Heating, Refrigerating and Air-Conditioning Engineers, Inc.
24.	ASME	American Society of Mechanical Engineers
25.	ASNT	American Society for Nondestructive Testing
26.	ASTM	ASTM International
27.	AWI	Architectural Woodwork Institute
28.	AWPA	American Wood Preservers' Association
29.	AWPI	American Wood Preservers' Institute
30.	AWS	American Welding Society
31.	AWWA	American Water Works Association
32.	BHMA	Builders Hardware Manufacturers' Association
33.	CBM	Certified Ballast Manufacturer
34.	CDA	Copper Development Association
35.	CGA	Compressed Gas Association
36.	CISPI	Cast Iron Soil Pipe Institute
37.	CMAA	Crane Manufacturers' Association of America
38.	CRSI	Concrete Reinforcing Steel Institute
39.	CS	Commercial Standard
40.	CSA	Canadian Standards Association
41.	CSI	Construction Specifications Institute
42.	DIN	Deutsches Institut für Normung e.V.
43.	DIPRA	Ductile Iron Pipe Research Association
44.	EIA	Electronic Industries Alliance

45.	EJCDC	Engineers Joint Contract Documents' Committee
46.	ETL	Electrical Test Laboratories
47.	FAA	Federal Aviation Administration
48.	FCC	Federal Communications Commission
49.	FDA	Food and Drug Administration
50.	FEMA	Federal Emergency Management Agency
51.	FIPS	Federal Information Processing Standards
52.	FM	Factory Mutual
53.	Fed. Spec.	Federal Specifications (FAA Specifications)
54.	FS	Federal Specifications and Standards (Technical Specifications)
55.	GA	Gypsum Association
56.	GANA	Glass Association of North America
57.	HI	Hydraulic Institute
58.	HMI	Hoist Manufacturers' Institute
59.	IBC	International Building Code
60.	ICBO	International Conference of Building Officials
61.	ICC	International Code Council
62.	ICEA	Insulated Cable Engineers' Association
63.	IFC	International Fire Code
64.	IEEE	Institute of Electrical and Electronics Engineers, Inc.
65.	IESNA	Illuminating Engineering Society of North America
66.	IFI	Industrial Fasteners Institute
67.	IGMA	Insulating Glass Manufacturer's Alliance
68.	IMC	International Mechanical Code
69.	INDA	Association of the Nonwoven Fabrics Industry
70.	IPC	International Plumbing Code
71.	ISA	Instrumentation, Systems, and Automation Society
72.	ISO	International Organization for Standardization
73.	ITL	Independent Testing Laboratory
74.	JIC	Joint Industry Conferences of Hydraulic Manufacturers
75.	MIA	Marble Institute of America
76.	MIL	Military Specifications
77.	MMA	Monorail Manufacturers' Association
78.	NAAMM	National Association of Architectural Metal Manufacturers
79.	NACE	NACE International
80.	NEBB	National Environmental Balancing Bureau
81.	NEC	National Electrical Code
82.	NECA	National Electrical Contractor's Association
83.	NEMA	National Electrical Manufacturers' Association

84.	NESC	National Electrical Safety Code
85.	NETA	InterNational Electrical Testing Association
86.	NFPA	National Fire Protection Association
87.	NHLA	National Hardwood Lumber Association
88.	NICET	National Institute for Certification in Engineering Technologies
89.	NIST	National Institute of Standards and Technology
90.	NRCA	National Roofing Contractors Association
91.	NRTL	Nationally Recognized Testing Laboratories
92.	NSF	NSF International
93.	NSPE	National Society of Professional Engineers
94.	NTMA	National Terrazzo and Mosaic Association
95.	NWWDA	National Wood Window and Door Association
96.	OSHA	Occupational Safety and Health Act (both Federal and State)
97.	PCI	Precast/Prestressed Concrete Institute
98.	PEI	Porcelain Enamel Institute
99.	PPI	Plastic Pipe Institute
100.	PS	Product Standards Section-U.S. Department of Commerce
101.	RMA	Rubber Manufacturers' Association
102.	RUS	Rural Utilities Service
103.	SAE	Society of Automotive Engineers
104.	SDI	Steel Deck Institute
105.	SDI	Steel Door Institute
106.	SJI	Steel Joist Institute
107.	SMACNA	Sheet Metal and Air Conditioning Contractors National Association
108.	SPI	Society of the Plastics Industry
109.	SSPC	The Society for Protective Coatings
110.	SWI	Steel Window Institute
111.	TEMA	Tubular Exchanger Manufacturers' Association
112.	TCA	Tile Council of North America
113.	TIA	Telecommunications Industry Association
114.	UBC	Uniform Building Code
115.	UFC	Uniform Fire Code
116.	UL	Underwriters Laboratories Inc.
117.	UMC	Uniform Mechanical Code
118.	USBR	U.S. Bureau of Reclamation
119.	WCLIB	West Coast Lumber Inspection Bureau
120.	WWPA	Western Wood Products Association

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01200
PROJECT MEETINGS

PART 1 GENERAL

1.01 GENERAL

A. Contractor shall schedule physical arrangements for meetings throughout progress of the Work, prepare meeting agenda with regular participant input and distribute with written notice of each meeting, preside at meetings, record minutes to include significant proceedings and decisions, and reproduce and distribute copies of minutes within 5 days after each meeting to participants and parties affected by meeting decisions.

1.02 PRECONSTRUCTION CONFERENCE

A. Contractor shall be prepared to discuss the following subjects, as a minimum:

1. Required schedules.
2. Status of Bonds and insurance.
3. Sequencing of critical path work items.
4. Progress payment procedures.
5. Project changes and clarification procedures.
6. Use of Site, access, office and storage areas, security and temporary facilities.
7. Major product delivery and priorities.
8. Contractor's safety plan and representative.

B. Attendees will include:

1. Owner's representatives.
2. Contractor's office representative.
3. Contractor's resident superintendent.
4. Contractor's quality control representative.
5. Subcontractors' representatives whom Contractor may desire or Engineer may request to attend.
6. Engineer's representatives.
7. Others as appropriate.

1.03 PRELIMINARY SCHEDULES REVIEW MEETING

A. As set forth in General Conditions and Section 01310, Progress Schedules.

1.04 PROGRESS MEETINGS

A. Engineer will schedule regular progress meetings at Site, conducted monthly to review the Work progress, Progress Schedule, Schedule of Submittals, Application for Payment, contract modifications, and other matters needing discussion and resolution.

B. Attendees will include:

1. Owner's representative(s), as appropriate.
2. Contractor, Subcontractors, and Suppliers, as appropriate.
3. Engineer's representative(s).
4. Others as appropriate.

1.05 PREINSTALLATION MEETINGS

A. When required in individual Specification sections, convene at Site prior to commencing the Work of that section.

B. Require attendance of entities directly affecting, or affected by, the Work of that section.

C. Notify Engineer 4 days in advance of meeting date.

D. Provide suggested agenda to Engineer to include reviewing conditions of installation, preparation and installation or application procedures, and coordination with related Work and work of others.

1.06 FACILITY STARTUP MEETINGS

A. Schedule and attend a minimum of two facility startup meetings. The first of such meetings shall be held prior to submitting Facility Startup Plan, as specified in Section 01810, Equipment Testing and Facility Startup, and shall include preliminary discussions regarding such plan.

B. Agenda items shall include, but not be limited to, content of Facility Startup Plan, coordination needed between various parties in attendance, and potential problems associated with startup.

C. Attendees will include:

1. Contractor.
2. Contractor's designated quality control representative.
3. Subcontractors and equipment manufacturer's representatives whom Contractor deems to be directly involved in facility startup.

4. Engineer's representatives.
5. Owner's operations personnel.
6. Others as required by Contract Documents or as deemed necessary by Contractor.

1.07 OTHER MEETINGS

A. In accordance with Contract Documents and as may be required by Owner and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01300
SUBMITTALS

PART 1 GENERAL

1.01 DEFINITIONS

A. Action Submittal: Written and graphic information submitted by Contractor that requires Engineer's approval.

B. Informational Submittal: Information submitted by Contractor that does not require Engineer's approval.

1.02 PROCEDURES

A. Direct submittals to Engineer at the following address, unless specified otherwise.

1. CH2M HILL
   Attn: Mr. Frank Duran
   300 E-Business Way, Suite 400
   Cincinnati, OH 45241
   Phone: 513-489-0779

B. Transmittal of Submittal:

1. Contractor shall:
   a. Review each submittal and check for compliance with Contract Documents.
   b. Stamp each submittal with uniform approval stamp before submitting to Engineer.
      1) Stamp to include Project name, submittal number, Specification number, Contractor's reviewer name, date of Contractor's approval, and statement certifying that submittal has been reviewed, checked, and approved for compliance with Contract Documents.
      2) Engineer will not review submittals that do not bear Contractor's approval stamp and will return them without action.
2. Complete, sign, and transmit with each submittal package, one Transmittal of Contractor's Submittal form attached at end of this section.
3. Identify each submittal with the following:
   a. Numbering and Tracking System:
      1) Sequentially number each submittal.
      2) Resubmission of submittal shall have original number with sequential alphabetic suffix.

b. Specification section and paragraph to which submittal applies.
c. Project title and Engineer's project number.
d. Date of transmittal.
e. Names of Contractor, Subcontractor or Supplier, and manufacturer as appropriate.

4. Identify and describe each deviation or variation from Contract Documents.

C. Format:

1. Do not base Shop Drawings on reproductions of Contract Documents.
2. Package submittal information by individual Specification section. Do not combine different Specification sections together in submittal package, unless otherwise directed in Specification.
3. Present in a clear and thorough manner and in sufficient detail to show kind, size, arrangement, and function of components, materials, and devices, and compliance with Contract Documents.
4. Index with labeled tab dividers in orderly manner.

D. Timeliness: Schedule and submit in accordance Schedule of Submittals, and requirements of individual Specification sections.

E. Processing Time:

1. Time for review shall commence on Engineer's receipt of submittal.
2. Engineer will act upon Contractor's submittal and transmit response to Contractor not later than 30 days after receipt, unless otherwise specified.
3. Resubmittals will be subject to same review time.
4. No adjustment of Contract Times or Price will be allowed due to delays in progress of Work caused by rejection and subsequent resubmittals.

F. Resubmittals: Clearly identify each correction or change made.

G. Incomplete Submittals:

1. Engineer will return entire submittal for Contractor's revision if preliminary review deems it incomplete.
2. When any of the following are missing, submittal will be deemed incomplete:
   a. Contractor's review stamp, completed and signed.
   b. Transmittal of Contractor's Submittal, completed and signed.
   c. Insufficient number of copies.

H. Submittals not required by Contract Documents:

1. Will not be reviewed and will be returned stamped "Not Subject to Review."

2. Engineer will keep one copy and return all remaining copies to Contractor.

1.03 ACTION SUBMITTALS

A. Prepare and submit Action Submittals required by individual Specification sections.

B. Shop Drawings:

1. Copies: Six, and one reproducible, except copyrighted documents. Submit eight copies of copyrighted materials.
2. Identify and Indicate:
   a. Applicable Contract Drawing and Detail number, products, units and assemblies, and system or equipment identification or tag numbers.
   b. Equipment and Component Title: Identical to title shown on Drawings.
   c. Critical field dimensions and relationships to other critical features of Work. Note dimensions established by field measurement.
   d. Project-specific information drawn accurately to scale.
3. Manufacturer's standard schematic drawings and diagrams as follows:
   a. Modify to delete information that is not applicable to the Work.
   b. Supplement standard information to provide information specifically applicable to the Work.
4. Product Data: Provide as specified in individual Specifications.
5. Foreign Manufacturers: When proposed, include following additional information:
   a. Names and addresses of at least two companies that maintain technical service representatives close to Project.
   b. Complete list of spare parts and accessories for each piece of equipment.

C. Samples:

1. Copies: Two, unless otherwise specified in individual Specifications.
2. Preparation: Mount, display, or package Samples in manner specified to facilitate review of quality. Attach label on unexposed side that includes the following:
   a. Manufacturer name.
   b. Model number.
   c. Material.
   d. Sample source.
3. Manufacturer's Color Chart: Units or sections of units showing full range of colors, textures, and patterns available.
4. Full-size Samples:
   a. Size as indicated in individual Specification section.

b. Prepared from same materials to be used for the Work.
c. Cured and finished in manner specified.
d. Physically identical with product proposed for use.

D. Action Submittal Dispositions: Engineer will review, mark, and stamp as appropriate, and distribute marked-up copies as noted:

1. Approved:
   a. Contractor may incorporate product(s) or implement Work covered by submittal.
   b. Distribution:
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
      4) Remaining copies returned to Contractor appropriately annotated.
2. Approved as Noted:
   a. Contractor may incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
   b. Distribution:
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
      4) Remaining copies returned to Contractor appropriately annotated.
3. Partial Approval, Resubmit as Noted:
   a. Make corrections or obtain missing portions, and resubmit.
   b. Except for portions indicated, Contractor may begin to incorporate product(s) or implement Work covered by submittal, in accordance with Engineer's notations.
   c. Distribution:
      1) One copy furnished Owner.
      2) One copy furnished Resident Project Representative.
      3) One copy retained in Engineer's file.
      4) Remaining copies returned to Contractor appropriately annotated.
4. Revise and Resubmit:
   a. Contractor may not incorporate product(s) or implement Work covered by submittal.
   b. Distribution:
      1) One copy furnished Resident Project Representative.
      2) One copy retained in Engineer's file.
      3) Remaining copies returned to Contractor appropriately annotated.

1.04 INFORMATIONAL SUBMITTALS

A. General:

1. Copies: Submit three copies, unless otherwise indicated in individual Specification section.
2. Refer to individual Specification sections for specific submittal requirements.
3. Engineer will review each submittal. If submittal meets conditions of the Contract, Engineer will forward copies to appropriate parties. If Engineer determines submittal does not meet conditions of the Contract and is therefore considered unacceptable, Engineer will retain one copy and return remaining copies with review comments to Contractor, and require that submittal be corrected and resubmitted.

B. Application for Payment: In accordance with Section 01025, Measurement and Payment.

C. Certificates:

1. General:
   a. Provide notarized statement that includes signature of entity responsible for preparing certification.
   b. Signed by officer or other individual authorized to sign documents on behalf of that entity.
2. Welding: In accordance with individual Specification sections.
3. Installer: Prepare written statements on manufacturer's letterhead certifying that installer complies with requirements as specified in individual Specification sections.
4. Material Test: Prepared by qualified testing agency, on testing agency's standard form, indicating and interpreting test results of material for compliance with requirements.
5. Certificates of Successful Testing or Inspection: Submit when testing or inspection is required by Laws and Regulations or governing agency or specified in individual Specification sections.
6. Manufacturer's Certificate of Compliance: In accordance with Section 01640, Manufacturers' Services.
7. Manufacturer's Certificate of Proper Installation: In accordance with Section 01640, Manufacturers' Services.

D. Contract Closeout Submittals: In accordance with Section 01780, Contract Closeout.

E. Contractor-Design Data:

1. Written and graphic information.
2. List of assumptions.
3. List of performance and design criteria.

4. Summary of loads or load diagram, if applicable.
5. Calculations.
6. List of applicable codes and regulations.
7. Name and version of software.
8. Information requested in individual Specification section.

F. Manufacturer's Instructions: Written or published information that documents manufacturer's recommendations, guidelines, and procedures in accordance with individual Specification sections.

G. Operation and Maintenance Data: As required in Section 01430, Operation and Maintenance Data.

H. Schedules:

1. Schedule of Submittals: Prepare separately or in combination with Progress Schedule as specified in Section 01310, Progress Schedules.
   a. Show for each, at a minimum, the following:
      1) Specification section number.
      2) Identification by numbering and tracking system as specified under Paragraph Transmittal of Submittal.
      3) Estimated date of submission to Engineer, including reviewing and processing time.
   b. On a monthly basis, submit updated schedule to Engineer if changes have occurred or resubmittals are required.
2. Schedule of Values: In accordance with Section 01025, Measurement and Payment.
3. Schedule of Estimated Progress Payments: In accordance with Section 01310, Progress Schedules.
4. Progress Schedules: In accordance with Section 01310, Progress Schedules.

I. Special Guarantee: Supplier's written guarantee as required in individual Specification sections.

J. Statement of Qualification: Evidence of qualification, certification, or registration as required in Contract Documents to verify qualifications of professional land surveyor, engineer, materials testing laboratory, specialty Subcontractor, trade, Specialist, consultant, installer, and other professionals.

K. Submittals Required by Laws, Regulations, and Governing Agencies:

1. Submit promptly notifications, reports, certifications, payrolls, and otherwise as may be required, directly to the applicable federal, state, or local governing agency or their representative.
2. Transmit to Engineer for Owner's records one copy of correspondence and transmittals (to include enclosures and attachments) between Contractor and governing agency.

L. Test and Inspection Reports:

1. General: Shall contain signature of person responsible for test or report.
2. Factory:
   a. Identification of product and Specification section, type of inspection or test with referenced standard or code.
   b. Date of test, Project title and number, and name and signature of authorized person.
   c. Test results.
   d. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
   e. Provide interpretation of test results, when requested by Engineer.
   f. Other items as identified in individual Specification sections.
3. Field: As a minimum, include the following:
   a. Project title and number.
   b. Date and time.
   c. Record of temperature and weather conditions.
   d. Identification of product and Specification section.
   e. Type and location of test, Sample, or inspection, including referenced standard or code.
   f. Date issued, testing laboratory name, address, and telephone number, and name and signature of laboratory inspector.
   g. If test or inspection deems material or equipment not in compliance with Contract Documents, identify corrective action necessary to bring into compliance.
   h. Provide interpretation of test results, when requested by Engineer.
   i. Other items as identified in individual Specification sections.

M. Testing and Startup Data: In accordance with Section 01810, Equipment Testing and Facility Startup.

N. Training Data: In accordance with Section 01640, Manufacturers' Services.

1.05 SUPPLEMENTS

A. The supplements listed below, following "End of Section", are part of this Specification.

1. Forms: Transmittal of Contractor's Submittal

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

TRANSMITTAL OF CONTRACTOR'S SUBMITTAL

(ATTACH TO EACH SUBMITTAL)

CH2MHILL

DATE: _____

TO: _____

_____

_____

_____

_____

FROM: _____
Contractor

_____

_____

_____

Submittal No.: _____

☐ New Submittal ☐ Resubmittal

Project: _____

Project No.: _____

Specification Section No.: _____
(Cover only one section with each transmittal)

Schedule Date of Submittal:

_____

SUBMITTAL TYPE: ☐ Shop Drawing ☐ Sample ☐ Informational

The following items are hereby submitted:

Number of Copies	Description of Item Submitted (Type, Size, Model Number, Etc.)	Spec. and Para. No.	Drawing or Brochure Number	Contains Variation to Contract	
				No	Yes

Contractor hereby certifies that (i) Contractor has complied with the requirements of Contract Documents in preparation, review, and submission of designated Submittal and (ii) the Submittal is complete and in accordance with the Contract Documents and requirements of laws and regulations and governing agencies.

By: _____
Contractor (Authorized Signature)

SECTION 01310
PROGRESS SCHEDULES

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Preliminary Progress Schedule: Submit within time specified in paragraph 2.05 of the General Conditions.
2. Detailed Progress Schedule:
   a. Submit initial Detailed Progress Schedule within 60 days after Effective Date of the Agreement.
   b. Submit an Updated Progress Schedule at each update, in accordance with Article Detailed Progress Schedule.
3. Submit with Each Progress Schedule Submission:
   a. Contractor's certification that Progress Schedule submission is actual schedule being utilized for execution of the Work.
   b. Disk file compatible with latest version of Microsoft Project, unless otherwise approved by Engineer.
   c. Progress Schedule: 4 legible copies.
   d. Narrative Progress Report: Same number of copies as specified for Progress Schedule.
4. Prior to final payment, submit a final Updated Progress Schedule.

1.02 PRELIMINARY PROGRESS SCHEDULE

A. In addition to basic requirements outlined in General Conditions, show a detailed schedule, beginning with Notice to Proceed, for minimum duration of 90 days, and a summary of balance of Project through Final Completion.

B. Show activities including, but not limited to the following:

1. Notice to Proceed.
2. Permits.
3. Submittals, with review time. Contractor may use Schedule of Submittals specified in Section 01300, Submittals.
4. Early procurement activities for long lead equipment and materials.
5. Initial Site work.
6. Earthwork.
7. Specified Work sequences and construction constraints.
8. Contract Milestone and Completion Dates.
9. Owner-furnished products delivery dates or ranges of dates.
10. Major structural, mechanical, equipment, electrical, architectural, and instrumentation and control Work.

11. System startup summary.
12. Project close-out summary.
13. Demobilization summary.

C. Update Preliminary Progress Schedule monthly; as part of progress payment process. Failure to do so may result in the Owner withholding all or part of the monthly progress payment until the Preliminary Progress Schedule is updated in a manner acceptable to Engineer.

D. Format: In accordance with Article Progress Schedule—Bar Chart.

1.03 DETAILED PROGRESS SCHEDULE

A. In addition to requirements of General Conditions, submit Detailed Progress Schedule beginning with Notice to Proceed and continuing through Final Completion.

B. Show the duration and sequences of activities required for complete performance of the Work reflecting means and methods chosen by Contractor.

C. When accepted by Engineer, Detailed Progress Schedule will replace Preliminary Progress Schedule and become Baseline Schedule. Subsequent revisions will be considered as Updated Progress Schedules.

D. Format: In accordance with Article Progress Schedule—Bar Chart.

E. Update monthly to reflect actual progress and occurrences to date, including weather delays.

1.04 PROGRESS SCHEDULE—BAR CHART

A. General: Comprehensive bar chart schedule, generally as outlined in Associated General Contractors of America (AGC) 580, "Construction Project Planning and Scheduling Guidelines." If a conflict occurs between the AGC publication and this Specification, this Specification shall govern.

B. Format:

1. Unless otherwise approved, white paper, 11-inch by 17-inch sheet size.
2. Title Block: Show name of project and Owner, date submitted, revision or update number, and name of scheduler.
3. Identify horizontally, across the top of the schedule, the time frame by year, month, and day.
4. Identify each activity with a unique number and a brief description of the Work associated with that activity.
5. Legend: Describe standard and special symbols used.

C. Contents: Identify, in chronological order, those activities reasonably required to complete the Work, including as applicable, but not limited to:

1. Obtaining permits, submittals for early product procurement, and long lead time items.
2. Mobilization and other preliminary activities.
3. Initial Site work.
4. Specified Work sequences, constraints, and Milestones, including Substantial Completion date(s).
5. Subcontract Work.
6. Major equipment design, fabrication, factory testing, and delivery dates.
7. Delivery dates for Owner-furnished products, as specified in Section 01010, Summary of Work.
8. Sitework.
9. Concrete Work.
10. Structural steel Work.
11. Architectural features Work.
12. Conveying systems Work.
13. Equipment Work.
14. Mechanical Work.
15. Electrical Work.
16. Instrumentation and control Work.
17. Interfaces with Owner-furnished equipment.
18. Other important Work for each major facility.
19. Equipment and system startup and test activities.
20. Project closeout and cleanup.
21. Demobilization.

1.05 PROGRESS OF THE WORK

A. Updated Progress Schedule shall reflect:

1. Progress of Work to within 5 working days prior to submission.
2. Approved changes in Work scope and activities modified since submission.
3. Delays in Submittals or resubmittals, deliveries, or Work.
4. Adjusted or modified sequences of Work.
5. Other identifiable changes.
6. Revised projections of progress and completion.
7. Report of changed logic.

B. Produce detailed subschedules during Project, upon request of Owner or Engineer, to further define critical portions of the Work such as facility shutdowns.

C. If Contractor fails to complete activity by its latest scheduled completion date and this Failure is anticipated to extend Contract Times (or Milestones), Contractor shall, within 7 days of such failure, submit a written statement as to how Contractor intends to correct nonperformance and return to acceptable current Progress Schedule. Actions by Contractor to complete the Work within Contract Times (or Milestones) will not be justification for adjustment to Contract Price or Contract Times.

D. Owner may order Contractor to increase plant, equipment, labor force or working hours if Contractor fails to:

1. Complete a Milestone activity by its completion date.
2. Satisfactorily execute Work as necessary to prevent delay to overall completion of Project, at no additional cost to Owner.

1.06 NARRATIVE PROGRESS REPORT

A. Format:

1. Organize same as Progress Schedule.
2. Identify, on a cover letter, reporting period, date submitted, and name of author of report.

B. Contents:

1. Number of days worked over the period, work force on hand, construction equipment on hand (including utility vehicles such as pickup trucks, maintenance vehicles, stake trucks).
2. General progress of Work, including a listing of activities started and completed over the reporting period, mobilization/demobilization of subcontractors, and major milestones achieved.
3. Contractor's plan for management of Site (e.g., lay down and staging areas, construction traffic), utilization of construction equipment, buildup of trade labor, and identification of potential Contract changes.
4. Identification of new activities and sequences as a result of executed Contract changes.
5. Documentation of weather conditions over the reporting period, and any resulting impacts to the work.
6. Description of actual or potential delays, including related causes, and the steps taken or anticipated to mitigate their impact.
7. Changes to activity logic.
8. Changes to the critical path.
9. Identification of, and accompanying reason for, any activities added or deleted since the last report.
10. Steps taken to recover the schedule from Contractor-caused delays.

1.07 SCHEDULE ACCEPTANCE

A. Engineer's acceptance will demonstrate agreement that:

1. Proposed schedule is accepted with respect to:
   a. Contract Times, including Final Completion and all intermediate Milestones are within the specified times.
   b. Specified Work sequences and constraints are shown as specified.
   c. Specified Owner-furnished Equipment or Material arrival dates, or range of dates, are included.
   d. Access restrictions are accurately reflected.
   e. Startup and testing times are as specified.
   f. Submittal review times are as specified.
   g. Startup testing duration is as specified and timing is acceptable.
2. In all other respects, Engineer's acceptance of Contractor's schedule indicates that, in Engineer's judgement, schedule represents reasonable plan for constructing Project in accordance with the Contract Documents. Engineer's review will not make any change in Contract requirements. Lack of comment on any aspect of schedule that is not in accordance with the Contract Documents will not thereby indicate acceptance of that change, unless Contractor has explicitly called the nonconformance to Engineer's attention in submittal. Schedule remains Contractor's responsibility and Contractor retains responsibility for performing all activities, for activity durations, and for activity sequences required to construct Project in accordance with the Contract Documents.

B. Unacceptable Preliminary Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process, during which time Contractor shall update schedule on a monthly basis to reflect actual progress and occurrences to date.

C. Unacceptable Detailed Progress Schedule:

1. Make requested corrections; resubmit within 10 days.
2. Until acceptable to Engineer as Baseline Progress Schedule, continue review and revision process.

D. Narrative Report: All changes to activity duration and sequences, including addition or deletion of activities subsequent to Engineer's acceptance of Baseline Progress Schedule, shall be delineated in Narrative Report current with proposed Updated Progress Schedule.

1.08 ADJUSTMENT OF CONTRACT TIMES

A. Reference General Conditions and Section 01035, Amending and Supplementing Contract Documents.

B. Evaluation and reconciliation of Adjustments of Contract Times shall be based on the Updated Progress Schedule at the time of proposed adjustment or claimed delay.

C. Schedule Contingency:

1. Contingency, when used in the context of the Progress Schedule, is time between Contractor's proposed Completion Time and Contract Completion Time.
2. Contingency included in Progress Schedule is a Project resource available to both Contractor and Owner to meet Contract Milestones and Contract Times. Use of Schedule contingency shall be shared to the proportionate benefit of both parties.
3. Use of schedule contingency suppression techniques such as preferential sequencing and extended activity times is prohibited.
4. Pursuant to Contingency sharing provisions of this Specification, no time extensions will be granted, nor will delay damages be paid until a delay occurs which (i) consumes all available contingency time, and (ii) extends Work beyond the Contract Completion date.

D. Claims Based on Contract Times:

1. Where Engineer has not yet rendered formal decision on Contractor's Claim for adjustment of Contract Times, and parties are unable to agree as to amount of adjustment to be reflected in Progress Schedule, Contractor shall reflect an interim adjustment in the Progress Schedule as acceptable to Engineer.
2. It is understood and agreed that such interim acceptance will not be binding on either Contractor or Owner, and will be made only for the purpose of continuing to schedule Work until such time as formal decision has been rendered as to an adjustment, if any, of the Contract Times.
3. Contractor shall revise Progress Schedule prepared thereafter in accordance with Engineer's formal decision.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

SECTION 01430
OPERATION AND MAINTENANCE DATA

PART 1 GENERAL

1.01 SECTION INCLUDES

A. Detailed information for the preparation, submission, and Engineer's review of Operations and Maintenance (O&M) Data, as required by individual Specification sections.

1.02 DEFINITIONS

A. Preliminary Data: Initial and subsequent submissions for Engineer's review.

B. Final Data: Engineer-accepted data, submitted as specified herein.

C. Maintenance Operation: As used on Maintenance Summary Form is defined to mean any routine operation required to ensure satisfactory performance and longevity of equipment. Examples of typical maintenance operations are lubrication, belt tensioning, adjustment of pump packing glands, and routine adjustments.

1.03 SEQUENCING AND SCHEDULING

A. Equipment and System Data:

1. Preliminary Data:
   a. Do not submit until Shop Drawing for equipment or system has been reviewed and approved by Engineer.
   b. Submit prior to shipment date.
2. Final Data: Submit Instructional Manual Formatted data not less than 30 days prior to equipment or system field functional testing.

B. Materials and Finishes Data:

1. Preliminary Data: Submit at least 15 days prior to request for final inspection.
2. Final Data: Submit within 10 days after final inspection.

1.04 DATA FORMAT

A. Prepare preliminary and final data in the form of an instructional manual.

B. Instructional Manual Format:

1. Binder: Commercial quality, permanent, three-ring or three-post binders with durable plastic cover.
2. Size: 8-1/2 inches by 11 inches, minimum.
3. Cover: Identify manual with typed or printed title "OPERATION AND MAINTENANCE DATA" and list:
   a. Project title.
   b. Designate applicable system, equipment, material, or finish.
   c. Identity of separate structure as applicable.
   d. Identity of general subject matter covered in manual.
4. Title Page:
   a. Contractor name, address, and telephone number.
   b. Subcontractor, Supplier, installer, or maintenance contractor's name, address, and telephone number, as appropriate.
      1) Identify area of responsibility of each.
      2) Provide name and telephone number of local source of supply for parts and replacement.
5. Table of Contents:
   a. Neatly typewritten and arranged in systematic order with consecutive page numbers.
   b. Identify each product by product name and other identifying numbers or symbols as set forth in Contract Documents.
6. Paper: 20-pound minimum, white for typed pages.
7. Text: Manufacturer's printed data, or neatly typewritten.
8. Three-hole punch data for binding and composition; arrange printing so that punched holes do not obliterate data.
9. Material shall be suitable for reproduction, with quality equal to original. Photocopying of material will be acceptable, except for material containing photographs.

C. Electronic Media Format:

1. Portable Document Format (PDF):
   a. After all preliminary data has been found to be acceptable to Engineer, submit Operation and Maintenance data in PDF format on CD.
   b. Files to be exact duplicates of Engineer-accepted preliminary data. Arrange by specification number and name.
   c. Files to be fully functional and viewable in most recent version of Adobe Acrobat.

1.05 SUBMITTALS

A. Informational:

1. Data Outline: Submit two copies of a detailed outline of proposed organization and contents of Final Data prior to preparation of Preliminary Data.
2. Preliminary Data:
   a. Submit three copies for Engineer's review.
   b. If data meets conditions of the Contract:
      1) One copy will be returned to Contractor.
      2) One copy will be forwarded to Resident Project Representative.
      3) One copy will be retained in Engineer's file.
   c. If data does not meet conditions of the Contract:
      1) All copies will be returned to Contractor with Engineer's comments (on separate document) for revision.
      2) Engineer's comments will be retained in Engineer's file.
      3) Resubmit two copies revised in accordance with Engineer's comments.
3. Final Data: Submit four copies in format specified herein.

1.06 DATA FOR EQUIPMENT AND SYSTEMS

A. Content For Each Unit (or Common Units) and System:

1. Product Data:
   a. Include only those sheets that are pertinent to specific product.
   b. Clearly annotate each sheet to:
      1) Identify specific product or part installed.
      2) Identify data applicable to installation.
      3) Delete references to inapplicable information.
   c. Function, normal operating characteristics, and limiting conditions.
   d. Performance curves, engineering data, nameplate data, and tests.
   e. Complete nomenclature and commercial number of replaceable parts.
   f. Original manufacturer's parts list, illustrations, detailed assembly drawings showing each part with part numbers and sequentially numbered parts list, and diagrams required for maintenance.
   g. Spare parts ordering instructions.
   h. Where applicable, identify installed spares and other provisions for future work (e.g., reserved panel space, unused components, wiring, terminals).
2. As-installed, color-coded piping diagrams.
3. Charts of valve tag numbers, with the location and function of each valve.

4. Drawings: Supplement product data with Drawings as necessary to clearly illustrate:
   a. Format:
      1) Provide reinforced, punched, binder tab; bind in with text.
      2) Reduced to 8-1/2 inches by 11 inches, or 11 inches by 17 inches folded to 8-1/2 inches by 11 inches.
      3) Where reduction is impractical, fold and place in 8-1/2-inch by 11-inch envelopes bound in text.
      4) Identify Specification section and product on Drawings and envelopes.
   b. Relations of component parts of equipment and systems.
   c. Control and flow diagrams.
   d. Coordinate drawings with Project record documents to assure correct illustration of completed installation.
5. Instructions and Procedures: Within text, as required to supplement product data.
   a. Format:
      1) Organize in consistent format under separate heading for each different procedure.
      2) Provide logical sequence of instructions for each procedure.
      3) Provide information sheet for Owner's personnel, including:
         a) Proper procedures in event of failure.
         b) Instances that might affect validity of guarantee or Bond.
   b. Installation Instructions: Including alignment, adjusting, calibrating, and checking.
   c. Operating Procedures:
      1) Startup, break-in, routine, and normal operating instructions.
      2) Test procedures and results of factory tests where required.
      3) Regulation, control, stopping, and emergency instructions.
      4) Description of operation sequence by control manufacturer.
      5) Shutdown instructions for both short and extended duration.
      6) Summer and winter operating instructions, as applicable.
      7) Safety precautions.
      8) Special operating instructions.
   d. Maintenance and Overhaul Procedures:
      1) Routine maintenance.
      2) Guide to troubleshooting.
      3) Disassembly, removal, repair, reinstallation, and re-assembly.
6. Guarantee, Bond, and Service Agreement: In accordance with Section 01780, Contract Closeout.

B. Content for Each Electric or Electronic Item or System:

1. Description of Unit and Component Parts:
   a. Function, normal operating characteristics, and limiting conditions.
   b. Performance curves, engineering data, nameplate data, and tests.
   c. Complete nomenclature and commercial number of replaceable parts.
   d. Interconnection wiring diagrams, including control and lighting systems.
2. Circuit Directories of Panelboards:
3. Electrical service.
4. Control requirements and interfaces.
5. Communication requirements and interfaces.
6. List of electrical relay settings, and control and alarm contact settings.
7. Electrical interconnection wiring diagram, including as applicable, single-line, three-line, schematic and internal wiring, and external interconnection wiring.
8. As-installed control diagrams by control manufacturer.
9. Operating Procedures:
   a. Routine and normal operating instructions.
   b. Startup and shutdown sequences, normal and emergency.
   c. Safety precautions.
   d. Special operating instructions.
10. Maintenance Procedures:
   a. Routine maintenance.
   b. Guide to troubleshooting.
   c. Adjustment and checking.
   d. List of relay settings, control and alarm contact settings.
11. Manufacturer's printed operating and maintenance instructions.
12. List of original manufacturer's spare parts, manufacturer's current prices, and recommended quantities to be maintained in storage.

C. Maintenance Summary:

1. Compile individual Maintenance Summary for each applicable equipment item, respective unit or system, and for components or sub-units.
2. Format:
   a. Use Maintenance Summary Form bound with this section or electronic facsimile of such.
   b. Each Maintenance Summary may take as many pages as required.
   c. Use only 8-1/2-inch by 11-inch size paper.
   d. Complete using typewriter or electronic printing.
3. Include detailed lubrication instructions and diagrams showing points to be greased or oiled; recommend type, grade, and temperature range of lubricants and frequency of lubrication.

4. Recommended Spare Parts:
    a. Data to be consistent with manufacturer's Bill of Materials/Parts List furnished in O&M manuals.
    b. "Unit" is the unit of measure for ordering the part.
    c. "Quantity" is the number of units recommended.
    d. "Unit Cost" is the current purchase price.

1.07 DATA FOR MATERIALS AND FINISHES

A. Content for Architectural Products, Applied Materials, and Finishes:

1. Manufacturer's data, giving full information on products:
    a. Catalog number, size, and composition.
    b. Color and texture designations.
    c. Information required for reordering special-manufactured products.
2. Instructions for Care and Maintenance:
    a. Manufacturer's recommendation for types of cleaning agents and methods.
    b. Cautions against cleaning agents and methods that are detrimental to product.
    c. Recommended schedule for cleaning and maintenance.

B. Content for Moisture Protection and Weather Exposed Products:

1. Manufacturer's data, giving full information on products:
    a. Applicable standards.
    b. Chemical composition.
    c. Details of installation.
2. Instructions for inspection, maintenance, and repair.

1.08 SUPPLEMENTS

A. The supplements listed below, following "End of Section", are part of this Specification.

1. Forms: Maintenance Summary Form.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION (NOT USED)

END OF SECTION

MAINTENANCE SUMMARY FORM

PROJECT:_____ CONTRACT NO.:_____

1. EQUIPMENT ITEM_____

2. MANUFACTURER _____

3. EQUIPMENT/TAG NUMBER(S) _____

4. WEIGHT OF INDIVIDUAL COMPONENTS (OVER 100 POUNDS)_____

5. NAMEPLATE DATA (hp, voltage, speed, etc.) _____

6. MANUFACTURER'S LOCAL REPRESENTATIVE _____

   a. Name_____ Telephone No. _____

   b. Address _____

7. MAINTENANCE REQUIREMENTS

Maintenance Operation Comments	**Frequency**	**Lubricant (If Applicable)**
List briefly each maintenance operation required and refer to specific information in manufacturer's standard maintenance manual, if applicable. (Reference to manufacturer's catalog or sales literature is not acceptable.)	List required frequency of each maintenance operation.	Refer by symbol to lubricant required.

8. LUBRICANT LIST

Reference Symbol	Shell	Exxon Mobile	Chevron Texaco	BP Amoco	Or Equal
List symbols used in No. 7 above.	List equivalent lubricants, as distributed by each manufacturer for the specific use recommended.				

9. RECOMMENDED SPARE PARTS FOR OWNER'S INVENTORY.

Part No.	Description	Unit	Quantity	Unit Cost
Note: Identify parts provided by this Contract with two asterisks.				

SECTION 01500
CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Association of Nurserymen: American Standards for Nursery Stock.
2. Federal Emergency Management Agency.
3. National Fire Prevention Association (NFPA): 241, Standard for Safeguarding Construction, Alteration, and Demolition Operations.
4. Telecommunications Industry Association (TIA); Electronic Industries Alliance (EIA): 568B, Commercial Building Telecommunications Cabling Standard.
5. U.S. Department of Agriculture: Urban Hydrology for Small Watersheds.
6. U.S. Weather Bureau: Rainfall-Frequency Atlas of the U.S. for Durations from 30 Minutes to 24 Hours and Return Periods from 1 to 100 Years.

1.02 SUBMITTALS

A. Informational Submittals:

1. Copies of permits and approvals for construction as required by Laws and Regulations and governing agencies.
2. Temporary Utility Submittals:
   a. Electric power supply and distribution plans.
   b. Water supply and distribution plans.
   c. Drainage plans.
   d. Dewatering well locations.
   e. Sanitary.
3. Temporary Construction Submittals:
   a. Access Roads: Routes, cross-sections, and drainage facilities.
   b. Parking area plans.
   c. Contractor's field office, storage yard, and storage building plans, including gravel surfaced area.
   d. Fencing and protective barrier locations and details.
   e. Engineer's field office plans.
   f. Staging area location plan.
   g. Traffic and Pedestrian Control and Routing Plans: As specified herein, and proposed revisions thereto.
   h. Plan for maintenance of existing plant operations.

4. Temporary Control Submittals:
    a. Noise control plan.
    b. Plan for disposal of waste materials and intended haul routes.

1.03 MOBILIZATION

A. Mobilization shall include, but not be limited to, these principal items:

1. Obtaining required permits.
2. Moving Contractor's field office and equipment required for first month operations onto Site.
3. Installing temporary construction power, wiring, and lighting facilities.
4. Providing onsite communication facilities, including telephones.
5. Providing onsite sanitary facilities and potable water facilities as specified and as required by Laws and Regulations, and governing agencies.
6. Arranging for and erection of Contractor's work and storage yard.
7. Posting OSHA required notices and establishing safety programs and procedures.
8. Having Contractor's superintendent at Site full time.

B. Use area designated for Contractor's temporary facilities as directed by Owner at Preconstruction Meeting.

1.04 PROTECTION OF WORK AND PROPERTY

A. Comply with Owner's safety rules while on Owner's property.

B. Keep Owner informed of serious onsite accidents and related claims.

C. Use of Explosives: No blasting or use of explosives will be allowed onsite.

PART 2 PRODUCTS

2.01 PROJECT SIGN

A. Provide and maintain one, 8-foot wide by 4-foot high sign constructed of 3/4-inch exterior high density overlaid plywood. Sign shall bear name of Project, Owner, Contractor, Engineer, and other participating agencies. Lettering shall be blue applied on a white background by an experienced sign painter. Paint shall be exterior type enamel. Information to be included will be provided by Engineer and Owner.

PART 3 EXECUTION

3.01 TEMPORARY UTILITIES

A. Power:

1. Electric power will be available at or near Site. Determine type and amount available and make arrangements for obtaining temporary electric power service, metering equipment, and pay all costs for electric power used during contract period for construction activities, except for portions of the Work designated in writing by Engineer as substantially complete.
2. During facility start-up and testing, electric power costs for installed portions of the work connected to the Owner's facility power system shall be borne by the Owner.
3. Cost of electric power will be borne by Contractor.

B. Lighting: Provide temporary lighting to meet applicable safety requirements to allow erection, application, or installation of materials and equipment, and observation or inspection of the Work.

C. Heating, Cooling, and Ventilating:

1. Provide as required to maintain adequate environmental conditions to facilitate progress of the Work, to meet specified minimum conditions for installation of materials, and to protect materials, equipment, and finishes from damage due to temperature or humidity. Costs for temporary heat shall be borne by Contractor responsible for constructing structure or building as specified in Section 01010, Summary of Work.
2. Provide adequate forced air ventilation of enclosed areas to cure installed materials, to dispense humidity, and to prevent hazardous accumulations of dust, fumes, vapors, or gases.
3. Pay all costs of installation, maintenance, operation, removal, and fuel consumed.
4. Provide portable unit heaters, complete with controls, oil- or gas-fired, and suitably vented to outside as required for protection of health and property.
5. If permanent natural gas piping is used for temporary heating units, do not modify or reroute gas piping without approval of utility company. Provide separate gas metering as required by utility.

D. Water:

1. Hydrant Water:
   a. Is available from nearby hydrants. Secure written permission for connection and use from water department and meet requirements for use.

b. Use only special hydrant-operating wrenches to open hydrants. Make certain hydrant valve is open full, since cracking valve causes damage to hydrant. Repair damaged hydrants and notify appropriate agency as quickly as possible. Hydrants shall be completely accessible to fire department at all times.

c. Include costs to connect and transport water to construction areas in Contract Price.

2. Owner will provide a place of temporary connection for construction and drinking water at Site. Provide temporary facilities and piping required to bring water to point of use and remove when no longer needed. Install an acceptable metering device for measurement of water used. Cost of water used at the site shall be borne by the Owner.

3. Provide a means to prevent water used for testing from flowing back into source pipeline.

E. Sanitary and Personnel Facilities:

1. Provide and maintain facilities for Contractor's employees, Subcontractors, and all other onsite employers' employees. Service, clean, and maintain facilities and enclosures.

2. Use of Owner's existing sanitary facilities by construction personnel will not be allowed.

F. Telephone Service:

1. Contractor: Arrange and provide onsite telephone service for use during construction. Pay costs of installation and monthly bills.

G. Fire Protection: Furnish and maintain on Site adequate firefighting equipment capable of extinguishing incipient fires. Comply with applicable parts of NFPA 241.

3.02 PROTECTION OF WORK AND PROPERTY

A. General:

1. Perform Work within right-of-way and easements in a systematic manner that minimizes inconvenience to property owners and the public.

2. No residence or business shall be cut off from vehicular traffic for a period exceeding 4 hours, unless special arrangements have been made.

3. Maintain in continuous service all existing oil and gas pipelines, underground power, telephone or communication cable, water mains, irrigation lines, sewers, poles and overhead power, and all other utilities encountered along line of the Work, unless other arrangements satisfactory to owners of said utilities have been made.

4. Where completion of the Work requires temporary or permanent removal or relocation of existing utility, coordinate all activities with owner of said utility and perform all work to their satisfaction.
5. Protect, shore, brace, support, and maintain underground pipes, conduits, drains, and other underground utility construction uncovered or otherwise affected by construction operations.
6. Keep fire hydrants and water control valves free from obstruction and available for use at all times.
7. In areas where Contractor's operations are adjacent to or near a utility, such as gas, telephone, television, electric power, water, sewer, or irrigation system, and such operations may cause damage or inconvenience, suspend operations until arrangements necessary for protection have been made by Contractor.
8. Notify property owners and utility offices that may be affected by construction operation at least 2 days in advance: Before exposing a utility, obtain utility owner's permission. Should service of utility be interrupted due to Contractor's operation, notify proper authority immediately. Cooperate with said authority in restoring service as promptly as possible and bear costs incurred.
9. Do not impair operation of existing sewer system. Prevent construction material, pavement, concrete, earth, volatile and corrosive wastes, and other debris from entering sewers, pump stations, or other sewer structures.
10. Maintain original Site drainage wherever possible.

B. Site Security:

1. Provide and maintain additional temporary security fences as necessary to protect the Work and Contractor-furnished products not yet installed.

C. Barricades and Lights:

1. Provide as required by the State of Kentucky Vehicle Code and in sufficient quantity to safeguard public and the Work.
2. Provide as necessary to prevent unauthorized entry to construction areas and affected roads, streets, and alleyways, inside and outside of fenced area, and as required to ensure public safety and the safety of Contractor's employees, other employer's employees, and others who may be affected by the Work.
3. Provide to protect existing facilities and adjacent properties from potential damage.
4. Locate to enable access by facility operators and property owners.
5. Protect streets, roads, highways, and other public thoroughfares that are closed to traffic by effective barricades with acceptable warning signs.

6. Locate barricades at the nearest intersecting public thoroughfare on each side of the blocked section.
7. Illuminate barricades and obstructions with warning lights from sunset to sunrise.

D. Signs and Equipment:

1. Conform to requirements of manual published by the State of Kentucky Transportation Cabinet.
2. Portable TOW-AWAY-NO STOPPING Signs: Place where approved by police department and Owner.
3. Traffic Cones: Provide to delineate traffic lanes to guide and separate traffic movements.
4. High-Level Warning Flag Units: Provide two in advance of traffic approaching the Work, each displaying three flags mounted at a height of 9 feet.
5. ROAD CONSTRUCTION AHEAD Signs: Provide four, size 48 inches by 48 inches. Place in conspicuous locations, approximately 200 feet in advance of the Work, and facing approaching traffic.
6. DETOUR Signs: Provide two, right arrow or left arrow, placed as approved by Engineer.
7. RIGHT or LEFT LANE CLOSED AHEAD Signs: Provide two, place in advance of lane to be closed.
8. Provide at obstructions, such as material piles and equipment.
9. Use to alert general public of construction hazards, which would include surface irregularities, unramped walkways, grade changes, and trenches or excavations in roadways and in other public access areas.

E. Trees and Plantings:

1. Protect from damage and preserve trees, shrubs, and other plants outside limits of the Work and within limits of the Work, which are designated on the Drawings to remain undisturbed.
   a. Where practical, tunnel beneath trees when on or near line of trench.
   b. Employ hand excavation as necessary to prevent tree injury.
   c. Do not stockpile materials or permit traffic within drip lines of trees.
   d. Provide and maintain temporary barricades around trees.
   e. Water vegetation as necessary to maintain health.
   f. Cover temporarily exposed roots with wet burlap, and keep burlap moist until soil is replaced around roots.
   g. No trees, except those specifically shown on Drawings to be removed, shall be removed without written approval of Engineer.
   h. Dispose of removed trees in a legal manner off the Site.

2. Balling and burlapping of trees indicated for replacement shall conform to recommended specifications set forth in the American Standards for Nursery Stock, published by American Association of Nurserymen. All balls shall be firm and intact and made-balls will not be accepted. Handle ball and burlap trees by ball and not by top.
3. In event of damage to bark, trunks, limbs, or roots of plants that are not designated for removal, treat damage by corrective pruning, bark tracing, application of a heavy coating of tree paint, and other accepted horticultural and tree surgery practices.
4. Replace each plant that dies as a result of construction activities.

F. Existing Structures:

1. Where Contractor contemplates removal of small structures such as mailboxes, signposts, and culverts that interfere with Contractor's operations, obtain approval of property owner and Engineer.
2. Move mailboxes to temporary locations accessible to postal service.
3. Replace items removed in their original location and a condition equal to or better than original.

G. Finished Construction: Protect finished floors and concrete floors exposed as well as those covered with composition tile or other applied surfacing.

H. Waterways:

1. Keep ditches, culverts, and natural drainages continuously free of construction materials and debris.

I. Dewatering: Construct, maintain, and operate cofferdams, channels, flume drains, sumps, pumps, or other temporary diversion and protection works. Furnish materials required, install, maintain, and operate necessary pumping and other equipment for the environmentally safe removal and disposal of water from the various parts of the Work. Maintain foundations and parts of the Work free from water.

J. Archaeological Finds:

1. General: Should finds of an archaeological or paleontological nature be made within the limits of the Site, immediately notify Owner and Engineer and proceed in accordance with the General Conditions. Continue the Work in other areas without interruption.
2. Archaeological Finds: Evidence of human occupation or use of an area within the contract limits prior to the Year 1840. Evidence may consist of skeletons, stone, or other utensils, or evidence of habitations or structures.

3. Paleontological Finds: Evidence of prehistoric plant or animal life, such as skeletons, bones, fossils, or casts and other indications such as pictographs.
4. Owner may order the Work stopped in other areas if, in Owner's opinion, the find is more extensive than may appear from uncovered material.
5. Protection of Finds:
   a. Cover, fence, or otherwise protect finds until notice to resume the Work is given.
   b. Cover finds with plastic film held in place by earth, rocks, or other weights placed outside the find. Should additional backfilling be necessary for safety or to prevent caving, place backfill material loosely over the plastic film.
   c. Sheet or shore as necessary to protect excavations underway. Place temporary fence to prevent unauthorized access.
   d. Dewater finds made below water table as necessary to protect construction Work underway. Divert groundwater or surface runoff away from find by ditching or other acceptable means.
6. Removal of Finds:
   a. All finds are property of Owner. Do not remove or disturb finds without Owner's written authorization.
   b. Should Owner elect to have a find removed, provide equipment, labor, and material to permit safe removal of find without damage. Provide transportation for delivery to individuals, institutions, or other places as Owner may find desirable, expedient, or required by law.

K. Endangered Species:

1. Take precautions necessary and prudent to protect native endangered flora and fauna.
2. Notify Engineer of construction activities that might threaten endangered species or their habitats.
3. Engineer will mark areas known as habitats of endangered species prior to commencement of onsite activities.
4. Additional areas will be marked by Engineer as other habitats of endangered species become known during construction.

3.03 TEMPORARY CONTROLS

A. Air Pollution Control:

1. Minimize air pollution from construction operations.
2. Burning:
   a. Of waste materials, rubbish, or other debris will not be permitted on or adjacent to Site.

3. Conduct operations of dumping rock and of carrying rock away in trucks to cause a minimum of dust. Give unpaved streets, roads, detours, or haul roads used in construction area a dust-preventive treatment or periodically water to prevent dust. Strictly adhere to applicable environmental regulations for dust prevention.
4. Provide and maintain temporary dust-tight partitions, bulkheads, or other protective devices during construction to permit normal operation of existing facilities. Construct partitions of plywood, insulating board, plastic sheets, or similar material. Construct partitions in such a manner that dust and dirt from demolition and cutting will not enter other parts of existing building or facilities. Remove temporary partitions as soon as need no longer exists.

B. Noise Control:

1. Provide acoustical barriers so noise emanating from tools or equipment will not exceed legal noise levels.

C. Water Pollution Control:

1. Divert sanitary sewage and nonstorm waste flow interfering with construction and requiring diversion to sanitary sewers. Do not cause or permit action to occur which would cause an overflow to existing waterway.
2. Prior to commencing excavation and construction, obtain Engineer's agreement with detailed plans showing procedures intended to handle and dispose of sewage, groundwater, and stormwater flow, including dewatering pump discharges.
3. Comply with procedures outlined in U.S. Environmental Protection Agency manuals entitled, "Guidelines for Erosion and Sedimentation Control Planning" and "Implementation, Processes, Procedures, and Methods to Control Pollution Resulting from All Construction Activity," and "Erosion and Sediment Control-Surface Mining in Eastern United States."
4. Do not dispose of volatile wastes such as mineral spirits, oil, chemicals, or paint thinner in storm or sanitary drains. Disposal of wastes into streams or waterways is prohibited. Provide acceptable containers for collection and disposal of waste materials, debris, and rubbish.

D. Erosion, Sediment, and Flood Control:

1. Provide, maintain, and operate temporary facilities to control erosion and sediment releases, and to protect the Work and existing facilities from flooding during construction period.

2. Erosion, sediment, and flood control procedures and precautions shall meet the requirements of the local storm water agency, Sanitation District No. 1 of Northern Kentucky, and any other agency having jurisdiction.

3.04 STORAGE YARDS AND BUILDINGS

A. Coordinate requirements with Section 01600, Material and Equipment.

B. Temporary Storage Yards: Construct temporary storage yards for storage of products that are not subject to damage by weather conditions.

C. Temporary Storage Buildings:

1. Provide environmental control systems that meet recommendations of manufacturers of equipment and materials stored.
2. Arrange or partition to provide security of contents and ready access for inspection and inventory.
3. Store combustible materials (paints, solvents, fuels) in a well-ventilated and remote building meeting safety standards.

3.05 PARKING AREAS

A. Control vehicular parking to preclude interference with public traffic or parking, access by emergency vehicles, Owner's operations, or construction operations.

B. Provide parking facilities for personnel working on the Project. No employee or equipment parking will be permitted on Owner's existing paved areas.

3.06 VEHICULAR TRAFFIC

A. Comply with Laws and Regulations regarding closing or restricting use of public streets or highways. No public or private road shall be closed, except by written permission of proper authority. Assure the least possible obstruction to traffic and normal commercial pursuits.

B. Conduct the Work to interfere as little as possible with public travel, whether vehicular or pedestrian.

C. Whenever it is necessary to cross, close, or obstruct roads, driveways, and walks, whether public or private, provide and maintain suitable and safe bridges, detours, or other temporary expedients for accommodation of public and private travel.

D. Road Closures: Maintain satisfactory means of exit for persons residing or having occasion to transact business along route of the Work. If it is necessary to close off roadway or alley providing sole vehicular access to property for periods greater than 2 hours, provide written notice to each owner so affected 3 days prior to such closure. In such cases, closings of up to 4 hours may be allowed. Closures of up to 10 hours may be allowed if a week's written notice is given and undue hardship does not result.

E. Maintenance of traffic is not required if Contractor obtains written permission from Owner and tenant of private property, or from authority having jurisdiction over public property involved, to obstruct traffic at designated point.

F. In making street crossings, do not block more than one-half the street at a time. Whenever possible, widen shoulder on opposite side to facilitate traffic flow. Provide temporary surfacing on shoulders as necessary.

G. Maintain top of backfilled trenches before they are paved, to allow normal vehicular traffic to pass over. Provide temporary access driveways where required. Cleanup operations shall follow immediately behind backfilling.

H. When flaggers and guards are required by regulation or when deemed necessary for safety, furnish them with approved orange wearing apparel and other regulation traffic control devices.

I. Provide snow removal to facilitate normal vehicular traffic on public or private roads affected by construction. Perform snow removal promptly and efficiently by means of suitable equipment whenever necessary for safety, and as may be directed by proper authority.

J. Notify fire department and police department before closing street or portion thereof. Notify said departments when streets are again passable for emergency vehicles. Do not block off emergency vehicle access to consecutive arterial crossings or dead-end streets, in excess of 300 linear feet, without written permission from fire department. Conduct operations with the least interference to fire equipment access, and at no time prevent such access. Furnish Contractor's night emergency telephone numbers to police department.

K. Coordinate traffic routing with that of others working in same or adjacent areas.

3.07 CLEANING DURING CONSTRUCTION

A. In accordance with General Conditions, as may be specified in other Specification sections, and as required herein.

B. Wet down exterior surfaces prior to sweeping to prevent blowing of dust and debris. At least weekly, sweep all floors (basins, tunnels, platforms, walkways, roof surfaces), and pick up all debris and dispose.

C. Provide approved containers for collection and disposal of waste materials, debris, and rubbish. At least at weekly intervals, dispose of such waste materials, debris, and rubbish offsite.

D. At least weekly, brush sweep entry drive and roadways, and all other streets and walkways affected by the Work and where adjacent to the Work.

END OF SECTION

SECTION 01600
MATERIAL AND EQUIPMENT

PART 1 GENERAL

1.01 DEFINITIONS

A. Products:

1. New items for incorporation in the Work, whether purchased by Contractor or Owner for the Project, or taken from previously purchased stock, and may also include existing materials or components required for reuse.
2. Includes the terms material, equipment, machinery, components, subsystem, system, hardware, software, and terms of similar intent and is not intended to change meaning of such other terms used in Contract Documents, as those terms are self-explanatory and have well recognized meanings in construction industry.
3. Items identified by manufacturer's product name, including make or model designation, indicated in manufacturer's published product literature, that is current as of the date of the Contract Documents.

1.02 DESIGN REQUIREMENTS

A. Where Contractor design is specified, design of installation, systems, equipment, and components, including supports and anchorage, shall be in accordance with provisions of latest edition of Kentucky Building Code and in accordance to design loads on Contract Drawings.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Altitude: Provide materials and equipment suitable for installation and operation under rated conditions at 1,000 feet above sea level.

B. Provide equipment and devices installed outdoors or in unheated enclosures capable of continuous operation within an ambient temperature range of 20 degrees F to 110 degrees F.

1.04 PREPARATION FOR SHIPMENT

A. When practical, factory assemble products. Mark or tag separate parts and assemblies to facilitate field assembly. Cover machined and unpainted parts that may be damaged by the elements with strippable protective coating.

B. Package products to facilitate handling and protect from damage during shipping, handling, and storage. Mark or tag outside of each package or crate to indicate its purchase order number, bill of lading number, contents by name, name of Project and Contractor, equipment number, and approximate weight. Include complete packing list and bill of materials with each shipment.

C. Extra Materials, Special Tools, Test Equipment, and Expendables:

1. Furnish as required by individual Specifications.
2. Schedule:
   a. Ensure that shipment and delivery occurs concurrent with shipment of associated equipment.
   b. Transfer to Owner shall occur immediately subsequent to Contractor's acceptance of equipment from Supplier.
3. Packaging and Shipment:
   a. Package and ship extra materials and special tools to avoid damage during long term storage in original cartons insofar as possible, or in appropriately sized, hinged-cover, wood, plastic, or metal box.
   b. Prominently displayed on each package, the following:
      1) Manufacturer's part nomenclature and number, consistent with Operation and Maintenance Manual identification system.
      2) Applicable equipment description.
      3) Quantity of parts in package.
      4) Equipment manufacturer.
4. Deliver materials to Site.

Taylor Mill Treatment Plant			
Name			
608 Grand Avenue	Taylor Mill	Kentucky	41015
Street	City	State	Zip

5. Notify Owner upon arrival for transfer of materials.
6. Replace extra materials and special tools found to be damaged or otherwise inoperable at time of transfer to Owner.

D. Request a minimum 7-day advance notice of shipment from manufacturer. Upon receipt of manufacturer's advance notice of shipment, promptly notify Engineer of anticipated date and place of equipment arrival.

E. Factory Test Results: Reviewed and accepted by Engineer before product shipment as required in individual Specification sections.

1.05 DELIVERY AND INSPECTION

A. Deliver products in accordance with accepted current Progress Schedule and coordinate to avoid conflict with the Work and conditions at Site. Deliver anchor bolts and templates sufficiently early to permit setting prior to placement of structural concrete.

B. Deliver products in undamaged condition, in manufacturer's original container or packaging, with identifying labels intact and legible. Include on label, date of manufacture and shelf life, where applicable.

C. Unload products in accordance with manufacturer's instructions for unloading or as specified. Record receipt of products at Site. Promptly inspect for completeness and evidence of damage during shipment.

D. Remove damaged products from Site and expedite delivery of identical new undamaged products, and remedy incomplete or lost products to provide that specified, so as not to delay progress of the Work.

1.06 HANDLING, STORAGE, AND PROTECTION

A. Handle and store products in accordance with manufacturer's written instructions and in a manner to prevent damage. Store in approved storage yards or sheds provided in accordance with Section 01500, Construction Facilities and Temporary Controls. Provide manufacturer's recommended maintenance during storage, installation, and until products are accepted for use by Owner.

B. Manufacturer's instructions for material requiring special handling, storage, or protection shall be provided prior to delivery of material.

C. Arrange storage in a manner to provide easy access for inspection. Make periodic inspections of stored products to assure that products are maintained under specified conditions, and free from damage or deterioration. Keep running account of products in storage to facilitate inspection and to estimate progress payments for products delivered, but not installed in the Work.

D. Store electrical, instrumentation, and control products, and equipment with bearings in weather-tight structures maintained above 60 degrees F. Protect electrical, instrumentation, and control products, and insulate against moisture, water, and dust damage. Connect and operate continuously space heaters furnished in electrical equipment.

E. Store fabricated products above ground on blocking or skids, and prevent soiling or staining. Store loose granular materials in well-drained area on solid surface to prevent mixing with foreign matter. Cover products that are subject to deterioration with impervious sheet coverings; provide adequate ventilation to avoid condensation.

F. Store finished products that are ready for installation in dry and well-ventilated areas. Do not subject to extreme changes in temperature or humidity.

G. After installation, provide coverings to protect products from damage due to traffic and construction operations. Remove coverings when no longer needed.

H. Hazardous Materials: Prevent contamination of personnel, storage area, and Site. Meet requirements of product specification, codes, and manufacturer's instructions.

PART 2 PRODUCTS

2.01 GENERAL

A. Provide manufacturer's standard materials suitable for service conditions, unless otherwise specified in the individual Specifications.

B. Where product specifications include a named manufacturer, with or without model number, and also include performance requirements, named manufacturer's products must meet the performance specifications.

C. Like items of products furnished and installed in the Work shall be end products of one manufacturer and of the same series or family of models to achieve standardization for appearance, operation and maintenance, spare parts and replacement, manufacturer's services, and implement same or similar process instrumentation and control functions in same or similar manner.

D. Do not use materials and equipment removed from existing premises, except as specifically permitted by Contract Documents.

E. Provide interchangeable components of the same manufacturer, for similar components, unless otherwise specified.

F. Equipment, Components, Systems, and Subsystems: Design and manufacture with due regard for health and safety of operation, maintenance, and accessibility, durability of parts, and shall comply with applicable OSHA, state, and local health and safety regulations.

G. Regulatory Requirement: Coating materials shall meet federal, state, and local requirements limiting the emission of volatile organic compounds and for worker exposure.

H. Safety Guards: Provide for all belt or chain drives, fan blades, couplings, or other moving or rotary parts. Cover rotating part on all sides. Design for easy installation and removal. Use 16-gauge or heavier; galvanized steel, aluminum coated steel, or galvanized or aluminum coated 1/2-inch mesh expanded steel. Provide galvanized steel accessories and supports, including bolts. For outdoors application, prevent entrance of rain and dripping water.

I. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

J. Equipment Finish:

1. Provide manufacturer's standard finish and color, except where specific color is indicated.
2. If manufacturer has no standard color, provide equipment with ANSI No. 61 gray finish as approved by Owner.

K. Special Tools and Accessories: Furnish to Owner, upon acceptance of equipment, all accessories required to place each item of equipment in full operation. These accessory items include, but are not limited to, adequate oil and grease (as required for first lubrication of equipment after field testing), light bulbs, fuses, hydrant wrenches, valve keys, handwheels, chain operators, special tools, and other spare parts as required for maintenance.

L. Lubricant: Provide initial lubricant recommended by equipment manufacturer in sufficient quantity to fill lubricant reservoirs and to replace consumption during testing, startup, and operation until final acceptance by Owner.

2.02 FABRICATION AND MANUFACTURE

A. General:

1. Manufacture parts to U.S.A. standard sizes and gauges.
2. Two or more items of the same type shall be identical, by the same manufacturer, and interchangeable.
3. Design structural members for anticipated shock and vibratory loads.
4. Use 1/4-inch minimum thickness for steel that will be submerged, wholly or partially, during normal operation.
5. Modify standard products as necessary to meet performance Specifications.

B. Lubrication System:

1. Require no more than weekly attention during continuous operation.
2. Convenient and accessible. Oil drains with bronze or stainless steel valves and fill-plugs easily accessible from the normal operating area or platform. Locate drains to allow convenient collection of oil during oil changes without removing equipment from its installed position.
3. Provide constant-level oilers or oil level indicators for oil lubrication systems.
4. For grease type bearings, which are not easily accessible, provide and install stainless steel tubing; protect and extend tubing to convenient location with suitable grease fitting.

2.03 SOURCE QUALITY CONTROL

A. Where Specifications call for factory testing to be witnessed by Engineer, notify Engineer not less than 14 days prior to scheduled test date, unless otherwise specified.

B. Calibration Instruments: Bear the seal of a reputable laboratory certifying instrument has been calibrated within the previous 12 months to a standard endorsed by the National Institute of Standards and Technology (NIST).

C. Factory Tests: Perform in accordance with accepted test procedures and document successful completion.

PART 3 EXECUTION

3.01 INSPECTION

A. Inspect materials and equipment for signs of pitting, rust decay, or other deleterious effects of storage. Do not install material or equipment showing such effects. Remove damaged material or equipment from the Site and expedite delivery of identical new material or equipment. Delays to the Work resulting from material or equipment damage that necessitates procurement of new products will be considered delays within Contractor's control.

3.02 INSTALLATION

A. Equipment Drawings show general locations of equipment, devices, and raceway, unless specifically dimensioned.

B. No shimming between machined surfaces is allowed.

C. Install the Work in accordance with NECA Standard of Installation, unless otherwise specified.

D. Repaint painted surfaces that are damaged prior to equipment acceptance.

E. Do not cut or notch any structural member or building surface without specific approval of Engineer.

F. Handle, install, connect, clean, condition, and adjust products in accordance with manufacturer's instructions, and as may be specified. Retain a copy of manufacturers' instruction at Site, available for review at all times.

G. For material and equipment specifically indicated or specified to be reused in the Work:

1. Use special care in removal, handling, storage, and reinstallation to assure proper function in the completed Work.
2. Arrange for transportation, storage, and handling of products that require offsite storage, restoration, or renovation. Include costs for such Work in the Contract Price.

3.03 FIELD FINISHING

A. In accordance with Section 09902, Painting and individual Specification sections.

3.04 ADJUSTMENT AND CLEANING

A. Perform required adjustments, tests, operation checks, and other startup activities.

3.05 LUBRICANTS

A. Fill lubricant reservoirs and replace consumption during testing, startup, and operation prior to acceptance of equipment by Owner.

END OF SECTION

SECTION 01640
MANUFACTURERS' SERVICES

PART 1 GENERAL

1.01 DEFINITIONS

A. Person-Day: One person for 8 hours within regular Contractor working hours.

1.02 SUBMITTALS

A. Informational Submittals:

1. Training Schedule: Submit not less than 21 days prior to start of equipment installation and revise as necessary for acceptance.
2. Lesson Plan: Submit proposed lesson plan not less than 21 days prior to scheduled training and revise as necessary for acceptance.
3. Training Session Tapes: Furnish Owner with one complete set of tapes fully indexed and cataloged with printed label stating session and date taped.

1.03 QUALIFICATION OF MANUFACTURER'S REPRESENTATIVE

A. Authorized representative of the manufacturer, factory trained, and experienced in the technical applications, installation, operation, and maintenance of respective equipment, subsystem, or system, with full authority by the equipment manufacturer to issue the certifications required of the manufacturer. Additional qualifications may be specified elsewhere.

B. Representative subject to acceptance by Owner. No substitute representatives will be allowed unless prior written approval by such has been given.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 FULFILLMENT OF SPECIFIED MINIMUM SERVICES

A. Furnish manufacturers' services when required by an individual specification section, to meet the requirements of this Section.

B. Where time is necessary in excess of that stated in the Specifications for manufacturers' services, or when a minimum time is not specified, the time required to perform the specified services shall be considered incidental.

C. Schedule manufacturer' services to avoid conflict with other onsite testing or other manufacturers' onsite services.

D. Determine, before scheduling services, that all conditions necessary to allow successful testing have been met.

E. Only those days of service approved by Engineer will be credited to fulfill the specified minimum services.

F. When specified in individual specification sections, manufacturer's onsite services shall include:

1. Assistance during product (system, subsystem, or component) installation to include observation, guidance, instruction of Contractor's assembly, erection, installation or application procedures.
2. Inspection, checking, and adjustment as required for product (system, subsystem, or component) to function as warranted by manufacturer and necessary to furnish Manufacturer's Certificate of Proper Installation.
3. Providing, on a daily basis, copies of all manufacturers' representatives field notes and data to Engineer.
4. Revisiting the Site as required to correct problems and until installation and operation are acceptable to Engineer.
5. Resolution of assembly or installation problems attributable to, or associated with, respective manufacturer's products and systems.
6. Assistance during functional and performance testing, and facility startup and evaluation.
7. Training of Owner's personnel in the operation and maintenance of respective product as required.
8. Additional requirements may be specified elsewhere.

3.02 MANUFACTURER'S CERTIFICATE OF COMPLIANCE

A. When so specified, a Manufacturer's Certificate of Compliance, a copy of which is attached to this section, shall be completed in full, signed by the entity supplying the product, material, or service, and submitted prior to shipment of product or material or the execution of the services.

B. Engineer may permit use of certain materials or assemblies prior to sampling and testing if accompanied by accepted certification of compliance.

C. Such form shall certify that the proposed product, material, or service complies with that specified. Attach supporting reference data, affidavits, and certifications as appropriate.

D. May reflect recent or previous test results on material or product, if acceptable to Engineer.

3.03 MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

A. When so specified, a Manufacturer's Certificate of Proper Installation form, a copy of which is attached to this section, shall be completed and signed by the equipment manufacturer's representative.

B. Such form shall certify that the signing party is a duly authorized representative of the manufacturer, is empowered by the manufacturer to inspect, approve, and operate their equipment and is authorized to make recommendations required to assure that the equipment is complete and operational.

3.04 TRAINING

A. General:

1. Furnish manufacturers' representatives for detailed classroom and hands-on training to Owner's personnel on operation and maintenance of specified product (system, subsystem, component) and as may be required in applicable Specifications.
2. Furnish trained, articulate personnel to coordinate and expedite training, to be present during training coordination meetings with Owner, and familiar with operation and maintenance manual information specified in Section 01430, Operation and Maintenance Data.
3. Manufacturer's representative shall be familiar with facility operation and maintenance requirements as well as with specified equipment.
4. Furnish complete training materials, to include operation and maintenance data, to be retained by each trainee.

B. Training Schedule:

1. List specified equipment and systems that require training services and show:
   a. Respective manufacturer.
   b. Estimated dates for installation completion.
   c. Estimated training dates.
2. Allow for multiple sessions when several shifts are involved.
3. Adjust schedule to ensure training of appropriate personnel as deemed necessary by Owner, and to allow full participation by manufacturers' representatives. Adjust schedule for interruptions in operability of equipment.
4. Coordinate with Section 01310, Progress Schedules, and Section 01810, Equipment Testing and Facility Startup.

C. Lesson Plan: When manufacturer or vendor training of Owner personnel is specified, prepare for each required course, containing the following minimum information:

1. Title and objectives.
2. Recommended types of attendees (e.g., managers, engineers, operators, maintenance).
3. Course description and outline of course content.
4. Format (e.g., lecture, self-study, demonstration, hands-on).
5. Instruction materials and equipment requirements.
6. Resumes of instructors providing the training.

D. Pre-startup Training:

1. Coordinate training sessions with Owner's operating personnel and manufacturers' representatives, and with submission of operation and maintenance manuals in accordance with Section 01430, Operation and Maintenance Data.
2. Complete at least 14 days prior to beginning of facility startup.

E. Post-startup Training: If required in Specifications, furnish and coordinate training of Owner's operating personnel by respective manufacturer's representatives.

F. Taping of Training Sessions:

1. Furnish audio and color video taping of prestartup and post-startup instruction sessions, including manufacturers' representatives' hands-on equipment instruction and classroom sessions.
2. Video training tapes shall be produced by a qualified, professional video production company unless Contractor demonstrates satisfactory skill of other personnel as acceptable to Owner.
3. Use VHS or DVD format, suitable for playback on standard equipment available commercially in the United States.
4. Include only one training session on each tape, or on a single track of a tape.

3.05 SUPPLEMENTS

A. The supplements listed below, following "End of Section", are part of this Specification.

1. Form: Manufacturer's Certificate of Compliance.
2. Form: Manufacturer's Certificate of Proper Installation.

END OF SECTION

MANUFACTURER'S CERTIFICATE OF COMPLIANCE

OWNER:

PRODUCT, MATERIAL, OR SERVICE SUBMITTED:

PROJECT NAME:

PROJECT NO:

Comments:_____

_____

_____

_____

_____

_____

I hereby certify that the above-referenced product, material, or service called for by the contract for the named project will be furnished in accordance with all applicable requirements. I further certify that the product, material, or service are of the quality specified and conform in all respects with the contract requirements, and are in the quantity shown.

Date of Execution: _____, 20___

Manufacturer:_____

Manufacturer's Authorized Representative *(print)*: _____

_____

(Authorized Signature)

MANUFACTURER'S CERTIFICATE OF PROPER INSTALLATION

OWNER _____ EQPT SERIAL NO:_____

EQPT TAG NO:_____ EQPT/SYSTEM:_____

PROJECT NO:_____ SPEC. SECTION:_____

I hereby certify that the above-referenced equipment/system has been:

(Check Applicable)

- ☐ Installed in accordance with Manufacturer's recommendations.
- ☐ Inspected, checked, and adjusted.
- ☐ Serviced with proper initial lubricants.
- ☐ Electrical and mechanical connections meet quality and safety standards.
- ☐ All applicable safety equipment has been properly installed.
- ☐ Functional tests.
- ☐ System has been performance tested, and meets or exceeds specified performance requirements. (When complete system of one manufacturer)

Note: Attach any performance test documentation from manufacturer.

Comments:_____

_____

_____

_____

_____

_____

I, the undersigned Manufacturer's Representative, hereby certify that I am (i) a duly authorized representative of the manufacturer, (ii) empowered by the manufacturer to inspect, approve, and operate his equipment and (iii) authorized to make recommendations required to assure that the equipment furnished by the manufacturer is complete and operational, except as may be otherwise indicated herein. I further certify that all information contained herein is true and accurate.

Date: _____, 20___

Manufacturer:_____

By Manufacturer's Authorized Representative: _____
(Authorized Signature)

SECTION 01780
CONTRACT CLOSEOUT

PART 1 GENERAL

1.01 SUBMITTALS

A. Informational Submittals:

1. Submit prior to application for final payment.
   a. Record Documents: As required in General Conditions.
   b. Approved Shop Drawings and Samples: As required in the General Conditions.
   c. Special bonds, Special Guarantees, and Service Agreements.
   d. Consent of Surety to Final Payment: As required in General Conditions.
   e. Releases or Waivers of Liens and Claims: As required in General Conditions.
   f. Releases from Agreements.
   g. Final Application for Payment: Submit in accordance with procedures and requirements stated in Section 01025, Measurement and Payment.
   h. Extra Materials: As required by individual Specification sections.

1.02 RECORD DOCUMENTS

A. Quality Assurance:

1. Furnish qualified and experienced person, whose duty and responsibility shall be to maintain record documents.
2. Accuracy of Records:
   a. Coordinate changes within record documents, making legible and accurate entries on each sheet of Drawings and other documents where such entry is required to show change.
   b. Purpose of Project record documents is to document factual information regarding aspects of the Work, both concealed and visible, to enable future modification of the Work to proceed without lengthy and expensive Site measurement, investigation, and examination.
3. Make entries within 24 hours after receipt of information that a change in the Work has occurred.
4. Prior to submitting each request for progress payment, request Engineer's review and approval of current status of record documents. Failure to properly maintain, update, and submit record documents may result in a deferral by Engineer to recommend whole or any part of Contractor's Application for Payment, either partial or final.

1.03 RELEASES FROM AGREEMENTS

A. Furnish Owner written releases from property owners or public agencies where side agreements or special easements have been made, or where Contractor's operations have not been kept within the Owner's construction right-of-way.

B. In the event Contractor is unable to secure written releases:

1. Inform Owner of the reasons.
2. Owner or its representatives will examine the Site, and Owner will direct Contractor to complete the Work that may be necessary to satisfy terms of the side agreement or special easement.
3. Should Contractor refuse to perform this Work, Owner reserves right to have it done by separate contract and deduct cost of same from Contract Price, or require Contractor to furnish a satisfactory bond in a sum to cover legal Claims for damages.
4. When Owner is satisfied that the Work has been completed in agreement with Contract Documents and terms of side agreement or special easement, right is reserved to waive requirement for written release if: (i) Contractor's failure to obtain such statement is due to grantor's refusal to sign, and this refusal is not based upon any legitimate Claims that Contractor has failed to fulfill terms of side agreement or special easement, or (ii) Contractor is unable to contact or has had undue hardship in contacting grantor.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 MAINTENANCE OF RECORD DOCUMENTS

A. General:

1. Promptly following commencement of Contract Times, secure from Engineer, one complete set of Contract Documents. Drawings will be full size.
2. Label or stamp each record document with title, "RECORD DOCUMENTS," in neat large printed letters.
3. Record information concurrently with construction progress and within 24 hours after receipt of information that change has occurred. Do not cover or conceal Work until required information is recorded.

B. Preservation:

1. Maintain documents in a clean, dry, legible condition and in good order. Do not use record documents for construction purposes.
2. Make documents and Samples available at all times for observation by Engineer.

C. Making Entries on Drawings:

1. Using an erasable colored pencil (not ink or indelible pencil), clearly describe change by graphic line and note as required.
   a. Color Coding:
      1) Green when showing information deleted from Drawings.
      2) Red when showing information added to Drawings.
      3) Blue and circled in blue to show notes.
2. Date entries.
3. Call attention to entry by "cloud" drawn around area or areas affected.
4. Legibly mark to record actual changes made during construction, including, but not limited to:
   a. Depths of various elements of foundation in relation to finished first floor data if not shown or where depth differs from that shown.
   b. Horizontal and vertical locations of existing and new Underground Facilities and appurtenances, and other underground structures, equipment, or Work. Reference to at least two measurements to permanent surface improvements.
   c. Location of internal utilities and appurtenances concealed in the construction referenced to visible and accessible features of the structure.
   d. Locate existing facilities, piping, equipment, and items critical to the interface between existing physical conditions or construction and new construction.
   e. Changes made by Addenda and Field Orders, Work Change Directive, Change Order, and Engineer's written interpretation and clarification using consistent symbols for each and showing appropriate document tracking number.
5. Dimensions on Schematic Layouts: Show on record drawings, by dimension, the centerline of each run of items such as are described in previous subparagraph above.
   a. Clearly identify the item by accurate note such as "cast iron drain," "galv. water," and the like.
   b. Show, by symbol or note, vertical location of item ("under slab," "in ceiling plenum," "exposed," and the like).
   c. Make identification so descriptive that it may be related reliably to Specifications.

3.02 FINAL CLEANING

A. At completion of the Work or of a part thereof and immediately prior to Contractor's request for certificate of Substantial Completion; or if no certificate is issued, immediately prior to Contractor's notice of completion, clean entire Site or parts thereof, as applicable.

1. Leave the Work and adjacent areas affected in a cleaned condition satisfactory to Owner and Engineer.
2. Remove grease, dirt, dust, paint or plaster splatter, stains, labels, fingerprints, and other foreign materials from exposed surfaces.
3. Repair, patch, and touch up marred surfaces to specified finish and match adjacent surfaces.
4. Clean all windows.
5. Clean and wax wood, vinyl, or painted floors.
6. Broom clean exterior paved driveways and parking areas.
7. Hose clean sidewalks, loading areas, and others contiguous with principal structures.
8. Rake clean all other surfaces.
9. Remove snow and ice from access to buildings.
10. Replace air-handling filters and clean ducts, blowers, and coils of ventilation units operated during construction.
11. Leave water courses, gutters, and ditches open and clean.

B. Use only cleaning materials recommended by manufacturer of surfaces to be cleaned.

END OF SECTION

SECTION 01810
EQUIPMENT TESTING AND FACILITY STARTUP

PART 1 GENERAL

1.01 DEFINITIONS

A. Facility: Entire Project, or an agreed-upon portion, including all of its unit processes.

B. Functional Test: Test or tests in presence of Engineer and Owner to demonstrate that installed equipment meets manufacturer's installation, calibration, and adjustment requirements and other requirements as specified.

C. Performance Test: Test or tests performed after any required functional test in presence of Engineer and Owner to demonstrate and confirm individual equipment meets performance requirements specified in individual sections.

D. Unit Process: As used in this section, a unit process is a portion of the facility that performs a specific process function, such as backwash treatment system and polymer feed system.

E. Facility Performance Demonstration:

1. A demonstration, conducted by Contractor, with assistance of Owner, to demonstrate and document the performance of the entire operating facility, both manually and automatically (if required), based on criteria developed in conjunction with Owner and as accepted by Engineer.
2. Such demonstration is for the purposes of (i) verifying to Owner entire facility performs as a whole, and (ii) documenting performance characteristics of completed facility for Owner's records. Neither the demonstration nor the evaluation is intended in any way to make performance of a unit process or entire facility the responsibility of Contractor, unless such performance is otherwise specified.

1.02 SUBMITTALS

A. Informational Submittals:

1. Facility Startup and Performance Demonstration Plan.
2. Functional and performance test results.
3. Completed Unit Process Startup Form for each unit process.
4. Completed Facility Performance Demonstration/Certification Form.

1.03 FACILITY STARTUP AND PERFORMANCE DEMONSTRATION PLAN

A. Develop a written plan, in conjunction with Owner's operations personnel; to include the following:

1. Step-by-step instructions for startup of each unit process and the complete facility.
2. Unit Process Startup Form (sample attached), to minimally include the following:
   a. Description of the unit process, including equipment numbers/nomenclature of each item of equipment and all included devices.
   b. Detailed procedure for startup of the unit process, including valves to be opened/closed, order of equipment startup, etc.
   c. Startup requirements for each unit process, including water, power, chemicals, etc.
   d. Space for evaluation comments.
3. Facility Performance Demonstration/Certification Form (sample attached), to minimally include the following:
   a. Description of unit processes included in the facility startup.
   b. Sequence of unit process startup to achieve facility startup.
   c. Description of computerized operations, if any, included in the facility.
   d. Contractor certification facility is capable of performing its intended function(s), including fully automatic operation.
   e. Signature spaces for Contractor and Engineer.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Facility Startup Meetings: Schedule, in accordance with requirements of Section 01200, Project Meetings, to discuss test schedule, test methods, materials, chemicals and liquids required, facilities operations interface, and Owner involvement.

B. Contractor's Testing and Startup Representative:

1. Designate and furnish one or more personnel to coordinate and expedite testing and facility startup.
2. Representative(s) shall be present during startup meetings and shall be available at all times during testing and startup.

C. Provide temporary valves, gauges, piping, test equipment and other materials and equipment required for testing and startup.

D. Provide Subcontractor and equipment manufacturers' staff adequate to prevent delays. Schedule ongoing work so as not to interfere with or delay testing and startup.

E. Owner will:

1. Provide water, power, chemicals, and other items as required for startup, unless otherwise indicated.
2. Operate process units and facility with support of Contractor.
3. Provide labor and materials as required for laboratory analyses.
4. Furnish assistance of manufacturer's representative(s) for Owner-furnished products, as specified in Section 01645, Owner-Furnished Products.

3.02 EQUIPMENT TESTING

A. Preparation:

1. Complete installation before testing.
2. Furnish qualified manufacturers' representatives, when required by individual Specification sections.
3. Obtain and submit from equipment manufacturer's representative Manufacturer's Certificate of Proper Installation Form, in accordance with Section 01640, Manufacturers' Services, when required by individual Specification sections.
4. Equipment Test Report Form: Provide written test report for each item of equipment to be tested, to include the minimum information:
   a. Owner/Project Name.
   b. Equipment or item tested.
   c. Date and time of test.
   d. Type of test performed (Functional or Performance).
   e. Test method.
   f. Test conditions.
   g. Test results.
   h. Signature spaces for Contractor and Engineer as witness.
5. Cleaning and Checking: Prior to beginning functional testing:
   a. Calibrate testing equipment in accordance with manufacturer's instructions.
   b. Inspect and clean equipment, devices, connected piping, and structures to ensure they are free of foreign material.
   c. Lubricate equipment in accordance with manufacturer's instructions.
   d. Turn rotating equipment by hand when possible to confirm that equipment is not bound.
   e. Open and close valves by hand and operate other devices to check for binding, interference, or improper functioning.

f. Check power supply to electric-powered equipment for correct voltage.
g. Adjust clearances and torque.
h. Test piping for leaks.

6. Ready-to-test determination will be by Engineer based at least on the following:
   a. Acceptable Operation and Maintenance Data.
   b. Notification by Contractor of equipment readiness for testing.
   c. Receipt of Manufacturer's Certificate of Proper Installation, if so specified.
   d. Adequate completion of work adjacent to, or interfacing with, equipment to be tested.
   e. Availability and acceptability of manufacturer's representative, when specified, to assist in testing of respective equipment.
   f. Satisfactory fulfillment of other specified manufacturer's responsibilities.
   g. Equipment and electrical tagging complete.
   h. Delivery of all spare parts and special tools.

B. Functional Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Owner and Engineer in writing at least 10 days prior to scheduled date of testing.
3. Prepare Equipment Test Report summarizing test method and results.
4. When, in Engineer's opinion, equipment meets functional requirements specified, such equipment will be accepted for purposes of advancing to performance testing phase, if so required by individual Specification sections. Such acceptance will be evidenced by Engineer/Owner's signature as witness on Equipment Test Report.

C. Performance Testing:

1. Conduct as specified in individual Specification sections.
2. Notify Engineer and Owner in writing at least 10 days prior to scheduled date of test.
3. Performance testing shall not commence until equipment has been accepted by Engineer as having satisfied functional test requirements specified.
4. Type of fluid, gas, or solid for testing shall be as specified.
5. Unless otherwise indicated, furnish labor, materials, and supplies for conducting the test and taking samples and performance measurements.
6. Prepare Equipment Test Report summarizing test method and results.

7. When, in Engineer's opinion, equipment meets performance requirements specified, such equipment will be accepted as to conforming to Contract requirements. Such acceptance will be evidenced by Engineer's signature on Equipment Test Report.

3.03 STARTUP OF UNIT PROCESSES

A. Prior to unit process startup, equipment within unit process shall be accepted by Engineer as having met functional and performance testing requirements specified.

B. Startup sequencing of unit processes shall be as chosen by Contractor to meet schedule requirements.

C. Make adjustments, repairs, and corrections necessary to complete unit process startup.

D. Startup shall be considered complete when, in opinion of Engineer, unit process has operated in manner intended for 5 continuous days without significant interruption. This period is in addition to functional or performance test periods specified elsewhere.

E. Significant Interruption: May include any of the following events:

1. Failure of Contractor to provide and maintain qualified onsite startup personnel as scheduled.
2. Failure to meet specified functional operation for more than 2 consecutive hours.
3. Failure of any critical equipment or unit process that is not satisfactorily corrected within 5 hours after failure.
4. Failure of any noncritical equipment or unit process that is not satisfactorily corrected within 8 hours after failure.
5. As determined by Engineer.

F. A significant interruption will require startup then in progress to be stopped. After corrections are made, startup test period to start from beginning again.

3.04 FACILITY PERFORMANCE DEMONSTRATION

A. When, in the opinion of Engineer, startup of all unit processes has been achieved, sequence each unit process to the point that facility is operational.

B. Demonstrate proper operation of required interfaces within and between individual unit processes.

C. After facility is operating, complete performance testing of equipment and systems not previously tested.

D. Document, as defined in Facility Startup and Performance Demonstration Plan, the performance of the facility, until all unit processes are operable and under control of computer system.

E. Certify, on the Facility Performance Demonstration/Certification Form, that facility is capable of performing its intended function(s), including fully automatic operation.

3.05 SUPPLEMENTS

A. Supplements listed below, following "End of Section," are a part of this Specification:

1. Unit Process Startup Form.
2. Facility Performance Demonstration/Certification Form.

END OF SECTION

UNIT PROCESS STARTUP FORM

OWNER:_____ **PROJECT:**_____

Unit Process Description: (Include description and equipment number of all equipment and devices):

Startup Procedure (Describe procedure for sequential startup and evaluation, including valves to be opened/closed, order of equipment startup, etc.):

Startup Requirements (Water, power, chemicals, etc.):_____

Evaluation Comments:_____

FACILITY PERFORMANCE DEMONSTRATION/CERTIFICATION FORM

OWNER:_____ **PROJECT:**_____

Unit Processes Description (List unit processes involved in facility startup):

_____

_____

_____

_____

Unit Processes Startup Sequence (Describe sequence for startup, including computerized operations, if any):

_____

_____

_____

_____

_____

Contractor Certification that Facility is capable of performing its intended function(s), including fully automatic operation:

Contractor: _____ **Date:** _____, **20**____

Engineer: _____ **Date:** _____, **20**____
(Authorized Signature)

SECTION 02200
SITE PREPARATION

PART 1 GENERAL

1.01 DEFINITIONS

A. Interfering or Objectionable Material: Trash, rubbish, and junk; vegetation and other organic matter, whether alive, dead, or decaying; topsoil.

B. Clearing: Removal of interfering or objectionable material lying on or protruding above ground surface.

C. Grubbing: Removal of vegetation and other organic matter including stumps, buried logs, and roots greater than 2 inches caliper to a depth of 6 inches below subgrade.

D. Scalping: Removal of sod without removing more than upper 3 inches of topsoil.

E. Stripping: Removal of topsoil remaining after applicable scalping is completed.

F. Project Limits: Areas, as shown or specified, within which Work is to be performed.

1.02 SCHEDULING AND SEQUENCING

A. Prepare Site only after adequate erosion and sediment controls are in place.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Clear, grub, and strip areas actually needed for waste disposal, borrow, or Site improvements within limits shown or specified.

B. Do not injure or deface vegetation that is not designated for removal.

3.02 LIMITS

A. As follows, but not to extend beyond Project limits.

1. Excavation Excluding Trenches: 5 feet beyond top of cut slopes.

2. Trench Excavation: 4 feet from trench centerline, regardless of actual trench width.
3. Structures: 15 feet outside of new structures.

B. Remove rubbish, trash, and junk from entire area within Project limits.

3.03 CLEARING

A. Clear areas within limits shown or specified.

3.04 GRUBBING

A. Grub areas within limits shown or specified.

3.05 SCALPING

A. Do not remove sod until after clearing and grubbing is completed and resulting debris is removed.

B. Scalp areas within limits shown or specified.

3.06 DISPOSAL

A. Clearing and Grubbing Debris:

1. Dispose of debris offsite.
2. Burning of debris onsite will not be allowed.
3. Limit offsite disposal of clearing and grubbing debris to locations that are approved by federal, state, and local authorities, and that will not be visible from Project.

B. Scalpings: As specified for clearing and grubbing debris.

END OF SECTION

SECTION 02220
DEMOLITION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. American National Standards Institute (ANSI): A10.6, Safety Requirements for Demolition Operations.
2. Occupational Safety and Health Administration (OSHA), U.S. Code of Federal Regulations (CFR) Title 29 Part 1926—Occupational Safety and Health Regulations for Construction.
3. Environmental Protection Agency (EPA), U.S. Code of Federal Regulations (CFR), Title 40:
   a. Part 61—National Emission Standards for Hazardous Air Pollutants.
   b. Part 82—Protection of Stratospheric Ozone.
   c. Part 273—Standards for Universal Waste Management.

1.02 DEFINITIONS

A. Demolition: Dismantling, razing, destroying, or wrecking of any fixed building or structure or any part thereof.

B. Modify: Provide all necessary material and labor to modify an existing item to the condition indicated or specified.

C. Relocate: Remove, protect, clean and reinstall equipment, including electrical, instrumentation, and all ancillary components required to make the equipment fully functional, to the new location identified on the Drawings.

D. Renovation: Altering a facility or one or more facility components in any way.

E. Salvage/Salvageable: Remove and deliver, to the specified location(s), the equipment, building materials, or other items so identified to be saved from destruction, damage, or waste; such property to remain that of Owner. Unless otherwise specified, title to items identified for demolition shall revert to Contractor.

1.03 SUBMITTALS

A. Informational Submittals:

1. Submit copies of any notifications, authorizations and permits required to perform the Work.
2. Submit a shipping receipt or bill of lading for all universal waste shipped.

1.04 REGULATORY AND SAFETY REQUIREMENTS

A. When applicable, demolition Work shall be accomplished in strict accordance with 29 CFR 1926-Subpart T.

B. Comply with federal, state, and local hauling and disposal regulations. In addition to the requirements of the General Conditions, Contractor's safety requirements shall conform to ANSI A10.6.

C. Furnish timely notification of this demolition project to applicable federal, state, regional, and local authorities in accordance with 40 CFR 61-Subpart M.

1.05 SEQUENCING AND SCHEDULING

A. Include the Work of this Specification in the progress schedule.

1.06 ENVIRONMENTAL PROTECTION

A. Conform to Soil Sedimentation Control Requirements.

1.07 UTILITY SERVICES

A. Maintain existing utilities indicated to remain, keep in service, and protect against damage during demolition operations.

B. Do not remove existing utilities to be demolished until proposed utility construction is completed and in service.

C. Demolish or abandon existing utilities as indicated after proposed utility installation is tested and accepted.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 EXISTING FACILITIES TO BE DEMOLISHED OR RENOVATED

A. Utilities and Related Equipment:

1. Notify Owner or appropriate utilities to turn off affected services at least 48 hours before starting demolition activities.
2. Remove existing utilities as indicated and terminate in a manner conforming to the nationally recognized code covering the specific utility and approved by Engineer.
3. When utility lines are encountered that are not indicated on the Drawings, notify Owner prior to further work in that area.
4. Plug sewer lines with concrete to a minimum plug length of 5 feet to prevent groundwater infiltration.

B. Paving and Slabs:

1. Provide neat sawcuts at limits of pavement removal as indicated.

3.02 PROTECTION

A. Building Occupancy: Refer to Section 01040, Coordination, for specific requirements related to concurrent occupancy of facilities to be partially demolished.

B. Dust and Debris Control: Prevent the spread of dust and debris to occupied portions of the building and avoid the creation of a nuisance or hazard in the surrounding area. Do not use water if it results in hazardous or objectionable conditions such as, but not limited to, ice, flooding, or pollution.

C. Traffic Control Signs: Where pedestrian and driver safety is endangered in the area of removal Work, use traffic barricades with flashing lights.

D. Existing Work:

1. Survey the site and examine the Drawings and Specifications to determine the extent of the Work before beginning any demolition or renovation.
2. Take necessary precautions to avoid damage to existing items scheduled to remain in place, to be reused, or to remain the property of Owner; any Contractor-damaged items shall be repaired or replaced as directed by Engineer.
3. Provide temporary weather protection during interval between removal of existing exterior surfaces and installation of new to ensure that no water leakage or damage occurs to structure or interior areas of existing building.
4. Ensure that structural elements are not overloaded as a result of or during performance of the Work. Responsibility for additional structural elements, or increasing the strength of existing structural elements as may be required as a result of any Work performed under this Contract shall be that of the Contractor. Repairs, reinforcement, or structural replacement must have Engineer approval.
5. Do not overload pavements to remain.

E. Facilities: Protect electrical and mechanical services and utilities. Where removal of existing utilities and pavement is specified or indicated, provide approved barricades, temporary covering of exposed areas, and temporary services or connections for electrical and mechanical utilities.

F. Protection of Personnel:

1. Provide temporary barricades and other forms of protection to protect Owner's personnel and the general public from injury due to demolition Work.
2. Provide protective measures as required to provide free and safe passage of Owner's personnel and the general public to occupied portions of the adjacent structure.

G. Underground Utility Protection:

1. Locate and mark all existing utility lines to be abandoned and obtain Owner approval prior to demolition.
2. Valve and cap piping prior to entering area.
3. Verify that electrical services have been de-energized prior to starting demolition.

H. Pavements and Sidewalks:

1. Locate and mark existing demolition limits with chalk line or paint.
2. Locate existing joints in concrete pavements. Expand limits of demolition to nearest joint, if existing joint is within 5 feet of limits specified.

I. Damages: Promptly repair or replace damaged items not designated to be demolished. Restore to original condition as directed at no additional cost.

3.03 BURNING

A. The use of burning at the Site for the disposal of refuse and debris will not be permitted.

3.04 BACKFILL

A. Do not use demolition debris as backfill material.

B. Fill excavations and other hazardous openings to existing ground level or foundation level of new construction in accordance with Section 02316, Fill and Backfill.

3.05 TITLE TO MATERIALS

A. All items designated to be removed shall become the property of Contractor.

3.06 DISPOSITION OF MATERIAL

A. Remove all demolished material from site.

3.07 UNSALVAGEABLE MATERIAL

A. Concrete, masonry, and other noncombustible material shall be disposed of in an approved landfill located off Site.

B. Combustible material shall be disposed of in the sanitary fill area located off Site.

3.08 STRUCTURES

A. Remove existing structures including slabs and foundations. Backfill remaining structures or excavations with compacted sand, crushed stone, or lean concrete.

B. Remove sidewalks, curbs, gutters, and street light bases as indicated.

3.09 UNDERGROUND UTILITIES

A. Underground Utility Structures:

1. Remove existing utility structures to at least 3 feet below bottom of proposed pavement and foundations.
2. Backfill remaining structures or excavations with compacted sand, crushed stone, or lean concrete.
3. Plug abandoned pipe entrances into structures with concrete.

B. Existing Abandoned Pipelines: Plug open ends of abandoned gravity utility lines with concrete. Use manufactured plug compatible with pipe material and concrete thrust blocking (apply NFPA 24 standards to all piping) for pressure pipe.

C. Pipelines:

1. Demolish existing underground utilities to facilitate proposed construction.
2. Abandon in place underground utilities as indicated.
3. Abandon in place underground utilities when following conditions are met:
   a. Location: Pipe is not in conflict with proposed construction.
   b. Depth: Top of pipe is at least 3 feet below bottom of proposed pavement or structures.
   c. Pipe Size: Less than 8 inches diameter.

D. Demolish or abandon existing utilities as indicated after proposed utility installation is tested and accepted.

3.10 PAVEMENTS AND SIDEWALKS

A. Saw cut (neat) existing pavement at limits of demolition or remove to nearest joint, if concrete. Replace pavement when removal extends beyond limits of demolition.

B. Remove all existing pavement and concrete within 5 feet of proposed.

3.11 CLEANUP

A. Debris and rubbish shall be removed and transported in a manner that prevents spillage on streets or adjacent areas. Local regulations regarding hauling and disposal shall apply.

END OF SECTION

SECTION 02260
EXCAVATION SUPPORT AND PROTECTION

PART 1 GENERAL

1.01 QUALITY ASSURANCE

A. Provide surveys to monitor movements of critical facilities.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Design, provide, and maintain shoring, sheeting, and bracing as necessary to support the sides of excavations and to prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed the Work.

3.02 REMOVAL OF EXCAVATION SUPPORT

A. Remove excavation support in a manner that will maintain support as excavation is backfilled.

B. Do not begin to remove excavation support until support can be removed without damage to existing facilities, completed Work, or adjacent property.

C. Remove excavation support in a manner that does not leave voids in the backfill.

3.03 TRENCHES

A. For trench excavation exceeding 5 feet in depth, provide adequate safety system meeting requirements of applicable state and local construction safety orders, and federal requirements.

END OF SECTION

SECTION 02315
EXCAVATION

PART 1 GENERAL

1.01 DEFINITIONS

A. Common Excavation: Removal of material not classified as rock excavation.

1.02 SUBMITTALS

A. Informational Submittals:

1. Excavation Plan, Detailing:
   a. Proposed locations of stockpiled excavated material.
   b. Proposed onsite and offsite spoil disposal sites.

1.03 QUALITY ASSURANCE

A. Provide adequate survey control to avoid unauthorized overexcavation.

1.04 WEATHER LIMITATIONS

A. Material excavated when frozen or when air temperature is less than 32 degrees F shall not be used as fill or backfill until material completely thaws.

B. Material excavated during inclement weather shall not be used as fill or backfill until after material drains and dries sufficiently for proper compaction.

1.05 SEQUENCING AND SCHEDULING

A. Demolition: Complete applicable Work specified in Section 02220, Demolition, prior to excavating.

B. Clearing, Grubbing, and Stripping: Complete applicable Work specified in Section 02200, Site Preparation, prior to excavating.

C. Excavation Support: Install and maintain, as specified in Section 02260, Excavation Support and Protection, as necessary to support sides of excavations and prevent detrimental settlement and lateral movement of existing facilities, adjacent property, and completed Work.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Excavate to lines, grades, and dimensions shown and as necessary to accomplish Work. Excavate to within tolerance of plus or minus 0.1 foot, except where dimensions or grades are shown or specified as maximum or minimum. Allow for forms, working space, granular base, topsoil, and similar items, wherever applicable. Trim to neat lines where concrete is to be deposited against earth.

B. Do not overexcavate without written authorization.

C. Remove or protect obstructions as shown and as specified in Section 01500, Construction Facilities and Temporary Controls, Article Protection of Work and Property.

3.02 UNCLASSIFIED EXCAVATION

A. Excavation is unclassified. Complete all excavation regardless of the type, nature, or condition of the materials encountered.

3.03 TRENCH WIDTH

A. Minimum Width of Trenches:

1. Single Pipes, Conduits, Direct-Buried Cables, and Duct Banks:
   a. Less than 4-inch Outside Diameter or Width: 18 inches.
   b. Greater than 4-inch Outside Diameter or Width: Comply with Drawings.
2. Multiple Pipes, Conduits, Cables, or Duct Banks in Single Trench: 18 inches greater than aggregate width of pipes, conduits, cables, duct banks, plus space between.
3. Increase trench widths by thicknesses of sheeting, if used.

B. Maximum trench width to be kept as narrow as possible.

3.04 EMBANKMENT AND CUT SLOPES

A. Shape, trim, and finish cut slopes to conform with lines, grades, and cross-sections shown, with proper allowance for topsoil or slope protection, where shown.

B. Remove stones and rock that exceed 3-inch diameter and that are loose and may roll down slope. Remove exposed roots from cut slopes.

C. Round tops of cut slopes in soil to not less than a 6-foot radius, provided such rounding does not extend offsite or outside easements and rights-of-way, or adversely impacts existing facilities, adjacent property, or completed Work.

3.05 STOCKPILING EXCAVATED MATERIAL

A. Stockpile excavated material that is suitable for use as fill or backfill until material is needed.

B. Segregate suitable and unsuitable material stockpiles.

C. Confine stockpiles to within easements, rights-of-way, and approved work areas. Do not obstruct roads or streets.

D. Do not stockpile excavated material adjacent to trenches and other excavations, unless excavation side slopes and excavation support systems are designed, constructed, and maintained for stockpile loads.

E. Do not stockpile excavated materials near or over existing facilities, adjacent property, or completed Work, if weight of stockpiled material could induce excessive settlement.

3.06 DISPOSAL OF SPOIL

A. Dispose of excavated materials, which are unsuitable or exceed quantity needed for fill or backfill, offsite.

B. Dispose of debris resulting from removal of underground facilities as specified in Section 02220, Demolition, for demolition debris.

C. Dispose of debris resulting from removal of organic matter, trash, refuse, and junk as specified in Section 02200, Site Preparation, for clearing and grubbing debris.

END OF SECTION

SECTION 02316
FILL AND BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C117, Standard Test Method for Materials Finer Than 75-Micrometers (No. 200) Sieve in Mineral Aggregates by Washing.
   b. C136, Standard Method for Sieve Analysis of Fine and Coarse Aggregates.
   c. D75, Standard Practice for Sampling Aggregates.
   d. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3)).
   e. D1556, Standard Test Method for Density and Unit Weight of Soil in Place by the Sand-Cone Method.
   f. D2922, Standard Test Methods for Density of Soil and Soil-Aggregate in Place by Nuclear Methods (Shallow Depth).
   g. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   h. D4254, Standard Test Method for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.

1.02 DEFINITIONS

A. Relative Compaction:

1. Ratio, in percent, of as-compacted field dry density to laboratory maximum dry density as determined in accordance with ASTM D698.
2. Apply corrections for oversize material to either as-compacted field dry density or maximum dry density, as determined by Geotechnical Engineer.

B. Optimum Moisture Content:

1. Determined in accordance with ASTM Standard specified to determine maximum dry density for relative compaction.
2. Determine field moisture content on basis of fraction passing 3/4-inch sieve.

C. Relative Density: Calculated in accordance with ASTM D4254 based on maximum index density determined in accordance with ASTM D4253 and minimum index density determined in accordance with ASTM D4254.

D. Prepared Ground Surface: Ground surface after completion of required demolition, clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and subgrade preparation.

E. Completed Course: A course or layer that is ready for next layer or next phase of Work.

F. Lift: Loose (uncompacted) layer of material.

G. Well-Graded:

1. A mixture of particle sizes with no specific concentration or lack thereof of one or more sizes.
2. Does not define numerical value that must be placed on coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.
3. Used to define material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids.

H. Influence Area: Area within planes sloped downward and outward at 60-degree angle from horizontal measured from:

1. 1 foot outside outermost edge at base of foundations or slabs.
2. 1 foot outside outermost edge at surface of roadways or shoulder.
3. 0.5 foot outside exterior at spring line of pipes or culverts.

I. Borrow Material: Material from required excavations or from designated borrow areas on or near Site.

J. Selected Backfill Material: Materials available onsite that Engineer determines to be suitable for specific use.

K. Imported Material: Materials obtained from sources offsite, suitable for specified use.

L. Structural Fill: Fill materials as required under structures, pavements, and other facilities.

M. Embankment Material: Fill materials required to raise existing grade in areas other than under structures.

1.03 QUALITY ASSURANCE

A. Notify Geotechnical Engineer when:

1. Structure is ready for backfilling, and whenever backfilling operations are resumed after a period of inactivity.
2. Soft or loose subgrade materials are encountered wherever embankment or site fill is to be placed.
3. Fill material appears to be deviating from Specifications.

1.04 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Sections 02220, Demolition; 02200, Site Preparation; 02315, Excavation; and 02319, Subgrade Preparation, prior to placing fill or backfill.

B. Backfill against concrete structures only after concrete has attained compressive strength, specified in Section 03301, Reinforced Concrete. Obtain Engineer's acceptance of concrete work and attained strength prior to placing backfill.

C. Do not place granular base, subbase, or surfacing until after subgrade has been prepared as specified in Section 02319, Subgrade Preparation.

PART 2 PRODUCTS

2.01 SOURCE QUALITY CONTROL

A. Gradation Tests:

1. As necessary to locate acceptable sources of imported material.

2.02 EARTHFILL

A. Excavated material from required excavations and designated borrow sites, free from rocks larger than 3 inches, from roots and other organic matter, ashes, cinders, trash, debris, and other deleterious materials.

2.03 GRANULAR FILL

A. 1-inch minus crushed gravel or crushed rock.

B. Free from dirt, clay balls, and organic material.

C. Well-graded from coarse to fine and containing sufficient fines to bind material when compacted, but with maximum 8 percent by weight passing No. 200 sieve.

2.04 SUITABLE MATERIAL

A. Earth materials meeting requirements of Unified Soil Classification System (ASTM D2487) types SW, GM, GC, SC, SM; or designated as being suitable for their intended use by the Geotechnical Engineer.

2.05 SAND

A. Free from clay, organic matter, or other deleterious material.

B. Gradation as determined in accordance with ASTM C117 and C136:

Sieve Size	Percent Passing by Weight
1/4-inch	100
No. 4	95—100
No. 200	0—8

2.06 GRANULAR DRAIN MATERIAL

A. As specified in Section 02320, Trench Backfill.

2.07 GRANULAR FILTER MATERIAL

A. Clean, hard, durable gravel, free from foreign materials and washed.

2.08 WATER FOR MOISTURE CONDITIONING

A. Free of hazardous or toxic contaminates, or contaminants deleterious to proper compaction.

PART 3 EXECUTION

3.01 GENERAL

A. Keep placement surfaces free of water, debris, and foreign material during placement and compaction of fill and backfill materials.

B. Place and spread fill and backfill materials in horizontal lifts of uniform thickness, in a manner that avoids segregation, and compact each lift to specified densities prior to placing succeeding lifts. Slope lifts only where necessary to conform to final grades or as necessary to keep placement surfaces drained of water.

C. During filling and backfilling, keep level of fill and backfill around each structure and buried tank even.

D. Do not place fill or backfill, if fill or backfill material is frozen, or if surface upon which fill or backfill is to be placed is frozen.

E. If pipe, conduit, duct bank, or cable is to be laid within fill or backfill:

1. Fill or backfill to an elevation 2 feet above top of item to be laid.
2. Excavate trench for installation of item.
3. Install bedding, if applicable, as specified in Section 02320, Trench Backfill.
4. Install item.
5. Backfill envelope zone and remaining trench, as specified in Section 02320, Trench Backfill, before resuming filling or backfilling specified in this section.

F. Tolerances:

1. Final Lines and Grades: Within a tolerance of 0.1 foot unless dimensions or grades are shown or specified otherwise.
2. Grade to establish and maintain slopes and drainage as shown. Reverse slopes are not permitted.

G. Settlement: Correct and repair any subsequent damage to structures, pavements, curbs, slabs, piping, and other facilities, caused by settlement of fill or backfill material.

3.02 BACKFILL UNDER AND AROUND STRUCTURES

A. Under Facilities: Within influence area beneath structures, slabs, pavements, curbs, piping, conduits, duct banks, and other facilities, backfill with granular fill, unless otherwise shown. Place granular fill in lifts of 6-inch maximum thickness and compact each lift to minimum of 95 percent relative compaction as determined in accordance with ASTM D698. Top 18-inches at 100% relative compaction as per ASTM D698.

B. Other Areas: Backfill with earthfill to lines and grades shown, with proper allowance for topsoil thickness where shown. Place in lifts of 6-inch maximum thickness and compact each lift to minimum 95 percent relative compaction as determined in accordance with ASTM D698.

3.03 SITE TESTING

A. Gradation:

1. One sample from each 1,500 tons of finished product or more often as determined by Geotechnical Engineer, if variation in gradation is occurring, or if material appears to depart from Specifications.
2. If test results indicate material does not meet Specification requirements, terminate material placement until corrective measures are taken.
3. Remove material placed in Work that does not meet Specification requirements.

B. In-Place Density Tests: In accordance with ASTM D1556 or D2922. During placement of materials, test granular fill.

3.04 REPLACING OVEREXCAVATED MATERIAL

A. Replace excavation carried below grade lines shown or established by Engineer as follows:

1. Beneath Footings: 2,000 psi concrete.
2. Beneath Fill or Backfill: Same material as specified for overlying fill or backfill.
3. Beneath Slabs-On-Grade: Granular fill.
4. Trenches:
   a. Unauthorized Overexcavation: Either trench stabilization material or granular pipe base material, as specified in Section 02320, Trench Backfill.
   b. Authorized Overexcavation: Trench stabilization material, as specified in Section 02320, Trench Backfill.
5. Permanent Cut Slopes (Where Overlying Area is Not to Receive Fill or Backfill):
   a. Flat to Moderate Steep Slopes (3:1, Horizontal Run: Vertical Rise or Flatter): Earthfill.
   b. Steep Slopes (Steeper than 3:1):
      1) Correct overexcavation by transitioning between overcut areas and designed slope adjoining areas, provided such cutting does not extend offsite or outside easements and right-of-ways, or adversely impacts existing facilities, adjacent property, or completed Work.
      2) Backfilling overexcavated areas is prohibited, unless in Engineer's opinion, backfill will remain stable, and overexcavated material is replaced as compacted earthfill.

END OF SECTION

SECTION 02319
SUBGRADE PREPARATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lb/ft^3 (600 kN-m/m^3)).
   b. D1557, Test Method for Laboratory Compaction Characteristics of Soil Using Modified Effort (56,000 ft-lbf/ft^3 (2,700 kN-m/m^3)).

1.02 DEFINITIONS

A. Optimum Moisture Content: As defined in Section 02316, Fill and Backfill.

B. Prepared Ground Surface: Ground surface after completion of clearing and grubbing, scalping of sod, stripping of topsoil, excavation to grade, and scarification and compaction of subgrade.

C. Relative Compaction: As defined in Section 02316, Fill and Backfill.

D. Relative Density: As defined in Section 02316, Fill and Backfill.

E. Subgrade: Layer of existing soil after completion of clearing, grubbing, scalping of topsoil prior to placement of fill, roadway structure or base for floor slab.

F. Proof-Rolling: Testing of subgrade by compactive effort to identify areas that will not support the future loading without excessive settlement.

1.03 SEQUENCING AND SCHEDULING

A. Complete applicable Work specified in Section 02220, Demolition; Section 02200, Site Preparation; and Section 02315, Excavation, prior to subgrade preparation.

1.04 QUALITY ASSURANCE

A. Notify Geotechnical Engineer when subgrade is ready for compaction or proof-rolling or whenever compaction or proof-rolling is resumed after a period of extended inactivity.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Prepare subgrade when unfrozen and free of ice and snow.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Keep subgrade free of water, debris, and foreign matter during compaction or proof-rolling.

B. Bring subgrade to proper grade and cross-section and uniformly compact surface.

C. Do not use sections of prepared ground surface as haul roads. Protect prepared subgrade from traffic.

D. Maintain prepared ground surface in finished condition until next course is placed.

3.02 COMPACTION

A. Compact upper 12 inches to minimum of 100 percent relative compaction as determined in accordance with ASTM D698.

3.03 MOISTURE CONDITIONING

A. Dry Subgrade: Add water, then mix to make moisture content uniform throughout.

B. Wet Subgrade: Aerate material by blading, discing, harrowing, or other methods, to hasten drying process.

3.04 TESTING

A. Proof-roll subgrade with equipment specified in Article Compaction to detect soft or loose subgrade or unsuitable material, as determined by Geotechnical Engineer.

3.05 CORRECTION

A. Soft or Loose Subgrade:

1. Adjust moisture content and recompact, or
2. Over excavate as specified in Section 02315, Excavation, and replace with suitable material from the excavation, as specified in Section 02316, Fill and Backfill.

B. Unsuitable Material: Over excavate as specified in Section 02315, Excavation, and replace with suitable material from the excavation, as specified in Section 02316, Fill and Backfill.

END OF SECTION

SECTION 02320
TRENCH BACKFILL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Public Works Association (APWA): Uniform Color Code for Temporary Marking of Underground Utility Locations.
2. ASTM International (ASTM):
   a. C33, Standard Specification for Concrete Aggregates.
   b. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   c. C117, Standard Test Method for Materials Finer than 75 Micrometer (No. 200) Sieve in Mineral Aggregates by Washing.
   d. C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.
   e. C150, Standard Specification for Portland Cement.
   f. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
   g. D698, Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))
   h. D1140, Standard Test Method for Amount of Material in Soils Finer than the No. 200 (75 micrometer) Sieve.
   i. D3776, Standard Test Methods for Mass Per Unit Area (Weight) of Fabric.
   j. D4253, Standard Test Methods for Maximum Index Density and Unit Weight of Soils Using a Vibratory Table.
   k. D4254, Standard Test Methods for Minimum Index Density and Unit Weight of Soils and Calculation of Relative Density.
   l. D4318, Standard Test Methods for Liquid Limit, Plastic Limit, and Plasticity Index of Soils.
   m. D4533, Standard Test Method for Trapezoid Tearing Strength of Geotextiles.
   n. D4832, Standard Test Method for Preparation and Testing of Controlled Low Strength Material (CLSM) Test Cylinders.
   o. D4991, Standard Test Method for Leakage Testing of Empty Rigid Containers by Vacuum Method.
   p. D5034, Standard Test Method for Breaking Strength and Elongation of Textile Fabrics (Grab Test).
3. National Electrical Manufacturers Association (NEMA): Z535.1, Safety Color Code.

1.02 DEFINITIONS

A. Base Rock: Granular material upon which manhole bases and other structures are placed.

B. Bedding Material: Granular material upon which pipes, conduits, cables, or duct banks are placed.

C. Imported Material: Material obtained by Contractor from source(s) offsite.

D. Lift: Loose (uncompacted) layer of material.

E. Pipe Zone: Backfill zone that includes full trench width and extends from prepared trench bottom to an upper limit above top outside surface of pipe, conduit, cable or duct bank.

F. Prepared Trench Bottom: Graded trench bottom after excavation and installation of stabilization material, if required, but before installation of bedding material.

G. Relative Compaction: The ratio, in percent, of the as-compacted field dry density to the laboratory maximum dry density as determined by ASTM D698. Corrections for oversize material may be applied to either as-compacted field dry density or maximum dry density, as determined by Geotechnical Engineer.

H. Relative Density: As defined by ASTM D4253 and ASTM D4254.

I. Selected Backfill Material: Material available onsite that Geotechnical Engineer determines to be suitable for a specific use.

J. Well-Graded: A mixture of particle sizes that has no specific concentration or lack thereof of one or more sizes producing a material type that, when compacted, produces a strong and relatively incompressible soil mass free from detrimental voids. Well-graded does not define any numerical value that must be placed on the coefficient of uniformity, coefficient of curvature, or other specific grain size distribution parameters.

PART 2 PRODUCTS

2.01 MARKING TAPE

A. Nondetectable:

1. Inert polyethylene, impervious to known alkalis, acids, chemical reagents, and solvents likely to be encountered in soil.
2. Thickness: Minimum 5 mils.
3. Width: 3 inches.
4. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.

5. Manufacturers and Products:
   a. Reef Industries; Terra Tape.
   b. Mutual Industries; Non-detectable Tape.
   c. Presco; Non-detectable Tape.

B. Detectable:

1. Solid aluminum foil, visible on unprinted side, encased in protective high visibility, inert polyethylene plastic jacket.
2. Foil Thickness: Minimum 0.35 mils.
3. Laminate Thickness: Minimum 5 mils.
4. Width: 3 inches.
5. Identifying Lettering: Minimum 1-inch high, permanent black lettering imprinted continuously over entire length.
6. Joining Clips: Tin or nickel-coated furnished by tape manufacturer.
7. Manufacturers and Products:
   a. Reef Industries; Terra Tape, Sentry Line Detectable.
   b. Mutual Industries; Detectable Tape.
   c. Presco; Detectable Tape.

C. Color: In accordance with APWA Uniform Color Code for Temporary Marking of Underground Facilities.

Color*	**Facility**
Red	Electric power lines, cables, conduit, and lightning cables
Orange	Communicating alarm or signal lines, cables, or conduit
Yellow	Gas, oil, steam, petroleum, or gaseous materials
Green	Sewers and drain lines
Blue	Potable water
Purple	Reclaimed water, irrigation, and slurry lines
*As specified in NEMA Z535.1, Safety Color Code.	

2.02 TRENCH STABILIZATION MATERIAL

A. Granular Backfill:

1. Clean gravel or crushed rock, reasonably well-graded from coarse to fine.
2. Maximum Particle Size: 1 inch.

2.03 BEDDING MATERIAL AND PIPE ZONE MATERIAL

A. Unfrozen, friable, and no clay balls, roots, or other organic material.

B. Clean or gravelly sand with less than 5 percent passing No. 200 sieve, as determined in accordance with ASTM D1140, or gravel or crushed rock within maximum particle size and other requirements as follows unless otherwise specified.

1. Pipe Under 18-Inch Diameter: 3/4-inch maximum particle size, except 1/4 inch for stainless steel pipe, copper pipe, tubing, and plastic pipe under 3-inch diameter.
2. Conduit and Direct-Buried Cable:
   a. Sand, clean or clean to silty, less than 12 percent passing No. 200 sieve.
   b. Individual Particles: Free of sharp edges.
   c. Maximum Size Particle: Pass a No. 4 sieve.
   d. If more than 5 percent passes No. 200 sieve, the fraction that passes No. 40 sieve shall be nonplastic as determined in accordance with ASTM D4318.

2.04 EARTH BACKFILL

A. Soil, loam, or other excavated material suitable for use as backfill.

B. Free from roots or organic matter, refuse, boulders and material larger than 1/2 cubic foot, or other deleterious materials.

2.05 CONTROLLED LOW STRENGTH FILL

A. Select and proportion ingredients to obtain compressive strength between 50 and 150 psi at 28 days in accordance with ASTM D4832.

B. Materials:

1. Cement: ASTM C150, Type I or Type II.
2. Aggregate: ASTM C33, Size 7.
3. Fly Ash (if used): ASTM C618, Class C.
4. Water: Clean, potable, containing less than 500 ppm of chlorides.

2.06 TOPSOIL

A. As specified in Section 02920, Lawns and Grasses.

2.07 SOURCE QUALITY CONTROL

A. Perform gradation analysis in accordance with ASTM C136 for:

1. Earth backfill, including specified class.

2. Trench stabilization material.
3. Bedding and pipe zone material.

PART 3 EXECUTION

3.01 TRENCH PREPARATION

A. Water Control:

1. Promptly remove and dispose of water entering trench as necessary to grade trench bottom and to compact backfill and install manholes, pipe, conduit, direct-buried cable, or duct bank. Do not place concrete, lay pipe, conduit, direct-buried cable, or duct bank in water.
2. Remove water in a manner that minimizes soil erosion from trench sides and bottom.
3. Provide continuous water control until trench backfill is complete.

B. Remove foreign material and backfill contaminated with foreign material that falls into trench.

3.02 TRENCH BOTTOM

A. Firm Subgrade: Grade with hand tools, remove loose and disturbed material, and trim off high areas and ridges left by excavating bucket teeth. Allow space for bedding material if shown or specified.

B. Soft Subgrade: If subgrade is encountered that may require removal to prevent pipe settlement, notify Geotechnical Engineer. Geotechnical Engineer will determine depth of overexcavation, if any required.

3.03 TRENCH STABILIZATION MATERIAL INSTALLATION

A. Rebuild trench bottom with trench stabilization material.

B. Place material over full width of trench in 6-inch lifts to required grade, providing allowance for bedding thickness.

C. Compact each lift so as to provide a firm, unyielding support for the bedding material prior to placing succeeding lifts.

3.04 BEDDING

A. Furnish imported bedding material where, in the opinion of Geotechnical Engineer, excavated material is unsuitable for bedding or insufficient in quantity.

B. Place over the full width of the prepared trench bottom in two equal lifts when the required depth exceeds 8 inches.

C. Hand grade and compact each lift to provide a firm, unyielding surface.

D. Minimum Thickness: 4 inches.

E. Check grade and correct irregularities in bedding material. Loosen top 1 inch to 2 inches of compacted bedding material with a rake or by other means to provide a cushion before laying each section of pipe, conduit, direct-buried cable, or duct bank.

F. Install to form continuous and uniform support except at bell holes, if applicable, or minor disturbances resulting from removal of lifting tackle.

G. Bell or Coupling Holes: Excavate in bedding at each joint to permit proper assembly and inspection of joint and to provide uniform bearing along barrel of pipe or conduit.

3.05 BACKFILL PIPE ZONE

A. Upper limit of pipe zone shall not be less than following:

1. Pipe: 12 inches, unless shown otherwise.
2. Conduit: 3 inches, unless shown otherwise.

B. Restrain pipe, conduit, cables, and duct banks as necessary to prevent their movement during backfill operations.

C. Place material simultaneously in lifts on both sides of pipe and, if applicable, between pipes, conduit, cables, and duct banks installed in same trench.

1. Pipe 10-Inch and Smaller Diameter: First lift less than or equal to 1/2 pipe diameter.
2. Pipe Over 10-Inch Diameter: Maximum 6-inch lifts.

D. Thoroughly tamp each lift, including area under haunches, with handheld tamping bars supplemented by "walking in" and slicing material under haunches with a shovel to ensure that voids are completely filled before placing each succeeding lift.

E. After the full depth of the pipe zone material has been placed as specified, compact the material by a minimum of three passes with a vibratory plate compactor only over the area between the sides of the pipe and the trench walls.

F. Do not use power-driven impact compactors to compact pipe zone material.

3.06 MARKING TAPE INSTALLATION

A. Continuously install marking tape along centerline of all buried piping on top of last lift of pipe zone material. Coordinate with piping installation drawings.

1. Detectable Marking Tape: Install with nonmetallic piping and waterlines.

2. Nondetectable Marking Tape: Install with metallic piping.

3.07 BACKFILL ABOVE PIPE ZONE

A. General:

1. Process excavated material to meet specified gradation requirements.
2. Adjust moisture content as necessary to obtain specified compaction.
3. Do not allow backfill to free fall into the trench or allow heavy, sharp pieces of material to be placed as backfill until after at least 2 feet of backfill has been provided over the top of pipe.
4. Do not use power driven impact type compactors for compaction until at least 4 feet of backfill is placed over top of pipe.
5. Backfill to grade with proper allowances for topsoil, crushed rock surfacing, and pavement thicknesses, wherever applicable.
6. Backfill around structures with same class backfill as specified for adjacent trench unless otherwise shown or specified.

B. Class D Backfill: Backfill trench above the pipe zone with granular backfill in lifts not exceeding 8 inches. Compact each lift to a minimum of 95 percent relative compaction prior to placing succeeding lifts.

C. Controlled Low Strength Fill:

1. Discharge from truck mounted drum type mixer into trench.
2. Place in lifts as necessary to prevent uplift (flotation) of new and existing facilities.
3. In traveled areas fill entire trench section to pavement finish grade for a temporary driving surface, and screed off excess and finish with a float.

3.08 REPLACEMENT OF TOPSOIL

A. Replace topsoil in top 6 inches of backfilled trench.

B. Maintain the finished grade of topsoil even with adjacent area and grade as necessary to restore drainage.

3.09 MAINTENANCE OF TRENCH BACKFILL

A. After each section of trench is backfilled, maintain the surface of the backfilled trench even with the adjacent ground surface until final surface restoration is completed.

B. Gravel Surfacing Rock: Add gravel surfacing rock where applicable and as necessary to keep the surface of the backfilled trench even with the adjacent ground surface, and grade and compact as necessary to keep the surface of backfilled trenches smooth, free from ruts and potholes, and suitable for normal traffic flow.

C. Topsoil: Add topsoil where applicable and as necessary to maintain the surface of the backfilled trench level with the adjacent ground surface.

D. Asphaltic Pavement: Replace settled areas or fill with asphalt.

E. Other Areas: Add excavated material where applicable and keep the surface of the backfilled trench level with the adjacent ground surface.

3.10 SETTLEMENT OF BACKFILL

A. Settlement of trench backfill, or of fill, or facilities constructed over trench backfill will be considered a result of defective compaction of trench backfill.

END OF SECTION

SECTION 02467
DRILLED CONCRETE PIERS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 306.1, Standard Specification for Cold Weather Concreting.
2. ASTM International (ASTM):
   a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   b. A276, Standard Specification for Stainless Steel Bars and Shapes.
   c. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   d. E329, Standard Specification for Agencies Engaged in the Testing and/or Inspection of Materials Used in Construction.

1.02 DEFINITIONS

A. Bearing Stratum: Formations or layers of soil or rock that support pier and loads imposed on it.

B. Casing: Protective steel casing usually of cylindrical shape, lowered into excavated pier to prevent collapse or cave-in of sidewalls and for purpose of excluding soil and water from excavation.

C. Design Position: The location of the centroid of the pile at cutoff elevation (x, y, and z coordinates) as shown.

D. Deviation: Difference between actual as-constructed horizontal location of center of pier from required location.

E. Plumbness: Difference in horizontal location of center of pier measured at top and at bottom.

1.03 SUBMITTALS

A. Action Submittals:

1. Steel Reinforcement:
   a. Show that steel layout and details conform with those shown on Drawings.

B. Informational Submittals:

1. Certified Test Results: Concrete mix design, including certification of minimum 28-day compressive strength.
2. Daily Log and Record: At end of each working day, submit two copies of each record for every pier constructed that day.

1.04 QUALIFICATIONS

A. Installer: Minimum of 5 years of past successful experience on 10 projects of drilled concrete pier installation.

1.05 SEQUENCING AND SCHEDULING

A. Complete earthwork in vicinity of pier to top elevation of drilled pier prior to commencing pier drilling.

B. Drill pier, clean out, inspect, install reinforcing steel, and place concrete, all in same day. Do not leave piers overnight.

PART 2 PRODUCTS

2.01 CONCRETE

A. Meet requirements specified in Section 03301, Reinforced Concrete, except slump shall be 4 to 6 inches.

2.02 BENTONITE SLURRY

A. Mix design by Contractor with the following minimum requirements:

1. Viscosity (Measured by March Funnel, Seconds): 30 to 60.
2. Sand Content by Volume (Percent): 6, maximum.
3. pH: 8 to 12.
4. Density: Not less than that required to maintain positive head within excavation and prevent sidewall sloughing and such to allow proper displacement during concreting.

2.03 REINFORCING STEEL

A. Deformed Bars: ASTM A615, Grade 60.

B. Spiral Steel Reinforcing: ASTM A82.

C. Rebar Spacers: ASTM A276, Type 304 stainless steel.

D. Centralizers: Plastic.

2.04 TEMPORARY SURFACE CASING

A. Provide to maintain sidewall stability and prevent caving, to exclude groundwater, and as otherwise may be required. Strength shall withstand handling stresses, concrete pressure, and surrounding earth and/or fluid pressures.

B. Steel Casing:

1. ACI 306.1.
2. Inside Diameter: Not less than pier diameter.
3. Length: Extend from bottom of pier to above surrounding ground line.

PART 3 EXECUTION

3.01 DRILLING EQUIPMENT

A. Suitable type and size to produce a drilled pier of required size and length.

B. Capable of producing a pier without disturbance to material along pier or at pier base.

C. Do not use equipment with bent kelley bars or that wobbles during rotation while drilling.

3.02 DEWATERING

A. As specified below:

1. Prevent water from entering drilled piers either directly or by infiltration adjacent to pier.
2. Where surface water damages sides or base of a drilled pier, redrill pier and clean base.
3. Upon completion of pier excavation, dewater each pier and maintain water to less than a depth of 2 inches.
4. If water in pier cannot be controlled at or below specified depth, obtain Engineer approval to place concrete by tremie method. If approved, pier shall be allowed to fill with water to natural level prior to placement of concrete.

3.03 TEMPORARY SURFACE CASING

A. Aid in pier alignment, prevent surface sloughing, and as necessary to extend drilled pier casing above surrounding grade to pier cutoff elevations and to sufficient depth to aid in pier alignment and prevent sloughing and caving of near-surface soil.

3.04 EXCAVATION

A. Unclassified: Complete excavation regardless of type of materials encountered.

3.05 DRILLING

A. Provide Geotechnical Engineer 7 days' notice of and perform only in presence of Geotechnical Engineer.

B. Water or drilling slurry shall not be permitted. Use temporary casing or drilling slurry to prevent caving and/or water inflow.

C. Perform in continuous operation without interruptions until pier is complete and in a manner so as not to disturb material adjacent to pier.

D. Avoid overdrilling of diameter and depth necessary to install casing.

E. Keep void space outside temporary casing to a minimum.

F. Drilling Depth:

1. Depth to be socketed into rock 24".
2. Actual depth determined by Geotechnical Engineer during excavation (plus or minus 6 inches).

G. Explore bearing stratum to depth equal to diameter of bearing area or 5 feet, whichever is greater, below estimated bottom elevation of drilled pier with a probe pier.

1. Provide downpier access and lighting for inspection and testing of bearing stratum at bottom of pier.
2. If inspection and tests confirm allowable service load-bearing value, promptly excavate for drilled pier bells upon receipt of such confirmation from Geotechnical Engineer.
3. If bearing stratum is not capable of providing required service load-bearing pressure, Geotechnical Engineer will indicate to either (i) continue advancing pier to deeper bearing stratum or (ii) enlarge pier diameter as provided by Geotechnical Engineer.

H. Where temporary casing is used, remove disturbed or loose material from sides and bottom of pier upon completion of pier excavation:

1. Pier Bottom: Not more than 1/2 inch of loose soil or mud.
2. Pier Sides: Clean and free of all debris, including mud and cuttings.

I. Defective Piers: Correct piers drilled in excess of specified tolerances by reaming to a larger diameter or by redrilling in correct locations, as determined by Engineer. Fill abandoned piers with specified concrete.

3.06 REINFORCING STEEL

A. As specified in 2.03.

B. Spacers: Locate to ensure specified coverage tolerances.

C. Reinforcing Cages:

1. Fasten bars together to form single, rigid, straight unit.
2. Position and securely fasten bars to ensure clearance between reinforcing bars and sides of drilled pier.

D. Ensure reinforcement will remain in place throughout concrete placement and that specified concrete cover is attained and maintained.

E. Rest cage on base of drilled pier or as shown.

3.07 CONCRETE PLACEMENT

A. Place concrete continuously in one pour to top elevation using a hopper with a spout that directs concrete down middle of pier. Extend rigid pipe spout from hopper to beyond bottom of reinforcement steel cage to direct concrete down pier center to prevent concrete from hitting sides of excavation.

B. Adjust rigid pipe spout length as pier is being filled such that maximum drop from bottom of rigid pipe to fresh concrete surface is no greater than 10 feet.

C. Vibrate concrete within top 10 feet of drilled piers with mechanical tools as specified in Section 03301, Reinforced Concrete.

D. Excess Concrete: Remove accumulation at top of pier so pier has a uniform diameter throughout.

E. Tremie Methods: If placement of concrete beneath surface of water or bentonite slurry are used:

1. Keep tremie pipe as near as possible to the bottom of excavation, equip with weight as necessary.
2. Prevent water intrusion into tremie pipe.
3. Equip tremie pipe with a bottom plate or floating plug. Vent as necessary to prevent formation of air pockets.
4. Keep discharge end entirely immersed in concrete at all times.
5. Support tremie pipe so that it can be raised to increase discharge rate or lowered to decrease discharge rate.
6. Provide continuous flow of concrete in order for concrete in tremie pipe to maintain a positive pressure differential at all times to prevent slurry intrusion into the pier concrete.

F. After concrete has attained an initial set as evidenced by absence of bleed water, place a suitable cover that prevents drying of top or contamination with foreign material. A curing compound may be used.

3.08 TEMPORARY CASING REMOVAL

A. Withdraw during concrete placement while concrete is still fluid and plastic, and before initial set.

B. Maintain minimum 5-foot head of concrete on bottom of temporary casing at all times.

C. Take every precaution to prevent caving pier while concrete is being placed.

D. Prevent arching of concrete as casing is removed.

3.09 TOLERANCES

A. Ground surface at time of drilled pier construction shall be at pier top elevation, plus or minus 0.1 foot.

B. Pier Centroid: Not more than 3 inches from design position.

C. Pier Out-of-Plumb: Not to exceed 2 percent of pier length for vertical piers.

D. Concrete Cutoff Elevation: Not to exceed plus 1 inch to minus 3 inches.

3.10 WASTE DISPOSAL

A. Remove spoil from Site and dispose of as specified in Section 02315, Excavation.

3.11 FIELD QUALITY CONTROL

A. Do not start reinforcing steel or concrete placement until pier excavation has been successfully inspected and accepted by Geotechnical Engineer.

B. Daily Log and Record: Document for each drilled concrete pier showing as a minimum:

1. Pier number and location.
2. Model and type of drilling equipment.
3. Pier diameter.
4. Pier length, deviation, and plumbness.
5. Depth drilled.
6. Elevation of ground surface at start of drilling.
7. Top and bottom elevations of concrete.
8. Description of bearing stratum.
9. Water conditions encountered during drilling including estimated inflow, source, and elevation(s).

10. Bottom elevation, type, length, and diameter of casing used, if any.
11. Nature and location of obstructions encountered.
12. Any unusual occurrences during drilling.
13. Dewatering, if performed, and depth of water in pier, if any, when concrete is placed.
14. Theoretical and actual volume of concrete placed.
15. Date and time at start of drilling, completion of drilling, inspection, start of concrete placement, and completion of concrete placement.

END OF SECTION

SECTION 02533
MANHOLES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
   a. A36, Standard Specification for Carbon Structural Steel.
   b. A48, Standard Specification for Gray Iron Castings.
   c. A123, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   d. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   e. A240, Standard Specification for Heat-Resisting Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels.
   f. A536, Standard Specification for Ductile Iron Castings.
   g. A615/A615M, Standard Specification for Rail-Steel Deformed and Plain Bars for Concrete Reinforcement.
   h. B139, Standard Specification for Phosphor Bronze Rod, Bar, and Shapes.
   i. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   j. C387, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   k. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.
   l. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.
   m. C923, Standard Specification for Resilient Connectors Between Reinforced Concrete Manhole Structures, Pipes, and Laterals.
   n. D4101, Standard Specification for Propylene Plastic Injection and Extrusion Materials.
   o. F593, Standard Specification for Stainless Steel Bolts, Hex Cap Screws, and Studs.
   p. F594, Standard Specification for Stainless Steel Nuts.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Precast Manholes: Details of construction.
   b. Precast Base, Cones, and Top Slab Sections: Details of construction.

1.03 QUALITY ASSURANCE

A. Tolerances: Reject pitting or honeycomb greater than plus or minus 1/4 inch. Do not deviate from design dimensions more than the tolerances specified in ASTM C913.

PART 2 PRODUCTS

2.01 PRECAST MANHOLES

A. Riser Sections:

1. Minimum 48 inches in diameter.
2. Fabricate in accordance with ASTM C478.
3. Minimum Wall Thickness: 4 inches or 1/12 times inside diameter, whichever is greater.
4. Top and bottom shall be parallel.
5. Joints: Confined O-ring with rubber gaskets meeting ASTM C443.

B. Cone Sections:

1. Provide eccentric cones.
2. Same wall thickness and reinforcement as riser section.
3. *Top and bottom shall be parallel.*

C. Base Sections and Base Slab:

1. Base Sections: Base slab integral with sidewalls.
2. Fabricate in accordance with ASTM C478.

D. Manhole Extensions:

1. Concrete grade rings; maximum 6 inches high.
2. Fabricate in accordance with ASTM C478.

E. Preformed Plastic Gaskets:

1. Hamilton Kent of Nevada, Sparks, NV; Kent-Seal No. 2.
2. Henry Company, Houston, TX; Ram-Nek.

F. Steps:

1. Fabricate from minimum 1/2 inch Grade 60, steel bar meeting ASTM A615/615M.
2. Polypropylene encasement to conform to ASTM D4101.
3. Minimum Width: 13 inches, center-to-center of legs.
4. Embedment 3 1/2 inch minimum and 4 1/2 inch projection from face of concrete at point of embedment to center of step.
5. Cast in manhole sections by manufacturer.
6. Load Test: Capable of withstanding ASTM C478 vertical and horizontal load tests.

2.02 MANHOLE FRAMES AND COVER

A. Castings:

1. Tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects.
2. Cast Iron: ASTM A48 Class 30B.
3. Plane or grind bearing surfaces to ensure flat, true surfaces.

B. Cover: True and seat within ring at all points with the word STORM or SANITARY SEWER in 2-inch raised letters.

C. All frames and covers to be heavy duty suitable for H20 highway loading.

2.03 WATERTIGHT FRAME FASTENERS

A. Galvanize after fabrication in conformance with ASTM A123.

2.04 MORTAR

A. Standard premixed in accordance with ASTM C387, or proportion one part portland cement to two parts clean, well-graded sand that will pass a 1/8-inch screen.

B. Admixtures: May be included but do not exceed the following percentages of weight of cement:

1. Hydrated Lime: 10 percent.
2. Diatomaceous Earth or Other Inert Material: 5 percent.

C. Mix Consistency:

1. Tongue-and-Groove Type Joint: Such that mortar will readily adhere to pipe.
2. Confined Groove (Keylock) Joint: Such that excess mortar will be forced out of groove and support is not provided for section being placed.

2.05 FLEXIBLE RUBBER BOOTS/CONNECTORS

A. Manufacturers:

1. "Kor-N-Seal" flexible rubber boot with stainless steel accessories as manufactured by NPC, Inc., Milford, New Hampshire or equal.
2. "Z-LOK XP" or "A-LOK" flexible connectors as manufactured by A-LOK Products, Inc., Tullytown, PA or equal.

PART 3 EXECUTION

3.01 GENERAL

A. Remove and keep all water clear from the excavation during construction and testing operations.

B. Place imported pipe base material on undisturbed earth; thoroughly compact with a mechanical vibrating or power tamper.

3.02 EXCAVATION AND BACKFILL

A. Excavation: As specified in Section 02315, Excavation.

B. Backfill: As specified in Section 02320, Trench Backfill.

3.03 INSTALLATION OF PRECAST MANHOLES

A. Concrete Base:

1. Cast-in-Place:
   a. Vibrate to densify concrete and screed so first precast manhole section to be placed has a level, uniform bearing for full circumference.
   b. Deposit sufficient mortar on base to assure watertight seal between base and manhole wall, or place first precast section of manhole in concrete base before concrete has set. Properly locate and plumb first section.

2. Precast:
   a. Place on compacted sand or granular fill (mat)
   b. Properly locate, ensure firm bearing throughout, and plumb first section.

B. Sections:

1. Carefully inspect precast manhole sections to be joined.
2. Thoroughly clean ends of sections to be joined.
3. Do not use sections with chips or cracks in the tongue.
4. Locate precast steps in line with each other to provide a continuous vertical ladder.

C. Preformed Plastic Gaskets:

1. Use only pipe primer furnished by gasket manufacturer.
2. Install gasket material in accordance with manufacturer's instructions.
3. Completed Manholes shall be rigid and watertight.

D. Rubber Gasketed Joints: Install in accordance with manufacturer's instructions.

E. Extensions:

1. Use precast concrete grade rings, same quality as manhole.
2. Provide on manholes in streets or other locations where a subsequent change in existing grade may be likely.
3. Install to height not exceeding 12 inches.
4. Lay grade rings in mortar with sides plumb and tops level.
5. Seal joints with mortar as specified for sections, and make watertight.

3.04 MANHOLE INVERT

A. Construct with smooth transitions to ensure an unobstructed flow through manhole. Remove sharp edges or rough sections that tend to obstruct flow.

B. Where full section of pipe is laid through manhole, break out top section as shown and cover exposed edge of pipe completely with mortar. Trowel mortar surfaces smooth.

3.05 MANHOLE FRAMES AND COVERS

A. Set frames in bed of mortar with mortar carried over flange as shown.

B. Set tops of covers flush with surface of adjoining pavement or ground surface, unless otherwise shown or directed.

3.06 MANHOLE PIPING

A. Drop Assembly:

1. Extend pipe from the drop to a minimum of 3 feet beyond the manhole excavation into the trench, and connect to sewer pipe with an adapter.
2. Support lower drop elbow with concrete monolithically-placed with manhole base.

3.07 MANHOLES OVER EXISTING PIPING

A. Maintain flow through existing pipelines at all times.

B. Plastic Pipe:

1. Use solvent recommended by pipe manufacturer to slightly soften the pipe wall.
2. Apply a dense coating of clean mortar sand over all areas that will be in contact with concrete.
3. Allow mortar to dry completely prior to placing concrete.

C. Concrete Pipe: Apply a bonding agent on all surfaces to be in contact with concrete.

D. Construct base under existing piping.

E. Construct manhole as specified.

F. Break out existing pipe within new manhole, cover edges with mortar, and trowel smooth.

3.08 CONNECTIONS TO EXISTING MANHOLES

A. Break out existing manhole bases or grouting as necessary.

B. Clean all surfaces and apply a bonding agent.

C. Regrout to provide smooth flow into and through manholes.

D. Provide diversion facilities and perform work necessary to maintain flow during connection.

3.09 CLEANING AND INSPECTION

A. Obtain approval 48 hours before beginning cleaning.

B. Verify pipes are true to line and grade.

C. Inspect drainage structures and flow channels.

D. Clean pipes and manholes of debris, dirt, and foreign matter.

E. Correct lines not meeting requirements.

3.10 TESTING – SANITARY SEWER ONLY

A. Manhole Vacuum Testing:

1. Test manholes immediately after assembly and prior to backfilling.
2. Place grout in horizontal joints before testing.
3. Plug pipes entering manhole and securely brace to prevent plugs being drawn into manhole.
4. Place vacuum testing device at top of cone section and seal in accordance with manufacturer's recommendations.
5. Induce vacuum of 10 inches of mercury and turn off vacuum pump. Close valves and record time measured for vacuum to drop to 9 inches. Test is successful if time is greater than 60 seconds for a 48 inch diameter manhole, 75 seconds for 60 inch, and 90 seconds for 72 inch.
6. Make necessary repairs with non shrink grout while under vacuum, if initial test fails. Proceed with retesting and necessary repairs until satisfactory test is obtained.
7. Grout manhole joints inside and outside after passing vacuum test.
8. Remove plugs and bracing after approval.

END OF SECTION

SECTION 02631
CATCH BASINS AND INLETS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. American Welding Society (AWS): Code for Welding in Building Construction.
2. ASTM International (ASTM):
   a. A36/A36M, Standard Specification for Carbon Structural Steel.
   b. A48, Standard Specification for Gray Iron Castings.
   c. A615/A615M, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   d. C94/C94M, Standard Specification for Ready-Mixed Concrete.
   e. C387, Standard Specification for Packaged, Dry, Combined Materials for Mortar and Concrete.
   f. C478, Standard Specification for Precast Reinforced Concrete Manhole Sections.

PART 2 PRODUCTS

2.01 PRECAST UNITS

A. Precast units shall conform to ASTM C478. Concrete risers for extensions shall be a maximum of 6 inches high and of same quality as sections.

2.02 MORTAR

A. Standard premixed mortar conforming to ASTM C387, Type S, or proportion 1 part portland cement to 2 parts clean, well-graded sand which will pass a 1/8-inch screen. Admixtures may be used not exceeding the following percentages of weight of cement: Hydrated lime, 10 percent; diatomaceous earth or other inert materials, 5 percent. Consistency of mortar shall be such that it will readily adhere to concrete.

2.03 FRAMES AND GRATINGS

A. Cast iron frames and gratings for catch basins and storm drain inlets shall be as indicated. Bearing surfaces shall be clean and shall provide uniform contact. Castings shall be tough, close-grained gray iron, sound, smooth, clean, free from blisters, blowholes, shrinkage, cold shuts, and defects, and shall conform to ASTM A48, Class 30.

PART 3 EXECUTION

3.01 EXCAVATION AND BACKFILL

A. Excavate as required to accomplish construction. Backfill shall be as specified for adjoining pipe trench.

3.02 PLACING PRECAST UNITS

A. If material in bottom of trench is unsuitable for supporting unit, excavate and backfill to required grade with 3-inch minus, clean, pit-run material. Set units to grade at locations shown.

3.03 EXTENSIONS

A. Install extensions to height determined in field. Lay risers in mortar with sides plumb and tops to grade. Joints shall be sealed with mortar, with interior and exterior troweled smooth. Prevent mortar from drying out and cure by applying a curing compound. Extensions shall be watertight.

3.04 INSTALLATION OF FRAMES AND GRATES

A. Set frames and grates at elevations indicated and as confirmed in field and in conformance with Drawings.

B. Frames may be cast in, or shall be set in mortar.

3.05 CLEANING

A. Upon completion, clean each structure of all silt, debris, and foreign matter.

END OF SECTION

SECTION 02632
STORM DRAIN, SANITARY SEWER, AND DRAINAGE PIPING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section and any supplemental Data Sheets:

1. American Association of State Highway and Transportation Officials (AASHTO):
   a. M36M, Standard Specification for Corrugated Steel Pipe, Metallic-Coated, for Sewers and Drains.
   b. M190M, Standard Specification for Bituminous Coated Corrugated Metal Culvert Pipe and Pipe Arches.
   c. M196M, Standard Specification for Corrugated Aluminum Pipe for Sewers and Drains.
2. American Water Works Association (AWWA):
   a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   b. C105/A21.5, Polyethylene Encasement for Ductile-Iron Pipe Systems.
   c. C110/A21.10, Ductile-Iron and Gray-Iron Fittings, 3 in. Through 48 in. (75 mm Through 1200 mm) for Water and Other Liquids.
   d. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   e. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
3. ASTM International (ASTM):
   a. A746, Standard Specification for Ductile Iron Gravity Sewer Pipe.
   b. C14, Standard Specification for Concrete Sewer, Storm Drain, and Culvert Pipe.
   c. C76, Standard Specification for Reinforced Concrete Culvert, Storm Drain, and Sewer Pipe.
   d. C150, Standard Specification for Portland Cement.
   e. C311, Standard Test Methods for Sampling and Testing Fly Ash or Natural Pozzolans for Use as a Mineral Admixture in Portland-Cement Concrete.
   f. C361, Standard Specification for Reinforced Concrete Low-Head Pressure Pipe.
   g. C425, Standard Specification for Compression Joints for Vitrified Clay Pipe and Fittings.
   h. C443, Standard Specification for Joints for Circular Concrete Sewer and Culvert Pipe, Using Rubber Gaskets.

i. C497, Standard Test Methods for Concrete Pipe, Manhole Sections, or Tile.
j. C507, Standard Specification for Reinforced Concrete Elliptical Culvert, Storm Drain, and Sewer Pipe.
k. C595, Standard Specification for Blended Hydraulic Cements.
l. C618, Standard Specification for Coal Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Concrete.
m. C655, Standard Specification for Reinforced Concrete D-Load Culvert, Storm Drain, and Sewer Pipe.
n. C700, Standard Specification for Vitrified Clay Pipe, Extra Strength, Standard Strength, and Perforated.
o. C1012, Standard Test Method for Length Change of Hydraulic-Cement Mortars Exposed to a Sulfate Solution.
p. D1248, Standard Specification for Polyethylene Plastics Extrusion Materials for Wire and Cable.
q. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
r. D2412, Standard Test Method for Determination of External Loading Characteristics of Plastic Pipe by Parallel-Plate Loading.
s. D3034, Standard Specification for Type PSM Poly(Vinyl Chloride) (PVC) Sewer Pipe and Fittings.
t. D3212, Standard Specification for Joints for Drain and Sewer Plastic Pipes Using Flexible Elastomeric Seals.
u. F477, Standard Specification for Elastomeric Seals (Gaskets) for Joining Plastic Pipe.
v. F679, Standard Specification for Poly(Vinyl Chloride) (PVC) Large-Diameter Plastic Gravity Sewer Pipe and Fittings.
w. F794, Standard Specification for Poly(Vinyl Chloride) (PVC) Profile Gravity Sewer Pipe and Fittings Based on Controlled Inside Diameter.
x. F894, Standard Specification for Polyethylene (PE) Large Diameter Profile Wall Sewer and Drain Pipe.

PART 2 PRODUCTS

2.01 PIPE AND FITTINGS

A. As specified in the Data Sheets following "End of Section."

2.02 PIPING

A. Pipe and fittings for individual service connection shall be of one type of material throughout.

B. Reinforced concrete, ductile iron, polyvinyl chloride pipe.

PART 3 EXECUTION

3.01 INSTALLATION OF PIPE, FITTINGS, AND APPURTENANCES

A. General:

1. Pipe laying shall proceed upgrade with spigot ends pointing in direction of flow.
2. Excavate bell holes at each joint to permit correct assembly and inspection of entire joint.
3. Pipe bedding shall form continuous and uniform bearing and support for pipe barrel between joints. Pipe shall not rest directly on bell or pipe joint.
4. Prevent entry of foreign material into gasketed joints.
5. Plug or close off pipes that are stubbed off for manhole, concrete structure, or for connection by others, with temporary watertight plugs.

B. Ductile Iron Pipe Corrosion Protection:

1. Remove foreign material from the exterior of the pipe.
2. Wrap pipe with polyethylene encasement tube 2 feet longer than the pipe section prior to laying pipe section
3. After assembling the pipe joint, overlap encasement tube with adjacent tube and seal joints with securing tape.
4. Provide additional securing tape at 3-foot intervals along the pipe.
5. Repair rips, punctures, or other damage to the polyethylene with securing tape.
6. Fittings may be wrapped with a flat sheet or split tube provided all seams are securely taped.

3.02 PRESSURE TESTING – SANITARY SEWER ONLY

A. Piping Low-Pressure Air Test:

1. Perform test in accordance with ASTM C828.
2. Sustain a 4.0 psi pressure for 8 minutes with no loss of pressure exceeding 0.5 psi.
3. Follow safety precautions noted below:
   a. No one allowed in manhole during test.
   b. Install plugs securely.
   c. Brace plugs.
   d. Do not over pressurize pipe.

B. Piping Deflection Testing:

1. Test at least 50 percent of pipe at time and location directed.
2. Test pipe by "Go-No-Go" mandrel or a sewer ball permitting no greater than maximum 7-1/2 percent deflection.
3. Remove and replace pipe not passing the 7 1/2 percent deflection limitation test.
4. Test 100 percent of pipe when deflections are noted.

3.03 REPAIR AND RETESTING

A. Sections of pipe not meeting the pressure test requirements shall be replaced.

B. Following repairs, sections shall be retested as specified.

3.04 SEWER CLEANING

A. Prior to final acceptance and final manhole-to-manhole inspection of the sewer system by Engineer, flush and clean all parts of the system. Remove all accumulated construction debris, rocks, gravel, sand, silt, and other foreign material from the sewer system at or near the closest downstream manhole.

B. Upon Engineer's final manhole-to-manhole inspection of the sewer system, if any foreign matter is still present in the system, reflush and clean the sections and portions of the lines as required.

3.05 SUPPLEMENTS

A. Data Sheets:

Number	Title
-02	Ductile Iron
-03	Polyvinyl Chloride (PVC)
-05	Reinforced Concrete

END OF SECTION

SECTION 02632-02 DUCTILE IRON	
Item	**Description**
Pipe	Material: ASTM A746 or ANSI/AWWA C151/A21.51. Centrifugally cast, Grade 60-42-10 iron.
Interior Lining	Cement-Mortar: ANSI/AWWA C104/A21.4, except cement shall conform to ASTM C150, Type II, with seal coat.
Fittings	ANSI/AWWA C110/A21.10.
Joints	Rubber Gasketed Push-On: ANSI/AWWA C111/A21.11 with lubricant as approved by manufacturer.
Plugs	Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
Source Quality Control	In accordance with specified reference standard.

END OF SECTION

SECTION 02632-03 POLYVINYL CHLORIDE (PVC)	
Item	**Description**
Pipe: 15-inch diameter and under	ASTM D3034: Standard dimension ratio less than 35, except that the cell classification shall be 12454-B or 12454-C as defined in ASTM D1784.
Joints	ASTM D3212 rubber gasketed.
Gaskets	ASTM F477. Lubricants: As approved by manufacturer.
Fittings	PVC, gasketed. Provide plug when service piping is not required.
Plugs	Removable. Removal shall provide a socket suitable for making a flexible jointed lateral connection or extension.
Source Quality Control Testing	In accordance with specified ASTM.

END OF SECTION

SECTION 02632-05 REINFORCED CONCRETE	
Item	**Description**
Pipe	ASTM C76, Wall B, class as shown. Mark each joint with pipe class. Rotating packer or platform not allowed.
Cement	ASTM C150, Type II.
Ratio: Water to Cementitious Materials	Not over 0.49.
Fly Ash	ASTM C618, Class C or Class F, Tables 1 and 2 modified as follows: Loss on Ignition: Maximum 3 percent Water Requirement: Maximum 100 percent of control Ratio Percent CaO/Fe_2O_3: Maximum 1.5 or test cement fly ash mix in accordance with ASTM C1012. Mix: Equal to or better than ASTM C150, Type II cement. 85 pounds per cubic yard minimum, 160 pounds per cubic yard maximum. Test: ASTM C311 and ASTM C618.
Joints	ASTM C361. Captive gasket in groove.
Circumferential Reinforcement	Not closer than 1 inch to inside surface of pipe. Area of outer circular reinforcing cage not less than 75 percent of inner cage.
Elliptical Reinforcement	Not allowed.
Source Quality Control Testing	Load Bearing 0.01-inch Crack, Compressive Strength and Absorption: ASTM C76. Load Bearing Ultimate: ASTM C76. Permeability: ASTM C497. Voids: Longitudinally sawcut one pipe from each 100 lengths of pipe manufactured in half with saw that will not damage the concrete or reinforcing steel. Inspect for voids adjacent to circumferential bars. Voids will be considered continuous if a 1/16-inch diameter pin can be inserted 1/4 inch deep. If voids exist adjacent to more than 10 percent of the circumferential bars, two additional pipes shall be tested. If either of the two pipes fail, the entire 100 lengths will be rejected.

END OF SECTION

SECTION 02920
LAWNS AND GRASSES

PART 1 GENERAL

1.01 DEFINITIONS

A. Maintenance Period: Begin maintenance immediately after each area is planted (seed, sod, or sprig) and continue for a period of 8 weeks after all planting under this section is completed.

B. Satisfactory Stand: Grass or section of grass that has:

1. No bare spots larger than 6 square inches.

1.02 DELIVERY, STORAGE, AND PROTECTION

A. Seed:

1. Furnish in standard containers with seed name, lot number, net weight, percentages of purity, germination, and hard seed and maximum weed seed content, clearly marked for each container of seed.
2. Keep dry during storage.

B. Hydroseeding Mulch: Mark package of wood fiber mulch to show air dry weight.

1.03 WEATHER RESTRICTIONS

A. Perform Work under favorable weather and soil moisture conditions as determined by accepted local practice.

1.04 SEQUENCING AND SCHEDULING

A. Complete Work under this section within 10 days following completion of soil preparation.

B. Planting Season: Follow guide as outlined in Kentucky Department of Transportation (KYDOT) 212.

1.05 MAINTENANCE SERVICE

A. Contractor: Perform maintenance operations during maintenance period to include:

1. Watering: Keep surface moist.

2. Washouts: Repair by filling with topsoil, liming, fertilizing, seeding, and mulching.
3. Mulch: Replace wherever and whenever washed or blown away.
4. Mowing: Mow to 2 inches after grass height reaches 3 inches, and mow to maintain grass height from exceeding 3-1/2 inches.
5. Fences: Repair and maintain until satisfactory stand of grass is established.
6. Reseed unsatisfactory areas or portions thereof immediately at the end of the maintenance period if a satisfactory stand has not been produced.
7. Reseed/replant during next planting season if scheduled end of maintenance period falls after September 15.
8. Reseed/replant entire area if satisfactory stand does not develop by July 1 of the following year.

1.06 QUALITY ASSURANCE

A. Test Reports (if requested:

1. Topsoil: Refer to Part 3 for test frequency.
   a. pH.
   b. Soluble salts concentration.
   c. Organic content by weight.
   d. Nutrient content.

PART 2 PRODUCTS

2.01 FERTILIZER

A. Commercial, uniform in composition, free-flowing, suitable for application with equipment designed for that purpose. Minimum percentage of plant food by weight.

B. Application Rates: Determined by soil analysis results.

C. Mix:

1. Nitrogen: 10.
2. Phosphoric Acid: 10.
3. Potash: 10.

2.02 SEED

A. Fresh, clean new-crop seed that complies with the tolerance for purity and germination established by Official Seed Analysts of North America.

B. Seed Mix to be Type I or III per KYDOT 212.

Species	Proportion By Weight
Baron Kentucky Bluegrass	25%
Nassu Kentucky Bluegrass	25%
Ram J Kentucky Bluegrass	25%
Georgetown Kentucky Bluegrass	25%

2.03 HYDROSEEDING MULCH

A. Wood Cellulose Fiber Mulch:

1. Specially processed wood fiber containing no growth or germination inhibiting factors.
2. Dyed a suitable color to facilitate inspection of material placement.
3. Manufactured such that after addition and agitation in slurry tanks with water, the material fibers will become uniformly suspended to form homogenous slurry.
4. When hydraulically sprayed on ground, material will allow absorption and percolation of moisture.

2.04 TACKIFIER

A. Derived from natural organic plant sources containing no growth or germination-inhibiting materials.

1. Capable of hydrating in water, and to readily blend with other slurry materials.
2. Wood Cellulose Fiber: Add as tracer, at rate of 150 pounds per acre.
3. Manufacturers and Products:
   a. Chevron Asphalt Co.; CSS 1.
   b. Terra; Tack AR.
   c. J Tack; Reclamare.

2.05 TOPSOIL

A. General: ASTM D5268, friable and loamy (loam, sandy loam, silt loam, sandy clay loam, clay loam), non toxic. Free of debris, trash, stumps, rocks, roots, and noxious weeds, and give evidence of being able to support healthy vegetation.

1. Organic Matter Content: Not less than 5 percent by weight.
2. pH: 5.5 to 7.5 standard unit. Use lime to adjust if pH falls below 5.5.
3. Soluble Salts: Not exceeding 500 part per million (ppm).
4. Exclusions: Not obtained from bogs or marshes.

PART 3 EXECUTION

3.01 PREPARATION

A. Place over topsoil.

1. Topsoil:
   a. Modify topsoil to meet specified requirements. If material does not appear to meet specification, test each 2,000 cubic yards of top soil or 2 tests minimum from topsoil composite of 10 sample locations.
   b. Spread topsoil in accordance with Section 02316, Fill and Backfill.
   c. Distribute topsoil to minimum settled depth of 4 inches.
   d. Bond topsoil with subsoil.
   e. Pulverize fertilizer lumps before placing in distributor.
   f. Use mechanical seed drills or rotary hand spreaders to distribute fertilizer evenly.
   g. Spread half of fertilizer in one general direction and other half at right angles to first.
   h. Mix fertilizer with topsoil by tilling, plowing, disking, harrowing, or other approved operations.
2. Surface:
   a. Provide uniform surface free from debris, stone, roots, grade stakes, rills, rocks, clods, construction debris, washes, and depressions.
   b. Slopes equal to or steeper than 5 (horizontal) to 1 (vertical) to have small furrows left by disking, harrowing, raking, or seed-planting machinery operated on contour.
   c. Slopes flatter than 5 (horizontal) to 1 (vertical), lightly roughened to depth of 2 to 4 inches prior to seeding area.
   d. Complete Work immediately to reduce runoff velocity until stabilization takes place.

B. Grade areas to smooth, even surface with loose, uniformly fine texture.

1. Roll and rake, remove ridges, fill depressions to meet finish grades.
2. Limit such Work to areas to be planted within immediate future.
3. Remove debris, and stones larger than 1-1/2 inch diameter, and other objects that may interfere with planting and maintenance operations.

C. Moisten prepared areas before planting if soil is dry. Water thoroughly and allow surface to dry off before seeding. Do not create muddy soil.

D. Restore prepared areas to specified condition if eroded or otherwise disturbed after preparation and before planting.

3.02 FERTILIZER

A. Apply evenly over area in accordance with manufacturer's instructions. Mix into top 2 inches of topsoil.

B. Application Rate: 23 pounds per 1,000 square feet.

3.03 SEEDING

A. Start within 2 days of preparation completion.

B. Hydroseeding:

1. Seed Application Rate: 87 pounds per acre.
2. Apply on moist soil, only after free surface water has drained away.
3. Prevent drift and displacement of mixture into other areas.
4. Upon application, allow absorption and percolation of moisture into ground.
5. Mixtures: Seed and fertilizer may be mixed together, apply within 30 minutes of mixing to prevent fertilizer from burning seed.

C. Mulching: Apply uniform cover of wood fiber mulch at rate of 1,500 pounds per acre.

D. Water: Apply with fine spray after mulching to saturate top 4 inches of soil.

3.04 FIELD QUALITY CONTROL

A. 8 weeks after seeding is complete and on written notice from Contractor, Engineer will, within 15 days of receipt, determine if a satisfactory stand has been established.

B. If a satisfactory stand has not been established, Engineer will make another determination after written notice from Contractor following the next growing season.

3.05 PROTECTION

A. Protect from pedestrian traffic by erecting temporary fence around each newly seeded area.

END OF SECTION

SECTION 03301
REINFORCED CONCRETE

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI):
   a. 301, Specifications for Structural Concrete for Buildings.
   b. 306R, Cold Weather Concreting.
   c. 318/318R, Building Code Requirements for Structural Concrete and Commentary.
   d. 347, Formwork for Concrete.
2. ASTM International (ASTM):
   a. A497, Standard Specification for Steel Welded Wire Fabric, Deformed, for Concrete Reinforcement.
   b. A615, Standard Specification for Deformed and Plain Billet-Steel Bars for Concrete Reinforcement.
   c. C31, Standard Practice for Making and Curing Concrete Test Specimens in the Field.
   d. C39, Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   e. C94, Standard Specification for Ready-Mixed Concrete.
   f. C150, Standard Specification for Portland Cement.
   g. C260, Standard Specification for Air-Entraining Admixtures for Concrete.
   h. C309, Standard Specification for Liquid Membrane-Forming Compounds for Curing Concrete.
   i. C494, Standard Specification for Chemical Admixtures for Concrete.
   j. C618, Standard Specification for Fly Ash and Raw or Calcined Natural Pozzolan for Use as a Mineral Admixture in Portland Cement Concrete.
   k. D994, Standard Specification for Preformed Expansion Joint Filler for Concrete (Bituminous Type).
3. Concrete Reinforcing Steel Institute (CRSI):
   a. Manual of Standard Practice.
   b. Recommended Practice for Placing Reinforcing Bars.

1.02 SUBMITTALS

A. Action Submittals:

1. Reinforcing steel in accordance with CRSI Manual of Standard Practice.
2. Curing compound data.
3. Complete data on the concrete mix, including aggregate gradations and admixtures, in accordance with ASTM C94.

1.03 QUALITY ASSURANCE

A. Formwork: Unless otherwise specified, follow the recommendations of ACI 347.

B. Concrete and Reinforcement: Unless otherwise specified, meet the requirements of ACI 301 and ACI 318/318R.

C. Cold Weather Concreting: Conform to ACI 306R.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Do not place Concrete when the ambient temperature is below 40 degrees F or approaching 40 degrees F and air temperature less than 40 degrees F for the first 7 days, without special protection to keep Concrete above 40 degrees F.

B. Do not use curing compound where solvents in the curing compounds are prohibited by state or federal air quality laws. Use only water curing methods.

PART 2 PRODUCTS

2.01 CONCRETE

A. Ready-mixed meeting ASTM C94, Option A.

B. Portland Cement: ASTM C150, Type I.

C. Admixtures:

1. Air-Entraining: ASTM C260.
2. Water-Reducing: ASTM C494, Type A or Type D.
3. Superplasticizers: ASTM C494, Type F or Type G.
4. Fly Ash: ASTM C618, Class C or Class F.
5. Color Pigments: Inert mineral or metaloxide pigments, either natural or synthetic; resistant to lime and other alkalies.

D. Mix Design:

1. Minimum Allowable 28-day Compressive Field Strength: 3,000 psi foundation, 4,000 psi slabs, when cured and tested in accordance with ASTM C31 and ASTM C39.
2. Water-cement Ratio: 0.48, maximum.
3. Cement Content: 540 pounds per cubic yard, minimum.
4. Coarse Aggregate Size: 1 inch and smaller.
5. Slump Range: 3 inches to 5 inches.
6. Air Entrainment: Between 3 and 6 percent by volume. Use 4 percent minimum for concrete placed under requirements of cold weather concreting.
7. Water Reducers: Use in concrete without plasticizers.

E. Mixing: Minimum 70 and maximum 270 revolutions of mixing drum. Nonagitating equipment is not allowed.

2.02 REINFORCING STEEL

A. Deformed Bars: ASTM A615, Grade 60.

B. Welded Wire Fabric: ASTM A497.

2.03 ANCILLARY MATERIALS

A. Expansion Joint Filler: ASTM D994, 1/2-inch thick, or as shown.

B. Curing Compound:

1. Water-based, high solids content nonyellowing curing compound meeting requirements of ASTM C309 and ASTM C1315.
   a. Moisture Loss: 0.40 kg/square meter/72 hours maximum.
   b. Capable of meeting moisture retention at manufacturer's specified application rate.
2. Manufacturers and Products:
   a. Chemrex, Inc., Shakopee, MN; Masterkure.
   b. Euclid Chemical Co., Cleveland, OH; Super Diamond Clear VOX.
   c. WR Meadows, Inc., Hampshire, IL; VOCOMP-30.
   d. Vexcon Chemical, Inc.; Philadelphia, PA; Starseal 1315.
   e. Dayton Superior; Safe Cure and Seal 30%.

C. Clear Floor Hardener (Surface-Applied): Colorless, aqueous solution of zinc and magnesium fluosilicate with a minimum 2 pounds of crystals per gallon.

1. Manufacturers:
   a. Master Builders, Co., Cleveland, OH.
   b. Tamms Industries, Inc., Kirkland, IL.
   c. Sonneborn, Minneapolis, MN.

PART 3 EXECUTION

3.01 FORMWORK

A. Form Materials:

1. Use hard plastic finished plywood for exposed areas, and new shiplap or plywood for unexposed areas.
2. Earth cuts may be used for forming footings.

B. Form Ties:

1. Fixed conical or spherical type inserts that remain in contact with forming material and allow for dry packing of form tie holes.
2. Ties shall withstand pressures and limit deflection of forms to acceptable limits.
3. Wire ties are not acceptable.

C. Construction:

1. In accordance with ACI 347.
2. Make joints tight to prevent escape of mortar and to avoid formation of fins.
3. Brace as required to prevent distortion during concrete placement.
4. On exposed surfaces locate form ties in uniform pattern or as shown.
5. Construct so ties remain embedded in the wall with no metal within 1 inch of concrete surface when forms, inserts, and tie ends are removed.

D. Form Removal:

1. Remove after concrete has attained 28-day strength, or approval is obtained in writing from Engineer.
2. Remove forms with care to prevent scarring and damaging the surface.
3. Prior to form removal, provide thermal protection for concrete being placed under the requirements of cold weather concreting.

3.02 PLACING REINFORCING STEEL

A. Unless otherwise specified, place reinforcing steel in accordance with CRSI Recommended Practice for Placing Reinforcing Bars.

B. Splices and Laps:

1. Top Bars: Horizontal bars placed such that 12 inches of fresh concrete is cast below in single placement.
2. Horizontal wall bars are considered top bars.
3. Lap top bars 42 diameters or minimum 24 inches.
4. Lap all other bars 30 diameters or minimum 18 inches.
5. Tie splices with 18-gauge annealed wire as specified in CRSI Standard.

3.03 PLACING CONCRETE

A. Place concrete in accordance with ACI 301.

B. Prior to placing concrete, remove water from excavation and debris and foreign material from forms. Check reinforcing steel for proper placement and correct discrepancies.

C. Before depositing new concrete on old concrete, clean surface using sandblast or bushhammer or other mechanical means to obtain a 1/4-inch rough profile, and pour a cement-sand grout to minimum depth of 1/2 inch over surface. Proportion 1 part cement to 2.5 parts sand by weight.

D. Place concrete as soon as possible after leaving mixer, without segregation or loss of ingredients, without splashing forms or steel above, and in layers not over 2 feet deep. Place within 1-1/2 hours after adding cement to mix.

E. Eight feet maximum vertical drop to final placement, when not guided with chutes or other devices to prevent segregation due to impact with reinforcing.

3.04 COMPACTION

A. Vibrate concrete as follows:

1. Apply approved vibrator at points spaced not farther apart than vibrator's effective radius.
2. Apply close enough to forms to vibrate surface effectively but not damage form surfaces.
3. Vibrate until concrete becomes uniformly plastic.
4. Vibrator must penetrate fresh placed concrete and into previous layer of fresh concrete below.

3.05 CONSTRUCTION JOINTS

A. Locate as shown or as approved.

B. Maximum Spacing Between Construction Joints: 40 feet.

3.06 FINISHING

A. Floor Slabs and Tops of Walls:

1. Screed surfaces to true level planes.
2. After initial water has been absorbed, float with wood float and trowel with steel trowel to smooth finish free from trowel marks.
3. Do not absorb wet spots with neat cement.

B. Unexposed Slab Surfaces: Screed to true surface, bull float with wood float, and wood trowel to seal surface.

C. Tolerances: Floors shall not vary from level or true plane more than 1/4 inch in 10 feet when measured with a straightedge.

D. Exterior Slabs and Sidewalks:

1. Bull float with wood float, wood trowel, and lightly trowel with steel trowel.
2. Finish with broom to obtain nonskid surface.
3. Finish exposed edges with steel edging tool.
4. Mark walks transversely at 5-foot intervals with jointing tool.
5. Match existing control joints when abutting existing slabs.

3.07 FINISHING AND PATCHING FORMED SURFACES

A. Cut out honeycombed and defective areas.

B. Cut edges perpendicular to surface at least 1 inch deep. Do not feather edges. Soak area with water for 24 hours.

C. Finish surfaces to match adjacent concrete.

D. Keep patches damp for minimum 7 days or spray with curing compound to minimize shrinking.

E. Fill form tie holes with nonshrink grout.

3.08 PROTECTION AND CURING

A. Protect fresh concrete from direct rays of sunlight, drying winds, and wash by rain.

B. Cure formed surfaces with curing compound applied in accordance with manufacturer's directions as soon as forms are removed and finishing is completed.

C. Remove and replace concrete damaged by freezing.

3.09 FLOOR HARDENER

A. Use where noted or scheduled.

B. Follow manufacturer's application instructions.

3.10 FIELD TESTS

A. Evaluation of Concrete Field Strength: In accordance with ACI 318/318R.

END OF SECTION

SECTION 03600
GROUT

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C230, Standard Specification for Flow Table for Use in Tests of Hydraulic Cement.
   b. C1107, Standard Specification for Packaged Dry, Hydraulic-Cement Grout (Nonshrink).
2. Corps of Engineers (COE):
   a. CRD-C611, Flow of Grout for Preplaced Aggregate Concrete.
   b. CRD-C621, Specification for Nonshrink Grout

1.02 SUBMITTALS

A. Action Submittals:

1. Product data of grouts.

1.03 QUALIFICATIONS

A. Nonshrink Grout Manufacturer's Representative: Authorized and trained representative of grout manufacturer. Minimum of 1-year experience that has resulted in successful installation of grouts similar to those for this Project.

1.04 GUARANTEE

A. Manufacturer's guarantee shall not contain disclaimer on the product data sheet, grout bag, or container limiting responsibility to only the purchase price of products and materials furnished.

B. Manufacturer guarantees participation with Contractor in replacing or repairing grout found defective due to faulty materials, as determined by industry standard test methods.

PART 2 PRODUCTS

2.01 NONSHRINK GROUT SCHEDULE

A. Furnish nonshrink grout for applications in grout category in the following schedule:

Application	Temperature Range	Max. Placing Time	
	40 to 100 deg F	20 min	Greater than 20 min
Filling tie holes	I	I	I
Column baseplates single-story	I or II	--	II
Machine bases 25 hp or less	II	II	II

2.02 NONSHRINK GROUT

A. Category I:

1. Nonmetallic and nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Grout shall not bleed at maximum allowed water.
4. Minimum strength of flowable grout, 3,000 psi at 3 days, 5,000 psi at 7 days, and 7,000 psi at 28 days.
5. Manufacturers and Products:
   a. Chemrex, Inc., Shakopee, MN; Set Grout.
   b. Euclid Chemical Co., Cleveland, OH; NS Grout.
   c. Dayton Superior Corp., Miamisburg, OH; 1107 Advantage Grout.
   d. US MIX Products, Denver, CO; US Spec Multi-Purpose Grout.
   e. L & M Construction Chemicals, Inc., Omaha, NE; Duragrout.

B. Category II:

1. Nonmetallic, nongas-liberating.
2. Prepackaged natural aggregate grout requiring only the addition of water.
3. Aggregate shall show no segregation or settlement at fluid consistency at specified times or temperatures.
4. Minimum strength of fluid grout, 3,500 psi at 1 day, 4,500 psi at 3 days, and 7,500 psi at 28 days.
5. Maintain fluid consistency when mixed in 1 to 9 yard loads in ready-mix truck.
6. Manufacturers and Products:
   a. Chemrex, Inc., Shakopee, MN; Master Flow 928.
   b. Five Star Products Inc., Fairfield, CT; Five Star 100.

c. Euclid Chemical Co., Cleveland, OH; Hi Flow Grout.
d. Dayton Superior Corp., Miamisburg, OH; Sure Grip High Performance Grout.
e. L & M Construction Chemicals, Inc., Omaha, NE; Crystex.

PART 3 EXECUTION

3.01 NONSHRINK GROUT

A. General: Mix, place, and cure nonshrink grout in accordance with grout manufacturer's representative's training instructions.

B. Form Tie or Through-Bolt Holes: Provide nonshrink grout, Category I and II, fill space with dry pack dense grout hammered in with steel tool and hammer. Coordinate with bonding agent in Section 03301, Reinforced Concrete.

C. Grouting Machinery Foundations:

1. Block out original concrete or finish off at distance shown below bottom of machinery base with grout. Prepare concrete surface by sandblasting, chipping, or by mechanical means to remove any soft material.
2. Set machinery in position and wedge to elevation with steel wedges, or use cast-in leveling bolts.
3. Form with watertight forms at least 2 inches higher than bottom of plate.
4. Fill space between bottom of machinery base and original concrete in accordance with manufacturer's representative's training instructions.

END OF SECTION

SECTION 04230
REINFORCED UNIT MASONRY

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Concrete Institute (ACI): 530.1/ASCE 6/TMS 602, Building Code Requirements for Masonry Structures and Specifications for Masonry Structures and Related Commentaries.
2. ASTM International (ASTM):
   a. A82, Standard Specification for Steel Wire, Plain, for Concrete Reinforcement.
   b. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   c. C33, Standard Specification for Concrete Aggregates.
   d. C90, Standard Specification for Loadbearing Concrete Masonry Units.
   e. C140, Standard Test Methods for Sampling and Testing Concrete Masonry Units and Related Units.
   f. C144, Standard Specification for Aggregate for Masonry Mortar.
   g. C150, Standard Specification for Portland Cement.
   h. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
   i. C216, Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
   j. C270, Standard Specification for Mortar for Unit Masonry.
   k. C404, Standard Specification for Aggregates for Masonry Grout.
   l. C476, Standard Specification for Grout for Masonry.
   m. C652, Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale).
   n. C744, Standard Specification for Prefaced Concrete and Calcium Silicate Masonry Units.
   o. C1314, Standard Test Method for Compressive Strength of Masonry Prisms.
   p. E514, Standard Test Method for Water Penetration and Leakage through Masonry.
3. Brick Institute of America (BIA).
4. International Code Council (ICC):
   a. Kentucky Building Code (KBC), Chapter 21.
   b. ICC Evaluation Service (ICC-ES) Reports.
5. National Concrete Masonry Association (NCMA).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Information illustrating horizontal joint reinforcement and preformed control joint materials proposed.
   b. Grout mix proposed.
   c. Mortar mix proposed.
2. Samples:
   a. One of each type of masonry unit to be used on Project.
   b. Two each; brick units for selection of color and texture.

B. Informational Submittals:

1. Method of placing grout.
2. Certified field test results within 5 days of performing specified tests.
3. Statement of acknowledgement of Quality Assurance Plan in accordance with KBC Section 1705.3
4. Method and materials for removal of efflorescence.

1.03 QUALITY ASSURANCE

A. Mockups:

1. Lay up Sample panel for each type of masonry at Site.
2. Dimensions: Minimum 4 feet high by 4 feet long.
3. Leave intact after approval until acceptance of permanent masonry work and then remove. May be part of permanent construction.
4. Approved panels shall serve as basis of color, texture, bond, quality of finished joints, and for acceptance of permanent construction.
5. Demonstrate ability to keep insulation and grout isolated and in certain cells during any sequence of placement, and to demonstrate materials will be restricted to cells and bond beams intended to receive each material.
6. Construction shall show areas required to receive mortar, including webs on each side of each cell to prevent insulation from entering cells to receive grout or to prevent grout from entering cells to receive insulation.
7. Where bond beams are to be used, demonstrate proper placement of both insulation and grout to bond beam level, and proper placement of bond beam prior to placement of insulation and grout above bond beam level.
8. Demonstrate proper use of running bond or stacked bond.

B. Efflorescence: Protect masonry construction to prevent efflorescence. Provide measures to prevent moisture from entering incomplete walls. Remove all efflorescence prior to applying water repellents.

C. Comply with the requirements and criteria of the National Concrete Masonry Association (NCMA), Brick Institute of America (BIA), ASTM C90, ASTM C216, and ACI 530.1 for masonry finish and appearance, dimension tolerances, tolerances of construction, joint tolerances, and wall plumb tolerances.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection: Keep lime and other ingredients dry.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Do not lay masonry when ambient temperature is below 32 degrees F on a rising temperature, or below 40 degrees F on a falling temperature, or when there is a probability of such conditions occurring within 48 hours, unless written approval of procedures for protection from freezing is obtained from Engineer.

B. Moisture Protection: Protect masonry construction from loss of moisture during curing period of 7 days when ambient air temperature is 90 degrees F or greater and when relative humidity is less than 50 percent.

PART 2 PRODUCTS

2.01 COMPRESSIVE STRENGTH OF MASONRY

A. Minimum 28-Day Compressive Field Strength (f'm) of Completed Assemblage: 1,500 psi.

2.02 MASONRY UNITS

A. General:

1. Furnish or cut special shapes for corners, jambs, lintels, and other areas shown or required.
2. Special units shall match color and texture of standard units.
3. Where units are placed so end of unit is exposed, such as at a corner or intersection, exposed end of that block shall have surface to match color and texture of sides of other units.
4. Furnish sound, dry, clean units free of cracks, prior to placing in structure.
5. Vertical Cells to be Grouted: Capable of alignment sufficient to maintain clear, unobstructed continuous vertical cell dimensions in accordance with ACI 530.1, Table 7.
6. Masonry unit size and shape shall allow for all placement patterns to prevent materials, such as grout or poured insulation, from escaping from cell being filled to adjacent cells where material is not intended to be placed.

B. Concrete Masonry Units (CMU):

1. ASTM C90: Lightweight.
2. Water Repellent Admixture:
   a. Structural concrete masonry units in weather exposed exterior wall shall be manufactured with integral liquid polymeric admixture to provide resistance to water penetration.
   b. Manufacturer and Product: W.R. Grace & Co.; Dry-Block Block Admixture.
3. Nominal Size: 16 inches long by 8 inches high by thickness shown on Drawings.
4. Compressive Strength: 1,900 psi minimum, in accordance with ASTM C90, Table 2.
5. Color of Units: Natural.
6. Surface Texture on Exposed Surfaces: Smooth.
7. Surface Texture: Smooth on interior, concealed exterior, and surface 1 foot below finished grade.

2.03 MORTAR AND GROUT MATERIALS

A. Cement: ASTM C150, Type I, portland cement.

B. Lime: ASTM C207, Type S hydrated.

C. Aggregates:

1. Mortar: ASTM C144, sand.
2. Grout: ASTM C404.

D. Water: Fresh, clean, and potable.

2.04 REINFORCEMENT

A. Horizontal Joint Reinforcement:

1. Two parallel, ASTM A82, No. 9 wires, galvanized in accordance with ASTM A153/A153M, weld connected to No. 9 perpendicular cross wire at 16 inches, maximum, on center.
2. Reinforcement: Clean and free from loose rust, scale, and coatings that reduce bond.
3. Furnish special manufactured corner and wall intersection pieces.
4. Manufacturer: Dur-O-Wal, Inc., Aurora, IL.

B. Deformed Bars: As specified in Section 03301, Reinforced Concrete.

2.05 PREFORMED CONTROL JOINTS

A. Solid rubber cross-shape extrusions as manufactured by:

1. Dur-O-Wal, Inc., Aurora, IL; Regular Rapid Control Joint.
2. Sonneborn-Contech Co., Oakland, CA; Sonneborn Control Joint.
3. Hohmann and Barnard, Inc; #RS-Standard.

2.06 MORTAR MIXES

A. Minimum Average Mortar 28-day Compressive Strength: 1,800 psi.

B. Proportions:

1. In accordance with ASTM C270, Type S.

C. Mixing:

1. Machine mix in approved mixers.
2. Keep mixer drums clean and free of debris and dried mortar.
3. Mix by placing 1/2 water and 1/2 aggregate in operating mixer.
4. Add cement.
5. Add remaining aggregate and water and mix for at least 2 minutes.
6. Add lime and continue mixing as long as needed to secure a uniform mass, but no less than 3 minutes after addition of lime.
7. Time addition of admixture in accordance with manufacturer's instructions. Procedure used for adding it to mix shall provide good dispersion.
8. Follow manufacturer's instructions for mortar plasticizer admixture.
9. Follow manufacturer's instructions for water repellent admixture.
10. Review compatibility with other mortar admixture.

2.07 GROUT MIXES

A. Proportions: Conform to ASTM C476 for coarse grout and as follows:

1. Compressive Strength: Minimum 2,000 psi at 28 days.
2. For Pouring:
   a. Fluid consistency (suitable for pouring without segregation) meeting requirements of ASTM C476.
   b. Conform to KBC Table 2103.10, except as noted.
3. For Pumping: Fluid consistency with minimum seven sacks of cement in each cubic yard.

B. Mixing:

1. Onsite: Follow procedure specified in Article Mortar Production.
2. Transit-Mixed Grout: Meet requirements of ASTM C476.

3. Add approved grout expansion admixture in accordance with manufacturer's recommendations. Premix admixture with water and add resulting solution to grout mix and thoroughly mix. Do not exceed quantity of admixture recommended by manufacturer.

2.08 WATER REPELLENT MASONRY SEALER

A. Characteristics:

1. Water-based blend of silanes and siloxanes.
2. VOC compliant.
3. 12 percent solids/active content by weight, with density of 8.2 pounds per gallon.

B. Manufacturer and Product: W. R. Grace & Co.; Infiniseal DB Sealer.

PART 3 EXECUTION

3.01 PREPARATION

A. Prepare surface contact area of foundation concrete for initial mortar placement by one of following methods:

1. Sandblasting foundation and reinforcing dowels after concrete has fully cured to remove laitance and spillage and to expose sound aggregate.
2. Water blasting foundation and reinforcing dowels after concrete has partially cured to remove laitance and spillage and to expose sound aggregate.
3. Green cutting fresh concrete with high pressure water and hand tools to remove laitance and spillage from foundation and reinforcing dowels and to expose sound aggregate.

B. Clean surfaces of loose material prior to initial mortar placement.

C. Prevent surface damage to foundation concrete that will be exposed to view outside of contact area.

3.02 LAYING MASONRY UNITS

A. General:

1. Conform to building code applicable to this Project and as supplemented by these Specifications.
2. Do not start laying masonry units unless foundation wall is plumb within 1/4 inch in 10 feet or not straight within 5/16 inch in 10 feet.
3. Finish Tolerances (Measured on Interior Surfaces):

a. Maximum permissible variation from plumb of masonry wall or of line of joints in masonry wall: 1/16 inch per foot of height and 1/4 inch in total height of wall.
b. Maximum permissible variation from horizontal line along base of wall or for lines of horizontal joints: 1/16 inch per block and 1/4 inch per 50 feet of wall with proportionately greater tolerance for longer walls up to 1/2 inch in total length of wall.

4. Place units with chipped edges or corners such that chipped area is not exposed to view.

B. Wall Units:

1. General:
   a. If necessary to move a unit after once set in-place, remove from wall, clean, and set in fresh mortar.
   b. Toothing of masonry units is not permitted.
2. Running Bond:
   a. Unless otherwise shown, lay up walls in straight, level, and uniform courses using a running bond pattern.
   b. Place units for continuous vertical cells and mortar joints to prevent materials, such as grout or poured insulation, from escaping from cell being filled to adjacent cells where material is not intended to be placed.

C. Special Shapes:

1. Provide and place such special units as corner block, doorjamb block, lintel block fillers, and similar blocks as may be required.
2. Use required shapes and sizes to work to corners and openings, maintaining proper bond throughout wall.

3.03 BUILT-IN ITEMS

A. Position door frames, windows, vents, louvers, and other items to be built in wall, and construct wall around them.

B. Install masonry anchors to secure items to wall.

C. Fill spaces around items with mortar or grout.

D. Do not place electrical, instrumentation, or water conduits in a cell containing reinforcement, unless approved in writing by Engineer.

3.04 MORTAR JOINTS

A. General:

1. Straight, clean, with uniform thickness of 3/8 inch.

2. Horizontal and vertical mortar joints shall have full mortar coverage on face shells.
3. Vertical Head Joints:
   a. Butter well on each unit for a width equal to face shell of unit, shove tightly so mortar bonds well to both units.
   b. Solidly fill joints from face of block to at least depth of face shell.
4. As units are laid, remove excess mortar from grout space of cells to be filled.
5. Place mortar before initial setting of cement takes place. Do not retemper mortar that has started to set or is not used within one hour. Retempering of colored mortar is not allowed.
6. Remove mortar containing water repellent admixture from face of masonry, before it sets.

B. Exposed Joints:

1. Tool joints exposed to view after final construction, unless otherwise noted or shown.
2. Cut joints flush and as mortar takes its initial set tool to provide a concave joint.
3. Perform tooling when mortar is partially set but still sufficiently plastic to bond.
4. Perform tooling with tool that compacts mortar, pressing excess mortar out rather than dragging it out.
5. Rake out joints that are not tight at time of tooling, point, and then tool.
6. Rake and tool joints at split-face surfaces, interior and exterior.

C. Concealed Joints: Strike flush with no further treatment required.

3.05 CONTROL JOINTS

A. Preformed Control Joints:

1. Omit mortar from vertical joints.
2. Place rubber control joint material as wall is built.
3. After wall is grouted, cured, and cleaned, install backing rod and sealant as specified in Section 07900, Joint Sealants.
4. Place and tool sealant to match depth of typical joint.

3.06 REINFORCING

A. Foundation Dowels:

1. Size, number, and location of foundation dowels shall match vertical wall reinforcing, unless otherwise noted.
2. When foundation dowel does not line up as intended, with vertical core, do not slope more than 1 horizontal to 6 vertical to bring it into alignment.

B. Vertical Reinforcing:

1. Use deformed bars.
2. Hold in position near the ends of bars by wire ties to dowels or by reinforcing positioners.
3. Hold in position at maximum intervals of 160 bar diameters by reinforcing positioners.

C. Horizontal Joint Reinforcement:

1. Space maximum 16 inches apart, vertically.
2. Lap ends 6 inches minimum.
3. At control joints make reinforcement discontinuous.
4. Use manufactured corner and other wall intersection pieces.

3.07 GROUTING

A. General:

1. Do not mix, convey, or place with equipment constructed of aluminum.
2. Secure vertical and horizontal reinforcement, ties, bolts, anchors, and other required embedments in place; inspect and verify before placing grout.
3. Grout beams over openings in one continuous operation.
4. Maintain vertical alignment in ACI 530.1, Table 7.
5. Place grout as soon as possible after mortar has set to reduce shrinkage cracking of vertical joints.
6. Vertical Reinforcement:
   a. First wire tie to foundation dowels, then build wall around it.
   b. Provide reinforcing positioners or approved cross bracing to secure top of steel in place.
   c. Do not drop in vertical steel after block is laid, unless reinforcing positioners are provided in the course above previously grouted course.

B. Grouting Requirements:

1. Do not start grouting until wall has cured for 24 hours, minimum.
2. Partial Grouting Requirements:
   a. Walls Not Requiring Solid Grouting: Fill cells containing reinforcing steel, anchor bolts, and other embedded items as shown with grout.
   b. Construct cells to be filled to confine grout within cell.
   c. Cover tops of unfilled vertical cells under a bond beam with metal lath to confine grout fill to bond beam section.
3. Form horizontal construction joints between pours by stopping grout pour 1-1/2 inches below a mortar joint, except at a bond beam; stop pour 1/2 inch below top of masonry unit.

4. Fully embed horizontal steel with grout in an uninterrupted pour.
5. Do not construct wall more than one course above top of grout pour prior to placing grout.
6. Vibration:
   a. Use internal "pencil" type, low energy vibrator to thoroughly consolidate grout and reduce amount of air voids. Do not use concrete vibrators.
   b. After waiting sufficient time to permit grout to become plastic, but before it has taken any set, reconsolidate grout.
   c. Waiting period will vary depending upon weather conditions and block absorption rates, but under "normal" weather conditions with average masonry units the waiting period should be between 30 to 60 minutes.
7. Cleanouts:
   a. Provide for grout pours over 5 feet in height.
   b. Provide of sufficient size to permit cleaning of cell, positioning of reinforcing, and inspection at bottom of every vertical cell containing reinforcing.
   c. Location: Concealed from view after final construction, unless otherwise approved by Engineer.
   d. After wall has been inspected and approved and prior to grouting, cap cleanouts in a manner that will seal them from grout leakage and provide a flush finish.

3.08 WATER REPELLENT MASONRY SEALER

A. Apply to all weather exposed exterior concrete masonry walls.

B. Repoint loose, cracked, or disintegrating mortar at least 7 days prior to application. Ensure joint sealants and caulking are fully cured and wall surfaces are clean, dry, and free of chemical cleaners, efflorescence, dirt, oils, mortar smears, and other surface contaminants.

C. Follow manufacturer's recommendations for weather conditions during application.

D. Test a 5-foot by 5-foot wall area to assure proper coverage, desired water repellency properties, and desired surface appearance when sealer is fully dried.

E. Apply with spray, brush, or roller following manufacturer's recommendations, at a coverage rate of 50 to 150 square feet per gallon, as determined by testing. Use two coat application where recommended by manufacturer.

3.09 FIELD QUALITY CONTROL

A. Special Inspection of masonry in accordance with KBC Section 1704.5.

B. Masonry shall be tested by independent testing agency, retained by Contractor and approved by Engineer.

C. Masonry test prisms, when required, shall be constructed onsite with same materials and workmanship to be used for Project.

D. Provide adequate facilities for safe storage and proper curing of masonry prisms, mortar samples, and grout samples, as applicable, onsite for first 24 hours, and for additional time as may be required before transporting to test lab.

3.10 CLEANING

A. Immediately after completion of grouting, clean masonry surfaces of excess mortar, grout spillage, scum, stains, dirt, and other foreign substances using clean water and fiber brushes.

B. Clean walls not requiring painting or sealing so there are no visible stains.

3.11 PROTECTION OF INSTALLED WORK

A. Do not allow grout and mortar stains to dry on face of exposed masonry.

B. Protect tops of walls at all times. Cover tops of walls with waterproof paper when rain or snow is imminent and when the Work is discontinued.

C. Adequately brace walls until walls and roof are completed.

D. Provide sufficient bracing to protect walls against damage from elements, including wind and snow.

E. Protect masonry against freezing for minimum 72 hours after being laid.

F. Protect masonry from damage until final acceptance of the Work. Damaged units will not be accepted.

END OF SECTION

SECTION 04813
MASONRY VENEER

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. B370, Standard Specification for Copper Sheet and Strip for Building Construction.
   b. C91, Standard Specification for Masonry Cement.
   c. C126, Standard Specification for Ceramic Glazed Structural Clay Facing Tile, Facing Brick, and Solid Masonry Units.
   d. C144, Standard Specification for Aggregate for Masonry Mortar.
   e. C150, Standard Specification for Portland Cement.
   f. C207, Standard Specification for Hydrated Lime for Masonry Purposes.
   g. C216, Standard Specification for Facing Brick (Solid Masonry Units Made from Clay or Shale).
   h. C270, Standard Specification for Mortar for Unit Masonry.
   i. C404, Standard Specification for Aggregates for Masonry Grout.
   j. C476, Standard Specification for Grout for Masonry.
   k. C652, Standard Specification for Hollow Brick (Hollow Masonry Units Made from Clay or Shale).
   l. D1056, Standard Specification for Flexible Cellular Materials – Sponge or Expanded Rubber.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Mix designs for mortar and grout.
   b. Details for cast stone units and special brickshapes and assemblies.
2. Samples:
   a. Full-size units for each different exposed masonry unit required showing full range of exposed color, texture, and dimensions to be expected in completed construction. Match selected Samples at Engineer's office or listed in Finish Schedule.
      1) Include size variation data verifying that actual range of sizes for brick falls within ASTM C216 dimension tolerances for brick where modular dimensioning is indicated.

b. Stone trim Samples not less than 12 inches in length showing full range of colors and textures expected in finished construction.
c. Accessories embedded in the masonry.

1.03 QUALITY ASSURANCE

A. Regulatory Requirements: For masonry construction meet requirements of the Kentucky Building Code (KBC) and as supplemented by these Specifications.

B. Mockups: Lay up a Sample panel for each type of masonry at the Site to show the bond pattern and method of finishing joints. Make Sample panels 4 feet high and 4 feet long, and may be a part of the permanent construction. The acceptable Sample panel serves as a basis of color, texture, pattern, and workmanship for acceptance of the permanent construction.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Storage and Protection:

1. Store all masonry materials off ground and protected from precipitation.
2. Protect veneer materials from mud splatters and staining.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Temperature: Do not lay masonry when the ambient temperature is below 32 degrees F on a rising temperature or below 40 degrees F on a falling temperature, or when there is a probability of such conditions occurring within 48 hours, unless express approval of Engineer is obtained. In such case, make special provisions for heating materials and protecting the finished Work. Protect masonry against freezing for a minimum of 48 hours after being laid. Protect the tops of walls from precipitation at all times. Cover with waterproof paper when rain or snow is imminent and the Work is discontinued.

B. Humidity: Protect masonry construction from direct exposure to wind and sun when erected in an ambient air temperature of 99 degrees F (37 degrees C) in the shade with relative humidity less than 50 percent.

PART 2 PRODUCTS

2.01 MASONRY UNITS

A. Color, Texture, and Pattern: Match the submitted Samples approved by the Engineer.

B. Facing Brick: ASTM C216, Grade SW, Type FBX. Minimum compressive strength for individual brick:2,200 psi; size: 8 by 4 by 2-2/3 .

2.02 CAST STONE

A. Homogeneous, manufactured from portland cement concrete, precast, and of the same composition throughout each piece. The use of selected aggregates for the faces only is expressly prohibited.

B. Sound and perfect, with sharp and true corners.

C. Furnish with holes, reglets, rebates, and other features as required by the design and for installation.

D. Aggregate: Known durability; proportioned to produce maximum density.

E. Properties:

1. Minimum Compressive Strength: 7,000 psi.
2. Maximum Average Water Absorption: 5 percent.

F. Reinforcing: By manufacturer as required for strength of unit.

G. Properly cure prior to delivery.

H. Coating:

1. Coat each stone with an acrylic textured coating.
2. Manufacturer/Product: Thoro System Products; Thorocoat.

I. Manufacturers:

1. Art Cement Products, Wilbrahim, MA.
2. Durastone Co., Inc., Lincoln, RI.
3. Londino Stone Company, Inc., Bronx, NY.
4. Pennsylvania Stone Products, York, PA.
5. W.N. Russell and Company, Westmont, NJ.

2.03 MORTAR AND GROUT MATERIALS

A. Masonry Cement: ASTM C91, low alkali content (0.03 percent maximum).

B. Portland Cement: ASTM C150, Type I, low alkali content (0.60 percent maximum).

C. Lime: ASTM C207, Type S.

D. Mortar: ASTM C270, Type S. Consisting of one part portland cement, from 1/4 to 1/2 part lime putty or hydrated lime, and clean well-graded sand in the proportion of three times the sum of the cementitious material; or 1/2 part portland cement, one part masonry cement, and clean well-graded sand in the proportion of three times the sum of the cementitious material.

1. If color is added, add in a consistent manner to provide final uniformity.
2. No antifreeze liquid, salts, or other substances are allowed to lower the freezing point. No calcium chloride is allowed in the mortar.

E. Tuck-Pointing Mortar: Prehydrated Type N, one part portland cement, one part Type S hydrated lime, and six parts sand, by volume.

F. Sand: ASTM C144, in addition not less than 5 percent passes the No. 100 sieve.

G. Water: Fresh, clean, and free of deleterious acids, alkalies, chlorides, and organic materials.

2.04 MASONRY CONTROL JOINTS

A. ASTM D1056, closed cell neoprene sponge, 3 inches wide by 3/8 inch thick.

2.05 CAVITY WALL INSULATION, AIR BARRIER, AND AIR SEAL

A. As specified in Section 07210, Building Insulation.

2.06 THROUGH-WALL FLASHING

A. Copper:

1. ASTM B370.
2. 16 ounces, 0.0216 inch thick, rib-bond cold-rolled with uniform, matching, pattern deformations, embossed to provide a mechanical bond in all directions within the mortar bed.
3. Manufacturers:
   a. Atlantic Distributing Co., Inc.
   b. Cheney Flashing Co., Dovetail design.

2.07 MASONRY ACCESSORIES AND ANCILLARY MATERIALS

A. Manufacturers, unless noted otherwise:

1. Dur-O-Wal, Inc.
2. Hohmann and Barnard, Inc.
3. Heckmann Building Products.

B. Corrugated Wall Ties: Form of 20-gauge minimum galvanized sheet steel. Length as required by 7/8 inch wide.

C. Stone Anchors: Where dovetail anchors are not applicable, use galvanized stone anchors unless otherwise shown, and size as shown.

D. Horizontal Joint Reinforcement:

1. Two parallel No. 9 wires, uncoated, weld connected to No. 9 perpendicular cross wire at 15 inches on center.
2. Reinforcement: Clean and free from loose rust, scale, and any coatings that reduce bond.
3. Furnish special manufactured corner and wall intersection pieces at these locations.

E. Dovetail Slots and Anchor Ties:

1. 20-gauge stainless steel anchor slots.
2. 16-gauge stainless steel anchor tie. Length as required by 7/8-inch minimum width.
3. Engage or enclose joint reinforcement with anchor tie.
4. Manufacturer and Product: Dur-O-Wal, Inc., Arlington Heights, IL; seismic dovetail anchor.

F. Adjustable Anchor Ties:

1. 16-gauge stainless steelplate with slot.
2. Anchor Tie: 12-gauge stainless steel pintle plate capable of being inserted into slotted plate.
3. Engage or enclose No. 9 gauge wire joint reinforcing with anchor tie.
4. Manufacturer and Product: Dur-O-Wal, Inc., Arlington Heights, IL; seismic Ladur-eye.

G. Weep Holes: Flexible ultraviolet resistant polypropolyene, cell vent weep hole ventilator as manufactured by Doe-O-Wall.

H. Reglets for Masonry:

1. Manufacturers and Products:
   a. Superior Concrete Accessories, Franklin Park, IL; Superior Cushion Lock reglets Type B-3.
   b. Fry Reglet Corp., Glendale, CA; Fry Springlok Type MA.

I. Felt: ASTM D226, Type I (No. 15) plain, unperforated asphalt saturated felt.

2.08 MORTAR PREPARATION

A. Place one-half the water and aggregate in the operating mixer; add cement; add the remaining aggregate and water and mix for at least 2 minutes. Add lime and continue mixing as long as needed to secure a uniform mass, but no less than 3 minutes after the addition of lime. Time the addition of admixture in strict accordance with the manufacturer's instructions and the procedure used for adding it to the mix shall provide good dispersion.

B. Mix mortar in machine with mixing drums clean and free of debris and dried mortar. Use mortar before the initial setting of the cement has taken place. Do not retemper mortar in which the cement has started to set.

C. Retemper mortar boards by adding water within a basin formed with the mortar and the mortar reworked into the water. Dashing or pouring water over mortar and retempering of harsh, nonplastic mortar is not permitted.

D. Where color tinting of mortar is required, add sufficient lime-proof color-fast mineral pigment to the mortar.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine conditions, with Installer present, for compliance with requirements for installation tolerances and other specific conditions, and other conditions affecting performance of masonry veneer.

B. Examine rough-in and built-in construction to verify actual locations of piping connections prior to installation.

C. Do not proceed until unsatisfactory conditions have been corrected.

3.02 INSTALLATION

A. Provide or cut special shapes for corners, jambs, lintels, and other areas as shown or as required. Match color and texture of standard units.

B. Cut masonry units with motor-driven saws to provide clean, sharp, unchipped edges. Cut units as required to provide continuous pattern and to fit adjoining construction. Use full-size units without cutting where possible.

C. Matching Existing Masonry: Match coursing, bonding, color, and texture of new masonry with existing masonry.

3.03 BRICK VENEER INSTALLATION

A. General: Do not install cracked, broken, or chipped masonry units exceeding ASTM C216 allowances. Thoroughly wet brick just before laying except in freezing weather where bricks are laid dry. Prewetting may also be omitted if the brick at the time of laying has a rate of absorption not exceeding 0.025 ounce of water per square inch of surface after being placed in 1/8 inch of water for 1 minute.

1. Coordinate installation with backup walls, through wall flashing, and other construction. Use masonry saws to cut and fit exposed units. Lay brick plumb, true to line, with level courses accurately spaced, and do not furrow bed joints.
2. Finish horizontal run by racking back in each course; toothing not permitted. Adjust all units to final position while mortar is soft and plastic. If units are displaced after mortar has stiffened, remove, clean joints and units of mortar, and relay with fresh mortar.
3. Bond unexposed units in wythe by lapping a minimum of 2 inches. Adjust shelf angles to keep Work level at proper elevation. Provide pressure relieving joints by placing a continuous compressible pad under the shelf angle.
4. When joining fresh masonry to set or partially set masonry:
   a. Remove loose brick and mortar.
   b. Clean and lightly wet exposed surface of set masonry prior to laying fresh masonry.

B. Pattern: Lay brick in running bond.

C. Mortar Beds: Lay brick with full mortar coverage on horizontal and vertical joints. Rock closures into place with head joints thrown against two adjacent bricks in-place. Do not pound corners or jambs to fit stretcher units after setting in-place. Where adjustment to corners or jambs must be made after mortar has started to set, remove mortar and replace with fresh mortar.

D. Horizontal and Vertical Face Joints:

1. Nominal Thickness: 3/8 inch.
2. Construct uniform joints.
3. Shove vertical joints tight.
4. Tool joints concave in exposed surfaces when thumbprint hard using jointing tool.
5. Concave tool exterior joints below grade.
6. Flush cut all joints not tooled.
7. Fill horizontal joints between top of masonry partition and underside of concrete beams with mortar.

E. Tuck-Point Joints:

1. Rake mortar joints to a depth of 1/2 to 3/4 inch.
2. Saturate exposed joints with clean water.
3. Fill joints solidly with pointing mortar.
4. Tool joints to match existing.

F. Movement Joints: Keep clean of all mortar and debris.

G. Masonry Control Joints:

1. Provide continuous vertical control joints in masonry as shown on Drawings.
2. Omit mortar from the vertical joints. Place the control joint material as the wall is built.

H. Through-Wall Flashing:

1. Place flashing on bed of mortar.
2. Lap cross joints of through-wall flashing at least 2 inches.
3. Extend flashing beyond exterior face of wall and provide dripedge.
4. Cover flashing with mortar.

I. Flashing: Clean surface of masonry smooth and free from projections that might puncture, gouge, or otherwise damage flashing material.

J. Weep Holes: Provide weep holes in head joints in first course immediately above all flashing leaving head joint free and clean of mortar.

1. Maximum Spacing: 24 inches OC.
2. Keep weep holes and area above flashing free of mortar droppings.

K. Sealant Joints: Retain sealant joints around outside perimeters of exterior doors, window frames, and other wall openings:

1. Uniform Depth: 3/4 inch.
2. Uniform Width: 1/4 inch.

L. Nonreinforced Brick Masonry: Fill vertical, longitudinal joints by parging. Keep cavity in cavity walls clean:

1. Slightly bevel mortar bed to incline toward cavity. Place wood strips with attached wire pulls on metal ties.
2. Remove and clean wood strips prior to placing each succeeding row of metal ties.
3. As the Work progresses, trowel all protruding fins in cavity flat on inner surface of wythe.

M. Anchoring: Anchor brick veneer to concrete backing with dovetail anchor ties and to CMU backing with adjustable anchor ties.

1. Maintain a space not less than 1 inch wide between masonry wall and concrete members.
2. Keep space free of mortar or other rigid material to permit differential movement between concrete and masonry.

3. Attach brick veneer to backing with anchor ties.
   a. Use one dovetail anchor tie for each 2 square feet of wall area and one adjustable anchor tie for each 1.77 square feet of wall area.
   b. Maximum Space Between Adjacent Ties:
      1) Vertically: 16 inches.
      2) Horizontally: 24 inches for dovetail anchor ties. 16 inches for adjustable anchor ties.
   c. Embed ties at least 2 inches in horizontal joint of brick veneer.
   d. Provide additional ties at openings:
      1) Maximum Spacing Around Perimeter: 24 inches.
      2) Install within 12 inches of opening.

N. Air Barrier, Air Seal:

1. Use material specified in Section 07210, Building Insulation.
2. Prime full surface of concrete block substrate in accordance with manufacturer's instructions.
3. Install continuously with 2-inch minimum lap at joints.
4. Extend membrane at peripheries minimum 6 inches to join and seal air barriers provided in adjacent construction.
5. Extend membrane minimum 12 inches into adjacent concrete substrates which are indicated to have no applied barrier.
6. Cut and tightly seal around penetrations.
7. At expansion joints install 6-inch wide strip of air barrier material looped into joint to allow for movement.
8. Apply continuous uniform air barrier.

O. Cavity Wall Insulation:

1. Use material specified in Section 07210, Building Insulation.
2. Install tight to face of backup material.
3. Fit edge joints tightly together.
4. Fit snugly between anchor ties.
5. Install as brick veneer work progresses and after installation of air barrier.

P. Pointing: Cut out defective joints and holes in exposed masonry and repoint with mortar. Dry brush masonry surface after mortar has set at end of each day's Work and after final pointing.

3.04 SETTING CAST STONE

A. Clean stone immediately before setting.

B. Set each piece accurately, true to line, level, and plumb, in full bed of fresh mortar. Completely fill all joints and beds with fresh mortar.

C. Install anchor system as shown.

D. After stones are set in mortar, do not move or disturb in any manner that might destroy bond between cast stone and mortar. Cast stones that have been disturbed shall be removed and reset in fresh mortar.

E. Keep faces of cast stone free of mortar. Promptly remove mortar splashed on stone faces and other surfaces. Rake joints and ends 3/4 inch deep for pointing or sealants at horizontal wash.

F. Upon completion, clean face of stone with stiff fiber brushes and detergent and water. Rinse thoroughly with fresh water.

3.05 CLEANING

A. Remove mortar stains with clear water as Work progresses. Upon completion, clean all exposed surfaces with a 10 percent solution of commercial muriatic acid, removing all stains with fiber brushes and rinse with clean water.

B. Cleaning Agents:

1. Proprietary Acidic Cleaner: Manufacturer's standard-strength, general-purpose cleaner designed for removing mortar/grout stains, efflorescence, and other new construction stains from new masonry surfaces of type indicated below without discoloring or damaging masonry surfaces; expressly approved for intended use by manufacturer of masonry units being cleaned.

C. Clean exposed unglazed masonry with stiff brush and clear water. If cleaning by water does not produce satisfactory results, apply cleaning agent to sample wall area of 20 square feet in location acceptable to Engineer. Do not proceed with cleaning until sample area is acceptable to Engineer.

D. Follow manufacturer's recommendations for use of cleaning agents.

E. Application:

1. Thoroughly wet surface of masonry on which no efflorescence appears before using cleaning agent.
2. Scrub with acceptable cleaning agent.
3. Immediately rinse with clear water.
4. Work small sections at a time.
5. Work from top to bottom.
6. Protect sash, metal lintels, and other materials, which may corrode when masonry is cleaned with acid solution.
7. Remove efflorescence in accordance with brick manufacturer's recommendations.

F. Leave Work area and surrounding surfaces clean and free of mortar spots, droppings, and broken masonry.

3.06 FIELD QUALITY CONTROL

A. At least once a week while installation of masonry veneer is in progress, take mortar Samples for testing. Continue on that basis for duration of installation of masonry veneer at the discretion of Engineer.

B. Take Samples in accordance with ASTM C270 and ASTM C476, as applicable.

3.07 PROTECTION

A. Wall Covering: During erection, cover top of wall with strong waterproof membrane at end of each day or shutdown and as follows:

1. Cover partially completed walls when Work is not in progress.
2. Extend cover minimum of 24 inches down both sides.
3. Hold cover securely in-place.

B. Protect sills, ledges, and offsets from mortar drippings or other damage during construction. Remove misplaced mortar or grout immediately. Protect face materials against staining. Protect the door jambs and corners from damage during construction.

END OF SECTION

SECTION 05050
WELDING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Society of Mechanical Engineers (ASME):
   a. BPVC SEC V, Nondestructive Examination.
   b. BPVC SEC IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
2. American Society of Nondestructive Testing (ASNT): SNT-TC-IA, Personnel Qualification and Certification in Non-destructive Testing.
3. ASTM International (ASTM): A370, Standard Test Methods and Definitions for Mechanical Testing of Steel Products.
4. American Welding Society (AWS):
   a. A2.4, Standard Symbols for Welding, Brazing, and Nondestructive Examination.
   b. A3.0, Standard Welding Terms and Definitions; Including Terms for Adhesive Bonding, Brazing, Soldering, Thermal Cutting and Thermalspraying.
   c. D1.1/D1.1M, Structural Welding Code - Steel.
   d. D1.2/D1.2M, Structural Welding Code - Aluminum.
   e. D1.3, Structural Welding Code - Sheet Steel.
   f. D1.4, Structural Welding Code - Reinforcing Steel.
   g. QC 1, Standard for AWS Certification of Welding Inspectors.

1.02 DEFINITIONS

A. CJP: Complete Joint Penetration.

B. CWI: Certified Welding Inspector.

C. MT: Magnetic Particle Testing.

D. NDE: Nondestructive Examination.

E. NDT: Nondestructive Testing.

F. PJP: Partial Joint Penetration.

G. PQR: Procedure Qualification Record.

H. PT: Liquid Penetrant Testing.

I. RT: Radiographic Testing.

J. UT: Ultrasonic Testing.

K. VT: Visual Testing.

L. WPQ: Welder/Welding Operator Performance Qualification.

M. WPS: Welding Procedure Specification.

1.03 SUBMITTALS

A. Shop Drawings:

1. Welding Data (Shop and Field):
   a. Distinguish between shop and field welds.
   b. Indicate, by welding symbols or sketches, details of welded joints and preparation of base metal. Provide complete joint welding details showing bevels, groove angles, and root openings for welds.
   c. Submit welding data together with shop drawings as a complete package.

B. Informational Submittals: CWI reports.

1.04 QUALIFICATIONS

A. WPSs: In accordance with AWS D1.1/D1.1M (Annex E Forms).

B. WPQs: In accordance with AWS D1.1/D1.1M (Annex E Forms).

C. CWI: Certified in accordance with AWS QC 1, and having prior experience with the welding codes specified.

D. Testing Agency: Personnel performing tests shall be NDT Level II Certified in accordance with ASNT SNT-TC-1A.

1.05 SEQUENCING AND SCHEDULING

A. Unless otherwise specified, all Submittals required in this Section shall be submitted and approved prior to commencement of welding operations.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Welding and Fabrication by Welding: Conform to governing welding codes referenced in attached Welding and Nondestructive Testing Table.

3.02 NONDESTRUCTIVE WELD TESTING REQUIREMENTS

A. Weld Inspection Criteria:

1. Selection of Welds to be Tested: 100 percent VT.
2. Weld Acceptance:
   a. VT: AWS D1.1/D1.1M, Paragraph 6.9, Visual Inspection, Statically Loaded Nontubular Connections.

3.03 FIELD QUALITY CONTROL

A. The CWI shall be present whenever field welding is performed. The CWI shall perform inspection prior to assembly, during assembly, during welding, and after welding. CWI duties include:

1. Verifying conformance of specified job material and proper storage.
2. Inspecting weld joint fit-up and in-process inspection.
3. Providing 100 percent visual inspection of all welds.
4. Maintaining records and preparing report confirming results of inspection comply with the Work.

3.04 WELD DEFECT REPAIR

A. Repair and retest rejectable weld defects until sound weld metal has been deposited in accordance with appropriate welding codes.

3.05 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.

1. Welding and Nondestructive Testing table.

END OF SECTION

WELDING AND NONDESTRUCTIVE TESTING						
Specification Section	**Governing Welding Codes or Standards**	**Submit WPS**	**Submit WPQ**	**Onsite CWI Req'd**	**Submit Written NDT Procedure Specifications**	**NDT Requirements**
05210 Open-Web Joists	AWS D1.1/D1.1M, Structural Welding Code–Steel	No	No	Yes	No	100% VT; see Section 05210
05310 Steel Deck	AWS D1.1/D1.1M, Structural Welding Code–Steel or AWS D1.3, Structural Welding Code–Sheet Steel	No	No	Yes	No	100% VT; see Section 05310

SECTION 05210
OPEN-WEB STEEL JOISTS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Institute of Steel Construction (AISC):
   a. Specification for Structural Steel Buildings-Allowable Stress Design and Plastic Design.
   b. Allowable Stress Design Specification for Structural Joints using ASTM A325 or A490 Bolts.
   c. Code of Standard Practice for Steel Buildings and Bridges.
2. American Welding Society (AWS): D1.1, Structural Welding Code - Steel.
3. Steel Joist Institute (SJI):
   a. Standard Specifications and Load Tables:
      1) Open-Web Steel Joists, K-Series.
      2) Long Span Steel Joists, LH-Series, and Deep Long Span Steel Joists, DLH-Series.
      3) Super Longspan Steel Joists, SLH-Series.
      4) Joist Girders.
   b. Recommended Code of Standard Practice for Steel Joists and Joist Girders.

1.02 SUBMITTALS

A. Action Submittals:

1. Plan view layout of joists and bridging.
2. Elevation view of each type of joist showing configuration, chord and web member sizes, panel point dimensions, and chord extensions.
3. Connection and bearing details.
4. Bridging member sizes and connection details.
5. Complete design, including stress and deflection calculations, for joists, joist members, and connections for design load and equipment weight as indicated, plus any construction loads applied by Contractor's operations.
6. Calculations shall include check of joist chord bending stresses for concentrated loads applied between panel points.
7. Registered Professional Engineer's stamp, valid in same state as Project, on design drawings and stress calculations.
8. Procedure for handling, erection, and bracing of steel joists.

B. Informational Submittals:

1. Joist manufacturer's installation requirements.
2. Welding Procedures, Qualifications, and Inspection Report: As specified in Section 05050, Welding.

1.03 QUALITY ASSURANCE

A. General: Design and fabricate steel joists and bridging to meet requirements of SJI Standard Specifications and Load Tables.

B. Certification: SJI Membership, with certification for joist types as indicated on Drawings.

C. Qualifications for Field Welding: As specified in Section 05050, Welding.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Protect joist paint system from abrasion at steel bands and other joists.

C. Store joists and bridging off ground on wood sleepers.

D. Support joists so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

2.01 STEEL JOISTS AND BRIDGING

A. Provide type of joist, chord configuration, and depth as indicated on Drawings.

B. Design and Manufacture:

1. In accordance with the applicable SJI Standard Specifications.
2. Chord Members: Rolled double angle sections only.
3. Provide the following where indicated, in accordance with SJI Standard Specifications and Load Tables:
   a. Bottom chord bracing and end anchorage for uplift design criteria.
   b. Ceiling extension to within 1 inch of finished wall surface, unless otherwise indicated.
   c. Full camber, unless otherwise indicated.

C. Joist Bridging:

1. In accordance with applicable SJI Standard Specifications for type of joist.
2. Furnish bridging of minimum size and type as indicated.
3. Provide anchorage connection to walls and girders at bridging lines as indicated.

2.02 SHOP PRIMER

A. Apply one shop coat of rust-inhibitive primer in accordance with SJI Standard Specifications.

1. Remove loose scale, rust, and slag from welds before painting.
2. Apply primer within 8 hours after surface preparation.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel joists.

3.02 INSTALLATION

A. Erection: SJI Standard Specifications and approved shop drawings.

B. Welded Connections: As specified in Section 05050, Welding.

3.03 TOUCHUP PAINTING

A. Immediately following erection, remove debris from completed installation.

B. Clean field welds, bolted connections, rust spots, and abraded areas.

C. Repair damaged painted and galvanized surfaces as specified in Section 09902, Painting.

3.04 FIELD QUALITY CONTROL

A. Welding:

1. Visually inspect field welds in accordance with AWS D1.1, Section 6 and Table 6.1, Visual Inspection Acceptance Criteria.

2. An independent testing agency shall be retained by Contractor and approved by Engineer to visually inspect field welded connections in accordance with AWS D1.1, Table 6.1, and as specified in Section 05050, Welding.
3. Repair defective welds as specified in Section 05050, Welding.

END OF SECTION

SECTION 05310
STEEL DECK

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Iron and Steel Institute (AISI): Specifications for the Design of Cold Formed Steel Structural Members.
2. American Welding Society (AWS): D1.3, Structural Welding Code - Sheet Steel.
3. ASTM International (ASTM):
   a. A611, Standard Specification for Structural Steel (SS), Sheet, Carbon, Cold-Rolled.
   b. A653, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   c. A780, Standard Practice for Repair of Damaged and Uncoated Areas of Hot-Dip Galvanized Coatings.
   d. A924, Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
4. Steel Deck Institute (SDI):
   a. Design Manual for Composite Decks, Form Decks and Roof Decks.
   b. Diaphragm Design Manual.
5. Factory Mutual (FM):
   a. Factory Mutual Approval Guide.
   b. FM Research Corporation (FMRC): Approval Requirements for Steel Roof Deck Construction.
6. International Code Council Evaluation Service, Inc. (ICC-ES): Evaluation Reports for Deck Fasteners.
7. Underwriters Laboratories, Inc. (UL): Fire Resistance Directory.

1.02 SUBMITTALS

A. Action Submittals:

1. Plan view layout of decking showing type and section properties of deck panels, reinforcing channels, pans, special jointing, and accessories.
2. Location of openings, deck laps, and deck attachment details.

B. Informational Submittals:

1. Decking manufacturer's installation requirements.

1.03 QUALITY ASSURANCE

A. General: For metal decking section properties, meet requirements of AISI Specifications for Design of Cold-Formed Steel Structural Members.

B. FM Requirements:

1. Steel Roof Deck: Listed in Factory Mutual "Approval Guide" for Class 1 fire rating and Class 1-90 wind uplift rating.
2. Mechanical Fasteners: Packing containers shall show name of manufacturer and product and FMRC approval mark.

C. Qualifications for Field Welding: As specified in Section 05050, Welding.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Protect steel deck from corrosion, deformation, and other damage during delivery, storage, and handling.

B. Store deck bundles on platforms or pallets, with one end elevated to provide drainage.

C. Protect bundles against condensation with a ventilated waterproof covering.

D. Stack bundles so there is no danger of tipping, sliding, rolling, shifting or material damage.

PART 2 PRODUCTS

2.01 METAL DECKING

A. Provide metal deck as shown in the following schedule:

STEEL DECK SCHEDULE

Type	Depth (in)	Panel Width (in)	Design Thickness (in)	Min. Yield Strength Fy (ksi)	Min. (+) S (in^3/ft)	Min. I (in^4/ft)	Minimum Diaphragm Shear Capacity (lbs/ft)	Finish
Roof Deck	1-1/2	36	0.0358	38	0.23	0.21	360	Galv, G-90

B. Materials and Finishes:

1. Galvanized Deck:
   a. Sheet steel for galvanized deck and accessories shall conform to ASTM A653 Structural Quality Grade 33 or higher, as shown in Steel Deck Schedule.

b. Galvanizing shall conform to ASTM A924 with coating class of G60 or G90 as defined in ASTM A653 and as shown in Steel Deck Schedule.

C. Manufacturers:

1. Vulcraft Division of Nucor Co., Brigham City, UT.
2. BHP Steel Building Products, USA, Inc., West Sacramento, CA.
3. Verco Manufacturing, Inc., Phoenix, AZ.
4. United Steel Deck, Inc., Summit, NJ.

2.02 ACCESSORIES

A. Provide pour stops, column closures, end closures, cover plates, girder fillers, ridge and valley plates, finish strips, reinforcing channels, and other accessories as required for complete installation.

B. Accessories shall be minimum 22-gauge, except edge forms shall be sized as required by the deck manufacturer, unless shown otherwise on the Drawings.

2.03 MECHANICAL FASTENERS

A. Self-Drilling Screws:

1. Self-drilling, self-tapping screws with hexagonal washer head and corrosion-resistant finish.
2. Manufacturers and Products:
   a. ITW Buildex, Itasca, IL; ICH Traxx Self-Drilling Fasteners with Climaseal Coating and Autotraxx Standup Installation Tool.
   b. Hilti, Inc., Tulsa, OK; Kwik-Pro HWH Self-Drilling Screws with Kwik-Cote Treatment and Kwik-Tapper Screwdriver.

B. Powder Driven Fasteners:

1. Knurled shank, minimum 1/2-inch diameter steel washer, corrosion-resistant coating.
2. Pin diameter and length to suit deck type and flange thickness of steel support member.
3. Manufacturers and Products:
   a. ITW Buildex, Itasca, IL; Buildex BX14 pins with yellow dichromate galvanizing and BX900 Installation Tool.
   b. Hilti, Inc., Tulsa, OK; ENP-series fasteners with electroplated zinc coating and DX-750 Installation Tool.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine supporting framing and field conditions for compliance with requirements for installation tolerances and other conditions affecting performance of steel deck.

3.02 INSTALLATION

A. Locate deck bundles to prevent overloading of support framing members.

B. Install at right angles to supporting members in a three span minimum lay-up, unless shown otherwise, and in accordance with Specification and manufacturer's installation recommendation.

C. Bearing: 1-1/2 inches, minimum.

D. Endlaps: Minimum of 2 inches and located over supports.

E. Do not stretch sidelaps.

F. Closure Plates:

1. Install closure and cover plate accessories as recommended by the metal deck manufacturer, unless shown otherwise on the Drawings.

G. Holes and Openings

1. Cut and fit around roof openings and other work projecting through or adjacent to decking.
2. Locate holes and openings as shown to clear structural framing and bracing members.
3. Reinforcement around openings:
   a. Roof Deck: For hole sizes of at least 6 inches across, but not more than 12 inches across in roof deck, reinforce with 0.0474-inch design thickness steel plate, painted or galvanized to match deck coating. Extend plate at least 12 inches beyond opening in all directions and attach to top of roof deck with No. 10 self-drilling screws at 6-inch spacing and at all corners. For openings larger than 12 inches across, reinforce roof deck with framing as shown on Drawings.

H. Protect deck areas from heavy concentrated loads or wheel traffic with planking or other approved means.

I. Completed Deck: Free from buckles and irregularities, and in accordance with FM and UL requirements.

3.03 DECK ATTACHMENT

A. Fasten panels as shown on Drawings.

B. Welded Connections: Weld deck sidelaps, attachment to framing, and accessories in accordance with AWS D1.3 and as specified in Section 05050, Welding.

C. Mechanical Fasteners:

1. Self-Drilling Screws:
   a. Install screws in accordance with manufacturer's written instructions and with special installation tool. Do not over-torque.
   b. Remove and redrive screws at sidelaps where upper sheet is not drawn tightly against lower sheet.
2. Powder Driven Fasteners:
   a. Install fasteners in accordance with manufacturer's written instructions and with special installation tool.
   b. Minimum Sidelap Edge Distance: 3/8 inch.
   c. Minimum End/End Lap Distance: 1 inch.
   d. Head Projection: As specified by manufacturer for correct penetration into flange of steel support member.

3.04 TOUCHUP PAINTING

A. Immediately following erection, remove unused deck edge trimmings, screws, fasteners, welding washers, butt ends of welding rods, and debris from completed installation.

B. Clean field welds, bolted connections, rust spots, and abraded areas.

C. Repair damaged painted surfaces as specified in Section 09902, Painting.

D. Repair damaged galvanized surfaces with zinc-rich spray paint in accordance with ASTM A780; color to match galvanized deck.

E. Use magnetic gauge to determine that thickness of repair is equal to or greater than base painted or galvanized coating.

3.05 FIELD QUALITY CONTROL

A. An independent testing agency shall be retained by Contractor and approved by Engineer to perform following inspections.

1. Welded Connections: Visually inspect in accordance with AWS D1.3, Section 7, and as specified in Section 05050, Welding.
2. Mechanical Fasteners: Visually inspect, in accordance with manufacturer's instructions, for each type of fastener.

B. Repair or replace defective welds and fasteners.

END OF SECTION

SECTION 06100
ROUGH CARPENTRY

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Forest and Paper Association (AF&PA): 01, National Design Specification for Wood Construction.
2. American Hardboard Association (AHA): A135.4, Basic Hardboard.
3. American Institute of Timber Construction (AITC): 112, Standard for Tongue-and-Groove Heavy Timber Roof Decking.
4. American Lumber Standards Committee's Board of Review (ALSC).
5. APA - The Engineered Wood Association (APA):
   a. AFG-01, Adhesives for Field-Gluing Plywood to Wood-Framing.
   b. PRP-108, Performance Standards and Qualification Policy for Structural-Use Panels.
6. American Wood Preservers' Association (AWPA):
   a. C2, Lumber, Timber, Bridge Ties and Mine Ties, Preservative Treatment by Pressure Processes.
   b. C9, Plywood—Preservative Treatment by Pressure Process.
   c. C20, Structural Lumber—Fire-Retardant Treatment by Pressure Processes.
   d. C27, Plywood—Fire-Retardant Treatment by Pressure Processes.
   e. M4, Standard for the Care of Preservative-Treated Wood Products.
7. ASTM International (ASTM):
   a. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 PSI Tensile Strength.
   b. A653/A653M, Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   c. C1396, Specification for Gypsum Board.
   d. D226, Standard Specification for Asphalt-Saturated Organic Felt Used in Roofing and Waterproofing.
   e. E84, Standard Test Method for Surface Burning Characteristics of Building Materials.
   f. F1667, Standard Specification for Driven Fasteners: Nails, Spikes, and Staples.
8. Composite Panel Association (CPA): A208.1, Standard for Particleboard.
9. National Evaluation Service, Inc. (NER): 272, Power-Driven Staples and Nails for Use in All Types of Building Construction.

10. National Fire Protection Association (NFPA): 255, Standard Method of Test of Surface Burning Characteristics of Building Materials.
11. Southern Pine Inspection Bureau (SPIB): 1003, Grading Rules.
12. Underwriters' Laboratories, Inc. (UL): 723 Test for Surface Burning Characteristics of Building Materials.
13. U.S. Department of Commerce—Product Standards (PS):
    a. PS 1, Construction and Industrial Plywood.
    b. PS 2, Performance Standard for Wood-Based Structural-Use Panels.
    c. PS 20, American Softwood Lumber Standard.
14. Western Wood Products Association (WWPA): G5, Western Lumber Grading Rules.

1.02 DELIVERY, STORAGE, AND HANDLING

A. Immediately upon delivery to Site, place materials in area protected from weather. Do not store seasoned materials in wet or damp areas.

B. Protect sheet materials from breaking corners and damaging surfaces while unloading.

C. Store materials a minimum of 6 inches above ground on framework or blocking and cover with waterproof covering, providing for adequate air circulation and ventilation. Store sheet materials flat, not on edge.

D. Protect fire-retardant materials against high humidity and moisture during storage and erection.

PART 2 PRODUCTS

2.01 GENERAL

A. Lumber Standards:

1. Lumber manufactured in accordance with DOC PS 20 and with applicable grading rules and wood species certified by ALSC. Design values for wood members equal to those published in supplement to AF&PA's National Design Specification for Wood Construction.
2. Stamp or brand each unexposed piece of lumber with grade, species, and moisture content at time of mill surfacing.

B. Lumber sizes shown on Drawings are nominal, unless shown otherwise. Provide actual sizes as required by DOC PS 20 for use.

C. Dressed lumber S4S, unless shown otherwise on Drawings.

D. Moisture content of lumber not to exceed 19 percent, unless otherwise specified and marked "DRY".

E. Each plywood panel identified with designated grade trademark of APA.

2.02 LUMBER

A. Furnish lumber as follows, unless specified otherwise:

Usage	Minimum Grade
General framing, studs, blocking, plates, blocking, furring, braces, & nailers	Standard and/or better or studgrade Douglas Fir, Hemlock, or Larch.

2.03 CONSTRUCTION PANELS

A. Plywood Backing Panels: Mounting electrical, telephone and like equipment, provide fire-retardant treated plywood panels with grade designation, APA C-D Plugged Exposure 1, in thickness shown on Drawings, or, if not shown on Drawings, not less than 15/32 inch.

B. Concealed Location: Douglas Fir plywood exterior bond, preservative treated.

2.04 PRESERVATIVE WOOD TREATMENT BY PRESSURE PROCESS

A. General: Where lumber or plywood is indicated as preservative treated wood, in accordance with AWPA C2 (Lumber) and AWPA C9 (Plywood). Mark and grade each treated item in accordance with SPIB 1003 or WWPA G5.

B. Aboveground Materials: Pressure treat items with waterborne preservatives to a minimum retention of 0.25 pcf. For interior uses, after treatment, kiln-dry lumber and plywood to maximum moisture content, respectively, of 19 percent and 15 percent. Treat the following items:

1. Wood cants, nailers, curbs, equipment support bases, blocking, stripping, and similar members in connection with roofing, flashing, vapor barriers, and waterproofing.
2. Wood sills, sleepers, blocking, furring, stripping, and similar concealed members in contact with masonry or concrete.

C. Complete fabrication of treated items prior to treatment, where possible. If cut after treatment, coat cut surfaces to comply with AWPA M4. Inspect each piece of lumber or plywood after drying and discard damaged or defective pieces.

2.05 AIR BARRIER

A. As specified in Section 07210, Building Insulation.

2.06 FIRE-RETARDANT TREATED WOOD

A. Pressure treat lumber and plywood with fire-retardant chemicals in accordance with AWPA C20 and AWPA C27, respectively, so that it has flame spread rating not higher than 25 with no evidence of significant progressive combustion when tested for 30 minutes duration under UL 723, NFPA 255, and ASTM E84. Treated lumber and plywood labeled and tested by Underwriters' Laboratories, Inc. shall show performance rating.

2.07 HARDWARE

A. Conforming to ASTM F1667.

B. Nails:

1. Conforming to ASTM F1667.
2. Steel common nails.
3. Use hot-dipped zinc-coated nails wherever exposed.
4. Use deformed shank nails for fastening underlayment.

C. Staples: Conforming to ASTM F1667, galvanized where exposed.

D. Power Driven Fasteners: Conforming to NER 272.

E. Bolts and Screws: Conforming to ASTM A307, galvanized where exposed.

F. Framing Anchors, Joist, and Beam Hangers:

1. Manufacturers:
   a. Bowman Distribution, Barnes Group, Inc., Cleveland, OH.
   b. United Steel Products, Kant-Sag Silver, Montgomery, MN.
   c. KC Metal Products, San Jose, CA.
   d. Simpson Strong-Tie Co., Pleasanton, CA.
   e. Cleveland Steel Specialty Co., Bedford Heights, OH; galvanized minimum 18-gauge steel, complete with nails.

2.08 MISCELLANEOUS

A. Roofing Felt: Asphalt-saturated organic felt conforming to ASTM D226, Type I (No. 15 Asphalt felt), nonperforated.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify that surfaces to receive rough carpentry materials are prepared to exact grades and dimensions.

3.02 GENERAL

A. Lay out, cut, fit, and install all rough carpentry items. Anchor sufficiently to ensure rigidity and permanence.

B. Install items accurate to dimension, true to line, level, and square unless shown otherwise on Drawings. Provide for installation and support of other Work.

C. Discard units of material with defects that impair quality of rough carpentry construction and that are too small to use in fabricating rough carpentry with minimum joints or optimum joint arrangement.

D. Countersink nail heads on exposed carpentry work and fill holes.

3.03 PRESERVATIVE TREATED WOOD PRODUCTS

A. Provide preservative treated wood for all framing, blocking, furring, nailing strips built into exterior masonry walls, wood in contact with concrete or masonry and in conjunction with gravel stops, and built-up roofing.

B. Apply two brush coats of same preservative used in original treatment to all sawed or cut surfaces of treated lumber.

3.04 FIRE-RETARDANT TREATED WOOD

A. Provide fire-retardant treated lumber and plywood for backing panels at electrical, telephones, and like equipment. Use exterior rated wood.

END OF SECTION

SECTION 07110
BITUMINOUS DAMPPROOFING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
   a. D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
   b. D449, Standard Specification for Asphalt Used in Dampproofing and Waterproofing.
   c. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
   d. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
   e. D6380, Standard Specification for Asphalt Roll Roofing (Organic Felt).

1.02 DELIVERY, STORAGE, AND HANDLING

A. Store materials in area where temperatures are not less than 50 degrees F or over 85 degrees F.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Weather: Proceed with dampproofing Work only when existing and forecast weather conditions will permit Work. Do not apply dampproofing in rainy conditions or within 3 days after surfaces become wet from rainfall or other moisture.

B. Temperature:

1. Do not apply materials when ambient temperature is less than 50 degrees F.
2. Do not apply materials when low temperature of 40 degrees F or less is predicted within a period of 24 hours after application.

C. Ventilation: Provide adequate ventilation during application of solvent-based components in enclosed spaces. Maintain ventilation until dampproofing membrane has thoroughly cured.

PART 2 PRODUCTS

2.01 BITUMINOUS DAMPPROOFING, GENERAL

A. Odor Elimination: For interior and concealed-in-wall uses, provide type of bituminous dampproofing material warranted by manufacturer to be substantially odor-free after drying for 24 hours under normal conditions.

2.02 COLD-APPLIED ASPHALT EMULSION DAMPPROOFING

A. Asphalt Emulsion: Asphalt and water emulsion coating, formulated to penetrate substrate and build to moisture-resistant coating.

1. Heavy fibrated type mastic asbestos-free emulsion; ASTM D1227, Type IV, except containing nonasbestos, inorganic fibrous reinforcement materials.

B. Manufacturers:

1. Celotex Corp.
2. ChemRex, Inc./Sonneborn Building Products Div.
3. J & P Petroleum Products, Inc.
4. Koch Materials Co.
5. Tremco, Inc.

2.03 MISCELLANEOUS ACCESSORIES

A. Glass-Fiber Mat: Nonwoven fiberglass fabric of continuous filament or jack-straw filament/yarn pattern of glass fiber, impregnated and bound together with type of organic/synthetic binder compatible with type of bituminous compound indicated to be reinforced, weighing 1 pound per 100 square feet, 36-inch wide rolls.

B. Plastic Cement: Asphalt based, except provide coal-tar base where specifically recommended by manufacturer of bituminous dampproofing materials.

C. Protection Course, Board Type: Asphalt-impregnated and coated organic fiberboard, 1/2 inch thick.

D. Protection Course, Roll Roofing Type: ASTM D6380, smooth-surfaced roll roofing, weighing not less than 55 pounds per 100 square foot.

E. Protection Course, Film Type: 4-mil carbonated polyethylene film.

PART 3 EXECUTION

3.01 SURFACE PREPARATION

A. Clean surfaces to remove dust, dirt, oil, wax, efflorescence, and other foreign materials, in accordance with dampproofing manufacturer's instructions.

B. Allow 3 days' drying time following washing down of substrate surfaces.

C. Fill cracks, voids, and honeycombs with mortar to provide sound surface for dampproofing.

3.02 APPLICATION

A. Apply dampproofing with a brush, trowel, or low pressure airless spray equipment with a coarse nozzle, as recommended by dampproofing manufacturer.

B. Apply materials at rate and as recommended by the manufacturer and in two coats.

C. Start application at top of wall and work down surface, keeping a wet edge at all times, forming a continuous, unbroken film, free from pinholes and other surface breaks.

3.03 FIELD QUALITY CONTROL

A. Inspection: Examine surfaces to receive dampproofing to assure conditions are satisfactory for application of materials.

B. After dampproofing has dried, spray surfaces with water.

C. Recoat, as recommended by manufacturer, surfaces showing water absorption. To prevent blistering, protect surfaces from heat and direct sunlight until dried, then backfill.

3.04 ADJUST AND CLEAN

A. Clean spillage and overspray from adjacent surfaces as recommended by manufacturer.

3.05 APPLICATION SCHEDULE

A. Dampproof all below grade walls and are as shown

B. Apply dampproofing to exterior surfaces of cast-in-place concrete structures below finish ground level that enclose spaces that may be occupied, and other areas as shown.

C. Apply dampproofing to exterior of inside wythe of masonry cavity walls.

END OF SECTION

SECTION 07210
BUILDING INSULATION

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C578, Standard Specification for Rigid, Cellular Polystyrene Thermal Insulation.
   b. C665, Standard Specification for Mineral-Fiber Blanket Thermal Insulation for Light Frame Construction and Manufactured Housing.
   c. D4397, Standard Specification for Polyethylene Sheeting for Construction, Industrial, and Agricultural Applications.

1.02 MATERIAL STORAGE

A. Store off ground and keep dry at all times. Protect against weather condensation and damage.

PART 2 PRODUCTS

2.01 MATERIALS

A. Batt Insulation and Fasteners:

1. Fiberglass or Mineral Wool Batts:
   a. ASTM C665, Type I, with no vapor retarder with thickness or R-Values as indicated on Drawings.
   b. Manufacturers:
      1) Certainteed.
      2) Owens-Corning Fiberglas Corp.
      3) Johns Manville.
2. Fasteners: As recommended by insulation manufacturer.

B. Rigid Insulation:

1. Extruded polystyrene foam.
2. ASTM C578, Type IV.
3. Flame Spread: Less than 25 when tested in accordance with ASTM E84.
4. Thickness and R-Value as shown on Drawings.
5. Manufacturers and Products:
   a. Dow Chemical Co.; Square Edge.
   b. UC Industries; Foamular.

C. Cavity Wall Insulation:

1. Material: Semi-rigid boards of inorganic glass fiber.
2. Conformance: ASTM C612.
3. Flame Spread: Less than 25 when tested in accordance with ASTM E84.
4. Thickness or R-Value: As shown on Drawings.
5. Manufacturers and Products:
   a. Owens Corning; AF530.
   b. Johns Manville; Insul-Shield 300.

D. Air Barrier and Air Seal:

1. Rubberized Asphalt Composite Wall Membrane:
   a. Meeting requirements of ASTM E96, Method B.
   b. Rubberized asphalt integrally bonded to a film of high density cross laminated polyethylene.
   c. Thickness: Minimum 40 mils.
   d. Primer: As recommended by membrane manufacturer.
   e. Manufacturer and Product: W.R. Grace Construction Products; Perm-A-Barrier.

PART 3 EXECUTION

3.01 RIGID INSULATION

A. Install boards in location and in thickness as specified and as shown.

B. Cut insulation with saw, knife, or other sharp tool to fit tightly around obstructions.

C. Butt insulation boards together tightly at joints.

D. Where shown thicker than 1-1/2 inches, install two layers of boards staggering all joints.

E. Apply to masonry or concrete with adhesive recommended by insulation manufacturer:

1. Adhere first layer to substratum, then adhere second layer to first, staggering all joints.
2. Follow manufacturer's recommendations for preparing surfaces and applying adhesive.

3.02 AIR BARRIER AND AIR SEAL

A. Install as specified in Section 04813, Masonry Veneer.

3.03 CAVITY WALL INSULATION

A. Install as specified in Section 04813, Masonry Veneer.

3.04 CLEANUP AND PROTECTION

A. Remove from Site all containers, wrappings, and scrap insulation material. Leave floors broom clean.

B. Protect installed insulation from tears or other damage until covered with finish material. Replace damaged material.

END OF SECTION

SECTION 07550
MODIFIED BITUMEN SHEET ROOFING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. ASTM International (ASTM):
   a. D41, Standard Specification for Asphalt Primer Used in Roofing, Dampproofing, and Waterproofing.
   b. D312, Standard Specification for Asphalt Used in Roofing.
   c. D451, Standard Specification for Test Method for Sieve Analysis of Granular Mineral Surfacing for Asphalt Roofing Products.
   d. D1079, Standard Specification for Terminology Relating to Roofing, Waterproofing, and Bituminous Materials.
   e. D1227, Standard Specification for Emulsified Asphalt Used as a Protective Coating for Roofing.
   f. D1863, Standard Specification for Mineral Aggregate Used as a Protective Coating for Roofing.
   g. D2178, Standard Specification for Asphalt Glass Felt Used as a Protective Coating for Roofing.
   h. D2822, Standard Specification for Asphalt Roof Cement.
   i. D2824, Standard Specification for Aluminum-Pigmented Asphalt Roof Coating.
   j. D4601, Standard Specification for Asphalt-Coated Glass Fiber Base Sheet Used in Roofing.
   k. D5147, Standard Specification for 1991 Test Method for Sampling and Testing Modified Bituminous Sheet Materials.
   l. D6162, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using a Combination of Polyester and Glass Fiber Reinforcements.
   m. D6163, Standard Specification for Styrene Butadiene Styrene (SBS) Modified Bituminous Sheet Materials Using Glass Fiber Reinforcement.
   n. E108, Standard Specification for Test Methods for Fire Test of Roof Coverings.
2. Factory Mutual (FM).
3. National Roofing Contractors Association (NRCA): Handbook of Accepted Roofing Knowledge (HARK).
4. Underwriters Laboratories, Inc. (UL).
5. Warnock Hersey (WH).

1.02 SUBMITTALS

A. Submit under provisions of Section 01300, Submittals.

B. Submit certification that the roof system furnished is approved by Factory Mutual, Underwriters Laboratories, Inc., and that the roof system is adhered properly to meet or exceed 1-90.

C. Product Data for each type of product specified including manufacturer's technical product data, installation instructions and recommendations for each type of roofing product required. Include data substantiating that materials comply with specified requirements.

D. Unexecuted Manufacturer's warranty.

E. Any deficiencies in performance, warranty terms or improper submittal procedure will constitute grounds for immediate rejection of alternate.

1.03 QUALITY ASSURANCE

A. Manufacturer Qualifications: Roofing system manufacturer shall have a minimum of five years experience in manufacturing bitumen roofing products in the United States.

B. Installer Qualifications: Installer (Roofer) shall be specialized in modified bituminous roof applications with a minimum of five years experience and who is certified by the roofing system manufacturer as qualified to install manufacturer's roofing materials.

C. It is the intent of this specification to provide a roof system with an external fire rating. The descriptions given below are general descriptions. The insulation, cover board, and other components shall be required by the membrane manufacturer to provide a Class A fire resistance rating.

D. Installer's Field Supervision: Require Installer to maintain a full-time Supervisor/Foreman on job site during all phases of bituminous sheet roofing work and at any time roofing work is in progress, proper supervision of workmen shall be maintained. A copy of the specification shall be in the possession of the Supervisor/Foreman and on the roof at all times.

E. It shall be the Contractor's responsibility to respond immediately to correction of roof leakage during construction. If the Contractor does not respond within 24 hours, the Owner has the right to hire a qualified contractor and charge the Contractor.

F. Pre-application Roofing Conference: Approximately 2 weeks before scheduled commencement of modified bitumen roof system installation and associated work, meet at the Site with installer of each component of associated work, installers of deck or substrate construction to receive roofing work, installers of rooftop units and other work in and around roofing must precede or follow roofing work (including mechanical work if any), Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of the Work, including (where applicable) Owner's contractor and architect for other work at the Site, insurers, test agencies, and governing authorities.

1. Objectives to include:
   a. Review foreseeable methods and procedures related to roofing work.
   b. Tour representative areas of roofing substrates (decks), inspect and discuss condition of substrate, roof drains, curbs, penetrations, and other preparatory work performed by other trades.
   c. Review structural loading limitations of deck and inspect deck for loss of flatness and for required attachment.
   d. Review roofing system requirements.
   e. Review required submittals both completed and yet to be completed.
   f. Review and finalize construction schedule related to roofing work and verify availability of materials, Installer's personnel, equipment, and facilities needed to make progress and avoid delays.
   g. Review required inspection, testing, certifying and material usage accounting procedures.
   h. Review weather and forecasted weather conditions and procedures for coping with unfavorable conditions, including possibility of temporary roofing (if not mandatory requirement).
   i. Record discussion of conference including decisions and agreements (or disagreements) reached and furnish copy of record to each party attending. If substantial disagreements exist at conclusion of conference, determine how disagreements will be resolved and set date for reconvening conference.
   j. Review notification procedures for weather or non-working days.

1.04 DELIVERY, STORAGE, AND HANDLING

A. Deliver products to site with seals and labels intact, in manufacturer's original containers, dry and undamaged.

B. Store and handle roofing sheets in a dry, well-ventilated, weather-tight place to ensure no possibility of significant moisture exposure. Store rolls of felt and other sheet materials on pallets or other raised surface. Stand all roll materials on end. Cover roll goods with a canvas tarpaulin or other breathable material (no polyethylene).

C. Do not leave unused materials on the roof overnight or when roofing work is not in progress unless protected from weather and other moisture sources.

D. It is the responsibility of the Contractor to secure all material and equipment on the job site. If any material or equipment is stored on the roof, the Contractor must make sure that the integrity of the deck is not compromised at any time. Damage to the deck caused by the Contractor will be the sole responsibility of the Contractor and will be repaired or replaced at his expense.

1.05 MANUFACTURER'S INSPECTIONS

A. When the project is in progress, the Roofing System Manufacturer will provide the following:

1. Keep the Owner informed as to the progress and quality of the work as observed.
2. Provide job site inspections a minimum of three days a week.
3. Report to the Owner in writing any failure or refusal of the Contractor to correct unacceptable practices called to the Contractor's attention.
4. Confirm after completion of the project and based on manufacturer's observation and tests that manufacturer has observed no application procedures in conflict with the specifications other than those that may have been previously reported and corrected.

1.06 PROJECT CONDITIONS

A. Weather Condition Limitations: Do not apply roofing membrane during inclement weather or when a 40 percent chance of precipitation is expected.

B. Do not apply roofing insulation or membrane to damp deck surface.

C. Do not expose materials vulnerable to water or sun damage in quantities greater than can be weatherproofed during same day.

D. Proceed with roofing work only when existing and forecasted weather conditions will permit unit of work to be installed in accordance with manufacturer's recommendations and warranty requirements.

1.07 SEQUENCING AND SCHEDULING

A. Sequence installation of modified bituminous sheet roofing to ensure that roof assemblies including roof accessories, flashing, trim and joint sealers are protected against damage from effects of weather, corrosion, and adjacent construction activity.

B. All work must be fully completed on each day. Phased construction will not be accepted.

C. The Contractor is to coordinate with the Owner and contractor on other construction work for the installation of HVAC units and other penetrations on roof areas.

1.08 WARRANTY

A. Upon completion of installation, and acceptance by the Owner, the manufacturer will supply to the Owner a 30 Year Warranty in the manufacturer's standard form as shown at the end of this section, without monetary limitation, in which manufacturer agrees to repair or replace components of roofing system that fail. Failure includes roof leaks in membrane and accessories, roof insulation, fasteners, flashings, cover boards, and other components of roofing system.

B. Contractor will submit a minimum of a two-year workmanship warranty, in the manufacturer's standard form at the end of this section, to the membrane manufacturer with a copy directly to Owner. The warranty period will be two years from date of Final Completion.

PART 2 PRODUCTS

2.01 GENERAL

A. When the particular trade name or performance standard is specified it shall be indicative of the standard required.

B. Provide products as manufactured by The Garland Company or approved equal.

C. Any item or materials submitted as an alternate to the manufacturer specified must comply in all respects to the quality and performance of the brand name specified. The Owner shall be the sole judge as to whether or not an item submitted as an equal is truly equal. Should the Contractor choose to submit on the equal basis, he shall assume all risk involved, monetary or otherwise should the Owner find the item unacceptable.

2.02 DESCRIPTION

A. Modified bituminous roofing work including, but not limited to:

1. Two plies of approved ASTM D2178 Type IV glass fiber roofing felt bonded to the prepared substrate with hot bitumen.
2. The hot bitumen will consist of ASTM D312 Type III steep asphalt.
   a. Softening Point: 180 degrees F to 205 degrees F.
   b. Flash Point: 500 degrees F.
   c. Penetration at 77 Degrees F: 15 to 35 units.
   d. Ductility at 77 Degrees F: 2.5 centimeters.
3. All flashings will be set in bitumen and will be one ply of 40 mil SBS base flashing ply covered by an additional layer of modified bitumen membrane.
4. The modified membrane will be:
   a. STRESSPLY E, 135 mil SIS and SBS (Styrene-Isoprene-Styrene and Styrene-Butadiene-Styrene) rubber modified roofing membrane with fire retardant characteristics and reinforced with a dual fiberglass scrim and polyester mat.

2.03 BITUMINOUS MATERIALS

A. Asphalt Primer: V.O.C. compliant, ASTM D41.

B. Asphalt Roofing Mastic: V.O.C. compliant, ASTM D2822, Type II.

C. Interply Adhesive: Shall meet ASTM D312, Type III.

2.04 SHEET MATERIALS

A. Felt Plies: Fiberglass Felts, ASTM D2178, Type IV.

B. Base Flashing Ply, Versiply 40: 40 mil SBS modified membrane with woven fiberglass scrim reinforcement with the following minimum performance requirements according to ASTM D5147.

1. Properties: Finished Membrane:
   a. Tensile Strength (ASTM D5147): 2 in/min. at 73.4 plus or minus 3.6 degrees F, MD 205 lbf/in, CMD 205 lbf/in.
   b. Tear Strength (ASTM D5147): 2 in/min. at 73.4 plus or minus 3.6 degrees F, MD 295 lbf, CMD 280 lbf.
   c. Elongation at Maximum Tensile (ASTM D5147): 2 in/min. at 73.4 plus or minus 3.6 degrees F, MD 4.5 percent, CMD 5.0 percent.
2. Modified Flashing Ply: STRESSPLY "E" MINERAL.

3. Modified Membrane Properties: Finished Membrane:
   a. STRESSPLY E, ASTM D6162, Type III, Grade G.
      1) Tensile Strength (ASTM D5147): 2 in/min. at 73.4 plus or minus 3.6 degrees F, MD 500 lbf/in, CMD 550 lbf/in; 50 mm/min. at 23 plus or minus 3 degrees C, MD 122.5 kN/m, CM 131.25 kNm.
      2) Tear Strength (ASTM 5147): 2 in/min. at 73.4 plus or minus 3.6 degrees F, MD 900 lbf, CMD 950 lbf; 50 mm/min. at 23 plus or minus 3 degrees C, MD 5783N, CMD 6227N.
      3) Elongation at Maximum Tensile (ASTM D5147): 2 in/min. at 73.4 plus or minus 3.6 degrees F, MD 6.0 percent, CMD 6.0 percent; 50 mm/min. at 23 plus or minus 3 degrees C.
      4) Low Temperature Flexibility (ASTM D5147): Passes -30 degrees F (-34 degrees C).

2.05 SURFACINGS

A. Garla-Brite:

1. Flash Point: 103 degrees F (39 degrees C) minimum.
2. Weight/Gallon: 7.9 lbs./gal. (1.0 g/cm3).

2.06 RELATED MATERIALS

A. Base Sheet: Shall meet the requirements of ASTM D4601, Type II and be recommended and furnished by the membrane manufacturer.

B. Nails and Fasteners: Non-ferrous metal or galvanized steel, except that hard copper nails shall be used with copper; aluminum or stainless steel nails shall be used with aluminum; and stainless steel nails shall be used with stainless steel. Fasteners shall be self-clinching type or penetrating type as recommended by the manufacturer of the deck material. Nails and fasteners shall be flush-driven through flat metal discs of not less than 1-inch diameter. Metal discs may be omitted when one-piece composite nails or fasteners with heads not less than 1-inch diameter are used.

C. Metal Discs: Flat discs or caps of zinc-coated sheet metal not lighter than 28 gauge and not less than 1-inch in diameter. Discs shall be formed to prevent dishing. Bell or cup shaped caps are not acceptable.

D. Walkway Pads: As recommended and furnished by the membrane manufacturer.

E. Roof Insulation for Replacement of Wet Areas: Polyisocyanurate board as manufactured by the Celotex Corporation, Apache Products Company, GAF Materials Corporation, or equal to match existing.

PART 3 EXECUTION

3.01 EXAMINATION

A. Examine substrate surfaces to receive modified bitumen sheet roofing system and associated work and conditions under which roofing will be installed. Do not proceed with roofing until unsatisfactory conditions have been corrected in a manner acceptable to Roof System Manufacturer.

3.02 GENERAL INSTALLATION REQUIREMENTS

A. Cooperate with manufacturer, inspection, and test agencies engaged or required to perform services in connection with installing the roof system.

B. Insurance/Code Compliance: Where required, install and test the roofing system to comply with governing regulation and specified insurance requirements.

C. Protect other work from spillage of roofing materials and prevent materials from entering or clogging drains and conductors. Replace or restore other work damaged by installation of the modified bituminous roofing system work.

D. Coordinate installing roofing system components so that insulation and roofing plies are not exposed to precipitation or left exposed overnight. Provide cut-offs at end of each day's work to cover exposed ply sheets and insulation with two (2) plies of #15 organic roofing felt set in full moppings of bitumen and with joints and edges sealed with roofing cement. Remove cut-offs immediately before resuming work.

E. Asphalt Bitumen Heating: Heat and apply bitumen according to EVT Method as recommended by NRCA. Do not raise temperature above minimum normal fluid-holding temperature necessary to attain EVT (plus 5 degrees F at point of application) more than 1 hour prior to time of application. Determine flash point, finished blowing temperature, EVT, and fire-safe handling temperature of bitumen either by information from manufacturer or by suitable test. Do not exceed recommended temperature limits during bitumen heating. Do not heat to a temperature higher than 25 degrees below flash point. Discard bitumen that has been held at temperature exceeding finish blowing temperature (FBT) for more than 3 hours. Keep kettle lid closed except when adding bitumen.

F. Bitumen Mopping Weights: For interplay mopping, apply bitumen at the rate of approximately 25 pounds of bitumen per roof square. For a flood coat, apply bitumen at the rate of approximately 60 to 70 pounds of bitumen per square (plus or minus 25 percent on a total job average basis).

G. Substrate Joint Penetrations: Prevent bitumen from penetrating substrate joints, entering building, or damaging roofing system components or adjacent building construction.

H. Apply roofing materials as specified herein unless recommended otherwise by manufacturer's instructions. Keep roofing materials dry before and during application. Do not permit phased construction. Complete application of roofing plies, modified sheet and flashing in a continuous operation. Begin and apply only as much roofing in one day as can be completed that same day.

I. Cut-Offs: At end of each day's roofing installation, protect exposed edge of incomplete work, including ply sheets and insulation. Provide temporary covering of two (2) plies of #15 organic roofing felt set in full moppings of bitumen with joints and edges sealed.

3.03 HPR MODIFIED MEMBRANE APPLICATION

A. The modified membrane shall then be solidly bonded to the base layers with specified asphalt at the rate of 25 to 30 pounds per 100 square feet.

B. The roll must push a puddle of asphalt in front of it with asphalt slightly visible at all side laps. Care should be taken to eliminate air entrapment under the membrane.

C. Apply pressure to all seams to ensure that the laps are solidly bonded to substrate.

D. Subsequent rolls of modified shall be installed across the roof as above with a minimum of 4-inch side laps and 8-inch end laps. The end laps shall be staggered. The modified membrane shall be laid in the same direction as the underlayers but the laps shall not coincide with the laps of the base layers.

E. Apply asphalt no more than five feet ahead of each roll being embedded.

F. Extend membrane 2 inches beyond top edge of all cants in full moppings of the specified asphalt as shown on the Drawings.

3.04 FLASHING MEMBRANE INSTALLATION (GENERAL)

A. All curb, wall, and parapet flashings shall be sealed with an application of mastic and mesh on a daily basis. No condition should exist that will permit moisture entering behind, around or under the roof or flashing membrane.

B. Prepare all walls, penetrations, and expansion joints to be flashed and where shown on the Drawings with asphalt primer at the rate of 100 square feet per gallon. Allow primer to dry tack free.

C. The modified membrane will be used as the flashing membrane and will be adhered to an underlying base flashing ply with specified asphalt unless otherwise noted in these specifications and nailed off 8 inches O.C. at all vertical surfaces.

D. The entire sheet of flashing membrane must be solidly adhered to the substrate.

E. Seal all vertical laps of flashing membrane with a three-course application of Flashing Bond and fiberglass mesh.

F. Counter flashing, cap flashings, expansion joints, and similar work to be coordinated with modified bitumen roofing work are specified in other sections.

G. Roof accessories, miscellaneous sheet metal accessory items, including piping vents and other devices to be coordinated with the roofing system work are in other sections.

3.05 APPLICATION OF SURFACING

A. Aggregate Surfacing:

1. Apply surfacing materials in the quantities specified (500 pounds per square for aggregate, 400 pounds per square for slag). After felt flashings, tests, repairs, and corrective actions have been completed and approved. Uniformly embed aggregate in a flood coat of bitumen at a rate of 60 to 70 pounds per square coverage.
2. Aggregate shall be dry and placed in a manner required to form a compact, embedded overlay. To aid in proper embedment, aggregate may be lightly rolled provided that there is not damage to the built-up roofing membrane.

3.06 CLEANING

A. Remove drippage of bitumen adhesive from all walls, windows, floors, ladders, and finished surfaces.

B. In areas where finished surfaces are soiled by asphalt or any other sources of soiling caused by work of this section, consult manufacturer of surfaces for cleaning advice and conform to their instructions.

3.07 FINAL INSPECTION

A. At completion of roofing installation and associated work, meet with Installer, installer of associated work, Owner, roofing system manufacturer's representative, and other representatives directly concerned with performance of roofing system.

B. Walk roof surface areas of the building, inspect perimeter of building edges as well as flashing of roof penetrations, walls, curbs, and other equipment. List all items requiring correction or completion and furnish copy of list to each party attending.

C. The Roofing System Manufacturer reserves the right to request a thermographic scan of the roof during final inspection to determine if any damp or wet materials have been installed. The thermographic scan shall be provided by the Roofing Contractor at a negotiated price.

D. If core cuts verify the presence of damp or wet materials, the Roofing Contractor shall be required to replace the damaged areas at its own expense.

E. Repair or replace (as required) deteriorated or defective work found at time of inspection to a condition free of damage and deterioration at time of Substantial Completion and according to warranty requirements.

F. The Contractor is to notify the Owner upon completion of corrections.

G. Following the final inspection, acceptance will be made in writing by the material manufacturer.

END OF SECTION

SECTION 07620
SHEET METAL FLASHING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A153/A153M, Standard Specification for Zinc Coating (Hot-Dip) on Iron and Steel Hardware.
   b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   c. A666, Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, and Flat Bar.
   d. A924/A924M Standard Specification for General Requirements for Steel Sheet, Metallic-Coated by the Hot-Dip Process.
   e. B32, Standard Specification for Solder Metal.
   f. B209, Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate.
   g. B370, Standard Specification for Copper Sheet and Strip for Building Construction.
   h. C920, Standard Specification for Elastomeric Joint Sealants.
   i. C1311, Standard Specification for Solvent Release Sealants.
   j. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
   k. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
2. Federal Specifications (FS): QQ-L-201F(2), Lead Sheet.
3. Sheet Metal and Air Conditioning Contractors National Association (SMACNA): Architectural Sheet Metal Manual, 5th Edition.

1.02 PERFORMANCE REQUIREMENTS

A. General: Sheet metal flashing and trim shall withstand wind loads, structural movement, thermally induced movement, and exposure to weather without failing, rattling, leaking, and fastener disengagement.

B. Thermal Movements:

1. Provide sheet metal flashing and trim that allows for thermal movements resulting from the following maximum change (range) in ambient and surface temperatures by preventing buckling, opening of joints, hole elongation, overstressing of components, failure of joint sealants, failure of connections, and other detrimental effects.

2. Provide clips that resist rotation and avoid shear stress as a result of sheet metal and trim thermal movements.

C. Water Infiltration: Provide sheet metal flashing and trim that does not allow water infiltration to building interior.

1.03 QUALITY ASSURANCE

A. Sheet Metal Flashing and Trim Standard: Comply with SMACNA's "Architectural Sheet Metal Manual." Conform to dimensions and profiles shown, unless more stringent requirements are indicated.

1.04 SUBMITTALS

A. Action Submittals:

1. Samples: Color Samples for items to be factory finished.

1.05 DELIVERY, HANDLING, AND STORAGE

A. Inspect for damage, dampness, and wet storage stains upon delivery to Work Site.

B. Remove and replace damaged or permanently stained materials that cannot be restored to like-new condition.

C. Carefully handle to avoid damage to surfaces, edges, and ends.

D. Do not open packages until ready for use.

E. Store materials in dry, weathertight, ventilated areas until immediately before installation.

1.06 SPECIAL GUARANTEE

A. Product: Furnish manufacturer's extended guarantee or warranty, with Owner named as beneficiary, in writing, as Special Guarantee. Special Guarantee shall provide for correction or, at the option of the Owner, removal and replacement of factory-applied fluoropolymer coating, finish, and accessories found defective during a period of 20 years after date of Substantial Completion. Duties and obligations for correction or removal and replacement of defective Work shall be as specified in General Conditions.

B. Conditions:

1. Finish: No cracking, blistering, flaking, chipping, checking, chalking, peeling, or fading.
2. All Components: Watertight and weathertight with normal usage.

PART 2 PRODUCTS

2.01 METAL

A. Prefinished Aluminum Sheet: ASTM B209, alloy and temper as required for application and finish: 0.032-inch thick; shop precoated with fluoropolymer coating (Kynar polyvinylidene fluoride resin) coating; color as selected from manufacturer's standard color range.

2.02 REGLETS AND COUNTERFLASHING

A. Surface Mounted:

1. Stainless steel, 0.015 inch.
2. Manufacturers and Products:
   a. Fry Reglet Corp.; Fry Springlok Type SM and Springlok Flashing.
   b. Cheney Flashing Co.; Type D reglet and Snap Lock Cap Flashing.

2.03 PREFABRICATED METAL SYSTEMS

A. Coping System:

1. Snap-on system, stucco embossed pattern aluminum, 0.050-inch minimum thickness.
2. Include ancillary items, such as mitered and welded corners, and end caps, where shown and as required for complete system.
3. Manufacturers and Products:
   a. W.P. Hickman Co.; Permasnap Coping.
   b. MM Systems Corp.; Snap-Lok Coping.

B. Finish: Factory finished with full strength fluoropolymer coating (Kynar polyvinylidene fluoride resin) in color to be selected from manufacturer's standard color range.

2.04 DOWNSPOUTS, GUTTERS, SCUPPERS, AND CONDUCTOR HEADS

A. Same metal and thickness as flashing.

2.05 ANCILLARY MATERIALS

A. Solder: ASTM B32, alloy composition Sn 50 and Sn 60 for stainless steel.

B. Soldering Flux: ASTM B32, Type RA.

C. Sealing Tape: Polyisobutylene sealing tape.

D. Isolation Paint: As specified in Section 09902, Painting. System No. 2.

E. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil thick minimum polyester.

F. Plastic Roof Cement: ASTM D4586, Type II.

2.06 FABRICATION OF FLASHING

A. Field measure prior to fabrication.

B. Fabricate in accordance with SMACNA Architectural Sheet Metal Manual that apply to design, dimensions, metal, and other characteristics of item indicated.

C. Reinforcements and Supports: Provide same material as flashing, unless other material is shown. Steel, where shown or required, shall be galvanized or stainless.

D. Rigid Joints and Seams: Make mechanically strong. Seal aluminum joints with sealant.

E. Fabricate sheet metal in 10-foot maximum lengths, unless otherwise indicated.

F. Fabricate corners in one-piece with legs extending 30 inches each way to field joint. Lap, rivet, or solder corner seams watertight. Apply sealant if necessary.

G. Pipe Penetrations Through Roof: As shown on Drawings.

2.07 FABRICATION OF DOWNSPOUTS, GUTTERS, SCUPPERS, AND CONDUCTOR HEADS

A. Form downspouts and gutters in maximum lengths as practicable to sizes and shapes indicated on Drawings:

1. Telescope end joints 1-1/2 inches and lock longitudinal joints of downspouts.
2. Furnish elbows at bottom where downspouts empty onto splash blocks.
3. Fit downspouts into cast iron boots or drainpipes where indicated on Drawings; neatly caulk or cement joints.

B. Form scuppers and conductor heads to shapes and sizes indicated on Drawings.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify roof openings, curbs, pipes, sleeves, ducts, or vents through roof are solidly set, and cant strips and reglets in place.

B. Verify nailing strips and blocking are properly located.

C. Verify membrane termination and base flashings are in place, sealed, and secure.

3.02 INSTALLATION

A. Flashing:

1. General: Install sheet metal roof flashing and trim to comply with performance requirements and SMACNA's "Architectural Sheet Metal Manual." Provide concealed fasteners where possible, set units true to line, and level as indicated. Install work with laps, joints, and seams that will be permanently watertight.
2. Roof Edge Flashing: Anchor to resist uplift and outward forces according to recommendations in FMG Loss Prevention Data Sheet 1-49 for specified wind zone and as indicated.
   a. Interlock bottom edge of roof edge flashing with continuous cleats anchored to substrate at 16-inch centers.
3. Isolate metal from wood and concrete and from dissimilar metal with isolation tape or two coats of isolation paint.
4. Use only stainless steel fasteners to connect isolated dissimilar metals.
5. Joints: 10-foot maximum spacing and 2-1/2 feet from corners, butted with 3/16-inch space centered over matching 8-inch-long backing plate with sealing tape in laps.
6. Set flanges of flashings and roof accessories on continuous sealer tape or in plastic roof cement on top of envelope ply of roofing. Nail flanges through sealing tape and at 3-inch maximum spacing. Touch up isolation paint on flanges.
7. Joints, Fastenings, Reinforcements, and Supports: Sized and located as required to preclude distortion or displacement due to thermal expansion and contraction.
8. Provide continuous holddown clips at counterflashing and gravel stops.
9. Conceal fastenings wherever possible.
10. Set flashing and sheet metal to straight, true lines with exposed faces aligned in proper plane without bulges or waves.
11. At vents through roof turn down lead flashing minimum 2 inches inside vent pipe.

B. Prefabricated Metal Systems:

1. Follow system manufacturer's printed instructions.
2. Place color variations in pieces so no extremes are next to each other.

C. Downspouts, Gutters, Scuppers, and Conductor Heads: Anchor downspouts to wall with straps of same material as downspouts. Install gutters, scuppers, and conductor heads as indicated on Drawings.

3.03 FINISH

A. Exposed Surfaces of Flashing and Sheet Metalwork: Free of dents, scratches, abrasions, or other visible defects, and clean and ready for painting where applicable.

3.04 CLEANING AND PROTECTION

A. Clean exposed metal surfaces of substances that interfere with uniform oxidation and weathering.

B. Remove temporary protective coverings and strippable films as sheet metal flashing and trim are installed. On completion of installation, clean finished surfaces, including removing unused fasteners, metal filings, pop rivet stems, and pieces of flashing. Maintain in a clean condition during construction.

C. Replace sheet metal flashing and trim that have been damaged or that have deteriorated beyond successful repair by finish touchup or similar minor repair procedures.

END OF SECTION

SECTION 07700
ROOF SPECIALTIES AND ACCESSORIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Air Movement and Control Association International (AMCA).
2. American Architectural Manufacturers Association (AAMA).
3. ASTM International (ASTM):
   a. D1187, Standard Specification for Asphalt-Base Emulsions for Use as Protective Coatings for Metal.
   b. D4586, Standard Specification for Asphalt Roof Cement, Asbestos-Free.
4. FM (Factory Mutual) Global (FMG).
5. Underwriters Laboratories Inc. (UL).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings of each item specified showing materials, details, flashing, anchorage, and relation to adjacent structure.
2. Catalog cuts of each item specified item.

1.03 SEQUENCING AND SCHEDULING

A. Coordination: Schedule and coordinate work of this section with work of Section 07550, Modified Bitumen Sheet Roofing, and Section 07620, Sheet Metal Flashing.

PART 2 PRODUCTS

2.01 PIPE SEALS

A. Prefabricated one-piece aluminum flanged base with stepped, graduated EPDM cap and adjustable stainless steel clamps.

B. Manufacturers and Products:

1. Pate Co.; Pipe Seal.
2. Portals Plus, Inc.; Alumi-Flash.

2.02 VENT PIPE FLASHING

A. Prefabricated flashing with elastomeric collar and 24-gauge galvanized steel base, sized to fit vent pipe.

B. Manufacturer and Product: Oatey; No-Caulk Roof Flashing.

2.03 EXPANSION JOINT COVER

A. Flexible Bellows: 0.018-inch stainless steel flanges with factory formed joints, intersections, transitions, and fasteners as indicated or required.

B. Manufacturers and Products:

1. Building Materials Corp. of America; Metalastic.
2. Johns Manville; Expand-O-Flash.

2.04 ANCILLARY MATERIALS

A. Sealer Tape: Polyisobutylene sealer tape specifically manufactured for setting flanges on bituminous roofing.

B. Isolation Paint: As specified in Section 09902, Painting.

C. Coat aluminum surfaces in contact with concrete or dissimilar metals as specified in Section 09902, Painting.

D. Isolation Tape: Butyl or polyisobutylene, internally reinforced, or 20-mil thick minimum polyester.

E. Plastic Roof Cement: ASTM D4586, Type II.

F. Fasteners: Stainless steel of type required.

PART 3 EXECUTION

3.01 PREPARATION

A. Examine surfaces and structures to receive the Work of this section.

B. Take measurements at Site and fabricate work to suit. No changes shall be made in supporting structure to accommodate this Work.

3.02 INSTALLATION

A. General:

1. Install roof specialties and accessories as detailed in approved shop drawings and in conformance with manufacturer's instructions, recommendations, and standards.
2. Use appropriate pipe seal, or vent pipe flashing where pipe, conduit, or cable, etc., penetrate roofing membrane.
3. Factory Finished Units: Place color variations in pieces so no extremes are next to each other.
4. Make Work weathertight and free of expansion and contraction noise.
5. Maintain separation between aluminum surfaces and concrete or dissimilar metals as specified in Section 09902, Painting.

END OF SECTION

SECTION 07900
JOINT SEALANTS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. C661, Standard Test Method for Indentation Hardness of Elastomeric Type Sealants by Means of a Durometer.
   b. C920, Standard Specification for Elastomeric Joint Sealants.
   c. C1193, Standard Guide for Use of Joint Sealants.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Surface preparation instructions. Indicate where each product is proposed to be used.
2. Samples: Material proposed for use showing color range available.

B. Informational Submittals:

1. Installation instructions.
2. Applicator Qualification: Documentation showing minimum of 5 years' experience installing sealants in projects of similar scope.
3. Certificate of Compliance: Proposed materials meet Specification requirements.
4. Special guarantee.

1.03 ENVIRONMENTAL REQUIREMENTS

A. Ambient Temperature: Between 40 and 80 degrees F (4 and 27 degrees C) when sealant is applied. Consult manufacturer when sealant cannot be applied within these temperature ranges.

PART 2 PRODUCTS

2.01 SEALANT MATERIALS

A. Sealant Characteristics:

1. Uniform, homogeneous.
2. Free from lumps, skins, and coarse particles when mixed.
3. Nonstaining, nonbleeding.

4. Hardness of 15 minimum and 50 maximum, measured by ASTM C661 method.
5. Immersible may be substituted for nonimmersible.

B. Sealant Color: As selected by Owner's representative.

C. Type 1-Silicone, Nonsag, Nonimmersible:

1. Silicone base, single-component, chemical curing; ASTM C920, Type S, Grade NS, Class 25.
2. Capable of withstanding movement up to 50 percent of joint width.
3. Manufacturers and Products:
   a. Dow Corning Corp.; No. 790.
   b. General Electric; Silpruf.
   c. Sonneborn; Sonolastic Omniseal.

D. Type 5-One-Part Polyurethane, Immersible:

1. Polyurethane base, single-component, moisture curing; ASTM C920, Type S, Grade NS or P, Class 25.
2. Capable of being continuously immersed in water.
3. Manufacturers and Products for Nonsag:
   a. Sika Chemical Corp.; Sikaflex-1a.
   b. Mameco International; Vulkem 116.
4. Manufacturers and Products for Self-Leveling:
   a. Sonneborn; Sonolastic SL-1.
   b. Mameco International; Vulkem 45.

2.02 BACKUP MATERIAL

A. Nongassing, extruded, closed-cell round polyethylene foam rod, compatible with sealant used, and as recommended by sealant manufacturer.

B. Size: As shown or as recommended by sealant material manufacturer. Provide for joints greater than 3/16 inch wide.

C. Manufacturers and Products:

1. Haveg Industries; Minicel.
2. Dow Corning; Ethafoam SB.
3. Sonneborn; Sonofoam.
4. Hercules, Inc.; HBR.

2.03 ANCILLARY MATERIALS

A. Bond Breaker: Pressure sensitive tape as recommended by sealant manufacturer to suit application.

B. Joint Cleaner: Noncorrosive and nonstaining type, recommended by sealant manufacturer; compatible with joint forming materials.

C. Primer: Nonstaining type recommended by sealant manufacturer to suit application.

PART 3 EXECUTION

3.01 GENERAL

A. Use of more than one material for the same joint is not allowed unless approved by the sealant manufacturer.

B. Install joint sealants in accordance with ASTM C1193.

C. Use joint sealant as required for the applicable application.

3.02 PREPARATION

A. Verify that joint dimensions, and physical and environmental conditions, are acceptable to receive sealant.

B. Surfaces to be sealed shall be clean, dry, sound, and free of dust, loose mortar, oil, and other foreign materials.

1. Mask adjacent surfaces where necessary to maintain neat edge.
2. Starting of work will be construed as acceptance of subsurfaces.
3. Apply primer to dry surfaces as recommended by sealant manufacturer.

C. Verify that joint shaping materials and release tapes are compatible with sealant.

D. Examine joint dimensions and size materials to achieve required width/depth ratios.

E. Carefully follow manufacturer's instructions for mixing multi-component products.

3.03 INSTALLATION

A. Use joint filler to achieve required joint depths, to allow sealants to perform intended function.

1. Install backup material as recommended by sealant manufacturer.
2. Where possible, provide full length sections without splices; minimize number of splices.
3. Tape sealant may be used as joint filler if approved by sealant manufacturer.

B. Use bond breaker where recommended by sealant manufacturer.

C. Seal joints around window, door and louver frames, expansion joints, and elsewhere as indicated.

D. Joint Sealant Materials: Follow manufacturer's recommendation and instructions, filling joint completely from back to top, without voids.

E. Joints: Tool slightly concave after sealant is installed.

1. When tooling white or light color sealant, use a water wet tool.
2. Finish joints free of air pockets, foreign embedded matter, ridges, and sags.

3.04 CLEANING

A. Clean surfaces next to the sealed joints of smears or other soiling resultant of sealing application.

B. Replace damaged surfaces resulting from joint sealing or cleaning activities.

3.05 JOINT SEALANT SCHEDULE

A. Use sealant Type 1 for:

1. Masonry wall control joints.
2. Material joints at metal door frames, window frames, louver frames, and wall penetrations.

B. Use Sealant Type 5 for:

1. Threshold sealant bed.
2. Sheet metal flashing.

END OF SECTION

SECTION 08150
STEEL DOOR ASSEMBLIES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI):
   a. A250.6, Hardware on Standard Steel Doors (Reinforcement - Application).
   b. A250.8, Recommended Specifications for Standard Steel Doors and Frames.
   c. A250.11, Recommended Erection Instructions for Steel Frames.
2. Builders Hardware Manufacturers Association (BHMA):
   a. 101, Butts and Hinges.
   b. 601, Bored and Preassembled Locks & Latches.
   c. 301, Door Controls - Closers.
   d. 621, Mortise Locks & Latches.
   e. 1201, Auxiliary Hardware.
   f. 1301, Materials and Finishes.
3. Door and Hardware Institute (DHI): A115, Specifications for Hardware Preparations in Standard Steel Doors and Frames.
4. ASTM International (ASTM):
   a. A366, Standard Specification for Steel, Sheet, Carbon, Cold-Rolled, Commercial Quality.
   b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process.
   c. C1048, Standard Specification for Heated-Treated Flat Glass-Kind HS, Kind FT Coated and Uncoated Glass.

1.02 SUBMITTALS

A. Action Submittals:

1. Showing door and frame construction and anchorage details.
2. Complete Hardware Schedule, including numbers and finishes.

1.03 DELIVERY, STORAGE, AND HANDLING

A. Provide packaging such as cardboard or other containers, separation, banding, and wrappings.

B. Store doors upright, inside, at least 1 inch off floor.

1.04 EXTRA MATERIALS

A. Special Tools: Furnish two sets of those required for installation, maintenance, or adjustment.

PART 2 PRODUCTS

2.01 DOOR AND FRAME MATERIALS

A. Sheet Steel for Doors and Frames: Cold-rolled, stretcher level sheet, ASTM A366.

B. Ancillary Items: Manufacturer's standard core filler, anchors, and fasteners.

C. Louver: Manufacturer's standard fixed Double-Zee, 16-gauge minimum, 30 percent free area.

2.02 HARDWARE MATERIALS

A. General:

1. Furnish finish hardware with suitable stainless steel fasteners for complete installation.
2. Products complete and of equal quality and finish.

B. Butt Hinges: BHMA 101.

Type	Item	ANSI/BHMA	Stanley	McKinney
H1	Regular, ball bearing, NRP (non-removable pins)	A2112	FBB191	TB2314
H2	Plain bearing	A5133	F179	T2714

C. Locks and Latches: BHMA 601 or BHMA 621, keying on schedule; furnish two keys for each lock and two master keys.

Type	Item	ANSI/BHMA	Schlage Planet	Sargent LB	Best 4C
L1	Entrance lock	F82	D53PD	8G05	84K7AB
L2	Privacy lock	F76	D40S	8U65	84K0L
L3	Latch set	F75	D10S	8U15	84K0N
L4	Storage lock	F86	D80PD	8G04	84K7D

D. Closers: BHMA 301 with painted finish.

Type	Item	ANSI/BHMA	LCN	Sargent
C1	Regular arm	C02011	4010	350
C2	Parallel arm	C02021	4110-CNS	350-P

E. Stops: BHMA 1201.

Type	Item	ANSI/BHMA	Builder's Brass	Baldwin
S1	Floor stops	L02131	F121X	4086
S2	Wall bumper	L02251	WC9X	4031
S3	Floor stop and holder	L01371	F823X	4096

F. Bolts: BHMA 1201.

Type	Item	ANSI/BHMA	Stanley	Lawrence
B1	Top and bottom surface	L04151	CD4060	283

G. Thresholds:

Type	Item	ANSI/BHMA	Pemco	Reese
T1	Saddle	--	175A	S104A

H. Weatherstripping:

Type	Item	ANSI/BHMA	Pemco	Reese
W1	Head and jamb Door shoe Rain drip	--	S88D 222AV 346C	797B DB596AF R201C
W2	Head and jamb Door shoe	--	PF114PS 222AV	794B DB596AF
W3	Head and jamb Door shoe	--	S88D 222AV	797B DB596AF

I. Finishes: BHMA 1301, satin chromium-plated No. 626, unless indicated otherwise.

2.03 DOOR AND FRAME FABRICATION

A. Hollow Metal Doors and Frames: Meet requirements of DHI A115, ANSI A250.6, and ANSI A250.8.

B. Hollow Metal Doors:

1. Type F: Insulated, 1-3/4 inches thick, flush panel.
2. Flush end closure on top.
3. Furnish overlapping astragal on active leaf of pairs of doors.
4. Rust-inhibiting prime coating over ASTM A653/A653M A60 zinc coating.
5. Exterior: ANSI A250.8, Level 3, Model 1, 16 gauge.
6. Transom Panels: Match doors.

C. Hollow Metal Frames:

1. Welded type.
2. Exterior Frame Thickness: 14 gauge.

PART 3 EXECUTION

3.01 PREPARATION

A. Coordinate doors, frames, and hardware.

B. Provide hardware templates as required to door and frame manufacturers.

3.02 FRAME AND DOOR INSTALLATION

A. Frames: Plumb and square, in accordance with ANSI A250.11 and manufacturer's recommendations, and secure to adjacent construction.

B. Doors: ASTM A250.8.

C. Leave clean and undamaged.

D. Touch up prime coating.

3.03 HARDWARE INSTALLATION

A. Mounting Dimensions: Follow National Builder's Hardware Association Standard; lock and latch backset, 3-3/4 inches.

B. Follow manufacturer's instructions. Make Work neat and secure, developing full strength of components and providing intended function.

C. Prevent marring, scratching, or otherwise damaging adjacent finishes during installation.

D. Set stops over solid backing after painting is complete.

E. Cope ends of thresholds neatly to jamb profile and set in sealant, anchoring securely.

F. Do fitting, dismantling, and reinstalling of finish hardware required before and after painting.

G. After installation, adjust hardware for noise-free operation without resistance.

3.04 PROTECTION

A. Protect doors, frames, and hardware from damage after installation.

3.05 HARDWARE SETS

A. Hardware sets are guide to functional requirements of each opening. Provide hardware complete. Size omitted shall be as recommended by manufacturer.

Item	Type
HDW-5. Double Doors, with Lock	
3 Pair butts, 4-1/2 by 4-1/2	H1
1 Lock	L4
2 Floor stop and holders	S3
2 Surface bolts	B1
Thresholds	T1
1 Closer	C2
1 Set weatherstripping	W3

END OF SECTION

SECTION 09902
PAINTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. NACE International (NACE): RP0188, Discontinuity (Holiday) Testing of New Protective Coatings on Conductive Substrates.
2. NSF International (NSF): 61, Drinking Water System Components-Health Effects.
3. The Society for Protective Coatings (SSPC):
   a. PA 2, Measurement of Dry Coating Thickness with Magnetic Gages.
   b. PA 3, Guide to Safety in Paint Applications.
   c. SP 1, Solvent Cleaning.
   d. SP 2, Hand Tool Cleaning.
   e. SP 3, Power Tool Cleaning.
   f. SP 5, Joint Surface Preparation Standard White Metal Blast Cleaning.
   g. SP 6, Joint Surface Preparation Standard Commercial Blast Cleaning.
   h. SP 7, Joint Surface Preparation Standard Brush-Off Blast Cleaning.
   i. SP 10, Joint Surface Preparation Standard Near-White Blast Cleaning.
   j. SP 11, Power Tool Cleaning to Bare Metal.
   k. SP 12, Surface Preparation and Cleaning of Steel and Other Hard Materials by High- and Ultrahigh-Pressure Water Jetting Prior to Recoating.
   l. SP 13, Surface Preparation of Concrete.

1.02 DEFINITIONS

A. Terms used in this section:

1. Coverage: Total minimum dry film thickness in mils or square feet per gallon.
2. FRP: Fiberglass Reinforced Plastic.
3. HCl: Hydrochloric Acid.
4. MDFT: Minimum Dry Film Thickness, mils.
5. MDFTPC: Minimum Dry Film Thickness per Coat, mils.
6. Mil: Thousandth of an inch.
7. PDS: Product Data Sheet.
8. PSDS: Paint System Data Sheet.

9. PVC: Polyvinyl Chloride.
10. SFPG: Square Feet per Gallon.
11. SFPGPC: Square Feet per Gallon per Coat.
12. SP: Surface Preparation.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Product Data Sheets:
      1) For each product, furnish a Product Data Sheet (PDS), the manufacturer's technical data sheets, and paint colors available (where applicable). The PDS form is appended to the end of this section.
      2) For each paint system, furnish a Paint System Data Sheet (PSDS). The PSDS form is appended to the end of this section.
      3) Furnish copies of paint system submittals to coating applicator.
      4) Indiscriminate submittal of manufacturer's literature is not acceptable.

1.04 QUALITY ASSURANCE

A. Applicator's Experience: Minimum 5 years' practical experience in application of specified products.

B. Regulatory Requirements:

1. Meet federal, state, and local requirements limiting emission of volatile organic compounds.
2. Perform surface preparation and painting in accordance with recommendations of the following:
   a. Paint manufacturer's instructions.
   b. SSPC PA 3, Guide to Safety in Paint Applications.
   c. Federal, state, and local agencies having jurisdiction.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Deliver materials to Site in unopened containers that plainly show designated name, date of manufacture, color, and manufacturer.

B. Store paints in a protected area that is heated or cooled to maintain temperature range recommended by paint manufacturer.

1.06 PROJECT CONDITIONS

A. Environmental Requirements:

1. Do not apply paint in temperatures outside of manufacturer's recommended maximum or minimum allowable, or in dust, smoke-laden atmosphere, damp or humid weather.
2. Do not perform abrasive blast cleaning whenever relative humidity exceeds 85 percent, or whenever surface temperature is less than 5 degrees F above dewpoint of ambient air. Strictly adhere to coating manufacturer's recommendations.

1.07 EXTRA MATERIALS

A. Provide small quantity kits for touchup painting and for painting other small areas.

B. Fusion Bonded Coating: Provide appropriate liquid repair kits for field use.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Paint manufacturer shall be nationally recognized manufacturer of paints and protective coatings and regularly engaged in production of such materials that have essentially identical service conditions as this Project.

B. Minimum of 5 years' verifiable experience in manufacture of specified products.

C. Each of the following manufacturers is capable of supplying most of the products specified herein:

1. Ameron Protective Coatings, Brea, California.
2. Tnemec Coatings, Kansas City, Missouri.
3. ICI Devoe Coatings, Louisville, Kentucky.
4. Sherwin Williams, Cleveland, Ohio.
5. PPG, Pittsburgh, Pennsylvania.

2.02 PAINT MATERIALS

A. General:

1. Material Quality: Manufacturer's highest quality products and suitable for the intended service.
2. Materials, Including Primer and Finish Coats: Produced by same paint manufacturer.

3. Thinners, Cleaners, Driers, and Other Additives: As recommended by paint manufacturer of particular coating.

B. Products:

Product	Definition
Acrylic Latex	Single component, gloss as specified
Acrylic Sealer	Clear acrylic
Alkyd Enamel	Optimum quality, gloss or semigloss finish as specified, medium long oil
Bituminous Paint	Single-component, coal-tar pitch based
Coal-Tar Epoxy	Amine, polyamide, or phenolic epoxy type; 70% volume solids minimum, suitable for immersion service
Epoxy Filler/Surfacer	100 percent solids epoxy trowel grade filler and surfacer, nonshrinking, suitable for application to concrete and masonry. Approved for potable water contact and conforming to NSF 61, where required
Epoxy Primer	Converted epoxy primer containing rust-inhibitive pigments
High Build Epoxy	Polyamidoamine epoxy, minimum 69% volume solids, capability of 4 MDFT to 8 MDFT per coat
Inorganic Zinc Primer	Solvent or water based, having 85% metallic zinc content in the dry film; follow manufacturer's recommendation for topcoating
NSF Epoxy	Polyamidoamine epoxy, approved for potable water contact and conforming to NSF 61
Epoxy, High Solids	Polyamidoamine epoxy, 80% volume solids, minimum, suitable for immersion service
Polyurethane Enamel	Two-component, aliphatic or acrylic based polyurethane; high gloss finish
Rust-Inhibitive Primer	Single-package steel primers with anticorrosive pigment loading

Product	Definition
Silicone/Silicone Acrylic	Elevated temperature silicone or silicone/acrylic based
Stain, Concrete	Acrylic, water repellent, penetrating stain

2.03 COLORS

A. Provide as selected by Owner.

B. Formulate with colorants free of lead, lead compounds, or other materials, which might be affected by presence of hydrogen sulfide or other gas likely to be present at Site.

C. Proprietary identification of colors is for identification only. Any authorized manufacturer may supply matches.

D. Piping shall be color-coded, banded, and tagged or stenciled with flow directional arrows.

E. Color Coding General Notes:

1. All banding to be 2-inches wide and 4-feet on center.
2. Sample, drain, vent, metering, blowoff, decant, and hot lines shall be painted the same color combination as the piping system from which the line originates unless specified otherwise above. The additional pertinent text shall be applied to the pipe.
3. Insulated pipe, jacketed with canvas, shall be painted with the color combination specified above.
4. Insulated pipe, jacketed with aluminum and/or stainless steel shall have the jacket unpainted. When valves and fittings for such lines are not insulated, the valves and fittings shall be color coded.
5. Building service lines such as plumbing lines, HVAC lines, and electrical conduit, shall not be color coded but shall be painted the same color as the background construction.
6. All potable water not otherwise specified above shall be painted medium Blue and stenciled as directed by the Engineer.
7. All electrical conduits and junction boxes not otherwise specified above shall be painted orange and stenciled as directed by the Engineer.
8. All natural gas lines not otherwise specified above shall be painted red and stenciled as directed by the Engineer.
9. All sewer lines not otherwise specified above shall be painted brown and stenciled as directed by the Engineer.
10. FRP panels, stainless steel panels, valves, tanks, and instruments shall not be painted.
11. All coagulant lines shall be painted orange with black bands and stenciled with arrows as directed by the Engineer.

12. All polymer lines shall be painted light green with red bands and stenciled as directed by the Engineer.
13. All sodium hypochlorite lines shall be painted yellow with red bands and stenciled as directed by the Engineer.
14. All chemical piping shall be painted, chemicals missing shall be painted yellow and stenciled as directed by the Engineer.
15. All lettering shall be done in capital letters of approved size and type.
16. Legend symbols shall be applied on piping on every run and spaced not greater than 8 feet apart.
17. Text shall be applied on piping in the middle of pipe runs for runs under 50 feet or in one room, whichever is the least distance. On runs greater than 50 feet, text shall be applied at third points in the run and no more than 35 feet apart.
18. Pumps and other items of equipment to be painted shall be painted a color corresponding to their service, in accordance with the above schedule.

2.04 SHOP FINISHES

A. Shop Blast Cleaning: Reference paragraph Shop Coating Requirements, this section.

B. Surface Preparation: Provide Engineer minimum 7 days' advance notice to start of shop surface preparation work and coating application work.

C. Shop Coating Requirements:

1. When required by equipment Specifications, such equipment shall be primed and finish coated in shop by manufacturer and touched up in field with identical material after installation.
2. Where manufacturer's standard coating is not suitable for intended service condition, Engineer may approve use of a tie-coat to be used between manufacturer's standard coating and specified field finish. In such cases, tie-coat shall be surface tolerant epoxy as recommended by manufacturer of specified field finish coat. Coordinate details of equipment manufacturer's standard coating with field coating manufacturer.

PART 3 EXECUTION

3.01 GENERAL

A. Surface Preparation Inspection:

1. Inspect and provide substrate surfaces prepared in accordance with these Specifications and printed directions and recommendations of paint manufacturer whose product is to be applied. In event of conflict, more stringent shall apply.

2. Notify Engineer minimum 7 days' prior to start of surface preparation work or coating application work.
3. Perform work only in presence of Engineer, unless Engineer grants prior approval to perform work in Engineer's absence.

B. For coatings subject to immersion, obtain full cure for completed system. Consult coatings manufacturer's written instructions for these requirements. Do not immerse coating until completion of curing cycle.

C. The intention of these Specifications is for new, interior and exterior masonry and metal surfaces to be painted, whether specifically mentioned or not, except as modified herein.

D. Perform painting in accordance with recommendations of the following:

1. Paint manufacturer's instructions.
2. Federal, state, and local agencies having jurisdiction.

3.02 PROTECTION OF MATERIALS NOT TO BE PAINTED

A. Protect all surfaces adjacent to, or downwind of Work area from overspray. Contractor shall be responsible for any damages resulting from overspray.

B. Remove, mask, or otherwise protect hardware, lighting fixtures, switchplates, aluminum surfaces, machined surfaces, couplings, shafts, bearings, nameplates on machinery, and other surfaces not specified elsewhere.

C. Provide drop cloths to prevent paint materials from falling on or marring adjacent surfaces.

D. Protect working parts of mechanical and electrical equipment from damage.

E. Mask openings in motors to prevent paint and other materials from entering the motors.

3.03 FIELD SANDBLASTING

A. Perform sandblasting for items and equipment where specified, and as required to restore damaged surfaces previously shop or field blasted and primed. Materials, equipment, procedures shall meet requirements of SSPC.

3.04 PREPARATION OF SURFACES

A. Metal Surface Preparation:

1. General:
   a. Submit samples prior to surface preparation blasting.

b. Conform to current SSPC specifications as follows:
   1) Solvent Cleaning: SP 1.
   2) Hand Tool Cleaning: SP 2.
   3) Power Tool Cleaning: SP 3.
   4) White Metal Blast Cleaning: SP 5.
   5) Commercial Blast Cleaning: SP 6.
   6) Brush-Off Blast Cleaning: SP 7.
   7) Near-White Blast Cleaning: SP 10.
   8) Power Tool Cleaning to Bare Metal: SP 11.
   9) High Pressure Waterjetting: SP 12.

c. Where OSHA or EPA regulations preclude standard abrasive blast cleaning, wet- or vacu-blast methods may be required. Follow coatings manufacturers' recommendations for wet-blast additives and first coat application.

d. Hand-tool clean areas that cannot be cleaned by power-tool cleaning.

2. Blast Cleaning Requirements:
   a. Comply with applicable federal, state, and local, air pollution and environmental control regulations for blast cleaning and disposition of spent aggregate and debris.
   b. Alternatives to standard abrasive blast cleaning methods subject to Engineer review.

B. Masonry Surfaces:

1. Complete and cure masonry construction for 14 days or more before starting surface preparation work.
2. Remove oil, grease, dirt, salts or other chemicals, loose materials, or other foreign matter by solvent, detergent washing, or other suitable cleaning methods.
3. Clean masonry surfaces of mortar and grout spillage and other surface deposits using one of the following:
   a. Nonmetallic fiber brushes and commercial muriatic acid followed by rinsing with clean water.
   b. Brush-off blasting.
   c. Water blasting.
4. Do not damage masonry mortar joints or adjacent surfaces.
5. Leave surfaces clean and, unless otherwise required for proper adhesion, dry prior to painting.
6. Masonry Surfaces to be Painted: Uniform texture and free of surface imperfections that would impair the intended finished appearance.
7. Clear Coated Masonry Surfaces: Free of discolorations and uniform in texture after cleaning.

C. Concrete Surface Preparation:

1. Do not begin until 30 days after concrete has been placed.
2. Meet requirements of SSPC SP 13.
3. Remove grease, oil, dirt, salts or other chemicals, loose materials or other foreign matter by solvent, detergent, or other suitable cleaning methods.
4. Brush-off blast clean concrete surfaces to remove loose concrete and to provide a tooth for binding. If brush-off blasting is impractical, surface may be acid etched with muriatic acid solution. Approval is subject to producing desired profile equivalent to No. 80 grit flint sandpaper. Acid etching of vertical or overhead surfaces will not be accepted.
5. Unless otherwise required for proper adhesion, ensure surfaces are dry prior to painting.

3.05 PAINT MIXING

A. Multiple-Component Coatings:

1. Prepare using contents of container for each component as packaged by paint manufacturer.
2. No partial batches will be permitted.
3. Do not use multiple-component coatings that have been mixed beyond their pot life.
4. Mix only components specified and furnished by paint manufacturer.
5. Do not intermix additional components for reasons of color or otherwise, even within same generic type of coating.

B. Keep paint materials sealed when not in use.

C. Where more than one coat of material is applied within given system, alternate color to provide visual reference that required number of coats has been applied.

3.06 PAINT APPLICATION

A. General:

1. Inspection: Schedule with Engineer in advance for cleaned surfaces and all coats prior to succeeding coat.
2. Apply coating in accordance with paint manufacturer's recommendations. Allow sufficient time between coats to ensure thorough drying of previously applied paint.
3. Fusion Bonded Coating Application: Electrostatic, fluidized bed, or flocking.

4. Paint units to be bolted together and to structures, prior to assembly or installation.
5. Extent of Coating (Immersion): Coatings shall be applied to internal vessel and pipe surfaces, nozzle bores, flange gasket sealing surfaces, carbon steel internals, and stainless steel internals, unless otherwise specified.

B. Shop Primed or Factory Finished Surfaces:

1. Inspection: Schedule inspection for compliance with Specifications of shop primed or factory finished items with Engineer in advance of delivery to Site.
2. Hand or power sand areas of chipped, peeled, or abraded coating, feathering the edges. Follow with a spot primer using specified primer.
3. For two-package or converted coatings, consult coatings manufacturer for specific procedures as relates to manufacturer's products.
4. Prior to application of finish coats, clean shop-primed surfaces free of dirt, oil, and grease and apply mist coat of specified primer, 1-mil dry film thickness.
5. After welding, prepare and prime holdback areas as required for specified paint system. Apply primer in accordance with manufacturer's instructions.

C. Manufacturer Applied Paint Systems:

1. Repair abraded areas on factory finished items in accordance with equipment manufacturer's directions.
2. Carefully blend repaired areas into original finish.

D. Porous Surfaces, Such As Concrete and Masonry:

1. Filler/Surfacer: Use coating manufacturer's recommended product to fill air holes, bug holes, and other surface voids or defects.
2. Prime Coat:
   a. May be thinned to provide maximum penetration and adhesion.
   b. Type and Amount of Thinning: Determined by paint manufacturer and dependent upon surface density and type of coating.
3. Surfaces Specified to Receive Water Base Coating: Damp, but free of running water, just prior to application of coating.

E. Film Thickness and Coverage:

1. Number of Coats:
   a. Minimum required, irrespective of coating thickness.
   b. Additional coats may be required to obtain minimum required paint thickness, depending on method of application, differences in manufacturers' products, and atmospheric conditions.

2. Application Thickness:
   a. Do not exceed coating manufacturer's recommendations.
   b. Use wet film thickness gauge to measure proper coating thickness during application.
3. Film Thickness Measurement and Electrical Inspection of Coated Surface:
   a. Perform with properly calibrated instruments.
   b. Recoat and repair as necessary for compliance with Specifications.
   c. Coats will be subject to inspection by Engineer and coating manufacturer's representative.
4. Visually inspect concrete, nonferrous metal, plastic, and wood surfaces to ensure proper and complete coverage has been attained.
5. Give particular attention to edges, angles, flanges, and other similar areas, where insufficient film thickness are likely to be present, and ensure proper millage in these areas.
6. Apply additional coats as required to complete hiding of underlying coats. Hiding shall be so complete that additional coats would not increase hiding.

3.07 PROTECTIVE COATINGS SYSTEMS

A. System No. 1 Exposed Metal—Atmospheric:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 6, Commercial Blast Cleaning	Rust-Inhibitive Primer	1 coat, 2 MDFT
	Alkyd Enamel	2 coats, 4 MDFT

B. System No. 2 Aluminum and Dissimilar Metal Insulation:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 1, Solvent Cleaning	Prime in accordance with manufacturer's recommendations	
	Bituminous Paint	1 coat, 10 MDFT

3.08 ARCHITECTURAL PAINT SYSTEMS

A. System No. 3 Concrete and Masonry, Semigloss:

Surface Prep.	Paint Material	Min. Coats, Cover
Masonry	Block Filler	1 coat, 75 SFPGPC
	Acrylic Latex (semigloss)	2 coats, 240 SFPGPC

B. System No. 4 Steel Structure/Galvanized Metal Deck, Dryfall – Alkyd:

Surface Prep.	Paint Material	Min. Coats, Cover
SP 1, Solvent Cleaning	Direct-to-Metal Wash Primer	1 coat, 1.0 MDFT
	Alykd Dryfall (eggshell)	1-2 coats, 2 MDFTPC

C. System No. 5 Concrete Floors – Interior:

Surface Prep.	Paint Material	Min. Coats, Cover
Concrete	High Solids, Moisture Tolerant Polyamide Epoxy	1 coat, 5-8 MDFT
	High Solids, Polyamide Epoxy	1 coat, 5-8.0 MDFT

3.09 FIELD QUALITY CONTROL

A. Testing Equipment:

1. Provide magnetic type dry film thickness gauge, to test coating thickness specified in mils, as manufactured by Nordson Corp., Anaheim, CA; Mikrotest.
2. Provide electrical holiday detector, low voltage, wet sponge type, to test completed coating systems, 20 mils or less MDFT, for holidays and discontinuities as manufactured by Tinker and Rasor, San Gabriel, CA, Model M-1.
3. Provide high voltage holiday detector for coatings in excess of 20 mils MDFT. Unit as recommended by coating manufacturer.

B. Testing:

1. Thickness and Continuity Testing:
   a. Measure coating thickness specified in mils with magnetic type dry film thickness gauge in accordance with SSPC PA 2.
   b. Check each coat for correct millage. Do not make measurement within 8 hours, minimum, after application of coating.
   c. Test finish coat, 20 mils thick or less, except zinc primer, galvanizing, and elastomeric coatings, for holidays and discontinuities with electrical holiday detector, low voltage, wet sponge type in accordance with NACE RP0188.
   d. Holiday detect coatings in excess of 20 mils MDFT with high voltage units recommended by coating manufacturer, and in accordance with NACE RP0188.
   e. After repaired and recoated areas have dried sufficiently, retest each repaired area. Final test may also be conducted by Engineer.

C. Unsatisfactory Application:

1. Clean and top coat surfaces found to have improper finish color or insufficient film thickness.
2. Evidence of runs, bridges, shiners, laps, or other imperfections shall be cause for rejection.
3. Repair defects in coating system per written recommendations of coating manufacturer.
4. Leave staging up until Engineer has inspected surface or coating. Replace staging removed prior to approval by Engineer.

D. Damaged Coatings, Pinholes, and Holidays:

1. Feather edges and repair in accordance with recommendations of paint manufacturer.
2. Hand or power sand visible areas of chipped, peeled, or abraded paint, and feather edges. Follow with primer and finish coat in accordance with Specifications. Depending on extent of repair and appearance, finish sanding and topcoat may be required.
3. Repair fusion bonded coatings as recommended by original applicator.
4. Apply finish coats, including touchup and damage-repair coats, in a manner, which will present uniform texture and color-matched appearance.

3.10 CLEANUP

A. Place cloths and waste that might constitute fire hazard in closed metal containers or destroy at end of each day.

B. Upon completion of work, remove staging, scaffolding, and containers from Site or destroy in legal manner.

C. Completely remove paint spots, oil, or stains from adjacent surfaces and floors and leave entire job clean.

3.11 APPLICATION SCHEDULE

A. Surfaces Not Requiring Painting:

1. Unless otherwise stated herein or shown, the following areas or items will not require painting:
   a. Nonferrous and corrosion-resistant ferrous alloys such as copper, bronze, Monel, aluminum, chromium plate, atmospherically exposed weathering steel, and stainless steel, except where:
      1) Required for electrical insulation between dissimilar metals.
      2) Aluminum and stainless steel are embedded in concrete or masonry, or aluminum is in contact with concrete or masonry.
      3) Color coding of equipment and piping is required.
   b. Nonmetallic materials such as glass, wood and porcelain, except as required for architectural painting or color coding.
   c. Prefinished electrical and architectural items such as motor control centers, switchboards, switchgear, panelboards, transformers, disconnect switches, acoustical tile, cabinets, elevators, building louvers, wall panels, color coding of equipment is required.
   d. Nonsubmerged electrical conduits attached to unpainted concrete surfaces.
   e. Cathodic protection anodes.
   f. Insulated piping and insulated piping with jacket will not require exterior coating, except as required for architectural painting or color coding.

B. System No. 1 Exposed Metal—Atmospheric: Use on the following items or areas:

1. Exposed metal surfaces, new and located inside or outside of structures and exposed to weather, including metal doors and frames, vents, louvers, flashing, sheet metalwork and miscellaneous architectural metal trim.
2. Apply surface preparation and primer to surfaces prior to installation. Finish coats need only be applied to surfaces exposed after completion of construction.

C. System No. 3 Concrete and Masonry: Use on interior face of Filter Room.

END OF SECTION

SECTION 11229
PARALLEL PLATE GRAVITY SETTLER EQUIPMENT

PART 1 GENERAL

1.01 SCOPE

A. Two complete sets of parallel plate gravity settler equipment consisting of rapid mix tank, flocculation tank, sludge pumps, and parallel plate gravity settler, and elevated platforms, stairways, and hand railings, furnished under this section, shall be designed, fabricated, assembled, erected, and placed in proper operating condition in full conformity with the detail drawings and specifications, and instructions and recommendations of the manufacturer.

1.02 GENERAL REQUIREMENTS

A. Equipment furnished under this section shall be designed, fabricated, assembled, erected, and placed in proper operating condition in full conformity with local building codes, drawings, specifications, engineering data, instructions, and recommendations as furnished by the parallel plate gravity settler equipment manufacturer and approved by the Engineer.

B. One Manufacturer shall supply all equipment specified in this Section. Equipment shall not have been in service at any time prior to delivery. Provide sludge pumps as specified in Section 11315, Progressing Cavity Pumps. Manufacturer shall ensure compatibility of control signals between plate settler PLC and applicable chemical feed pumps and systems.

C. Basis of Design: Project drawings and equipment specifications for this project are based on the Parkson Corporation parallel plate gravity settler equipment. Any costs resulting from the use of equipment by another manufacturer shall be borne solely by the Contractor. The Contractor shall submit drawings and supporting documents, identifying all proposed changes, to the Engineer for approval. Supporting documents shall delineate all proposed changes and their associated costs.

D. All equipment shall be designed and fabricated in accordance with recognized engineering and fabrication standards. Codes and standards shall include but not limited to the following:

1. AISI, American Iron and Steel Institute.
2. AISC, American Institute of Steel Construction.
3. ASTM, American Society for Testing and Materials.
4. AWS, American Welding Society.
5. ANSI, American National Standards Institute.
6. Kentucky Building Code (KBC).

E. Responsibilities: The Manufacturer shall be responsible for delivery of equipment and supplies required under these specifications. The Contractor shall ensure that the parallel plate gravity settler system is in full accordance with these specifications and shall properly function as a unit. The Contractor shall bear ultimate responsibility for equipment coordination, installation, operation, and guarantees.

F. Experience: The Manufacturer shall have a minimum of ten (10) installations operating for at least five (5) years in the United States.

G. Acceptable Manufacturers: The drawings and specifications for the parallel plate gravity settler are based on Model LGS 1500/55 FD, as manufactured by Parkson Corporation. Acceptable alternate manufacturers are:

1. Siemens Water Technologies (U.S. Filter).
2. Meurer Research Inc. (MRI).

H. Contractor shall submit with Bid the following information from the alternate manufacturer(s):

1. Reference list with contacts.
2. Structural design calculations.
3. Hydraulic calculations showing head loss, water elevations, and maldistribution.
4. General arrangement drawing.

I. Contractor shall provide alternate manufacturers' equipment for at least 30 days of onsite pilot testing to confirm loading rates and sizing. Contractor shall furnish all costs for redesign of equipment by alternate manufacturers, if required. Owner will provide up to 30-day extension of substantial completion and final completion deadlines if there is testing of alternate equipment. No adjustment of contract price shall be allowed for this testing. If alternate manufacturer's equipment does not pass the pilot testing, then Contractor shall provide specified equipment from another manufacturer.

J. This unit shall be structurally designed with the following coefficients as required: Ss = 0.21; Ss,0 = 0.17; S1 and S1,0= 0.09. Seismic design category is C.

K. All submerged assembly bolts, nuts, and washers shall be Type 304 stainless steel (SST). All other assembly bolts, nuts, and washers shall be zinc plated in conformity with ASTM 307. All welded joints, which will be fully or partially submerged, shall be sealed watertight with continuous welds. All welding shall be in accordance with the latest acceptable codes of the American Welding Society (AWS). All tankage shall be shop-hydrostatically tested.

1.03 SUBMITTALS

A. Provide four (4) copies of Shop Drawing submittals. Submittals shall include, as a minimum, the following information:

1. The Contractor shall submit to the Engineer, for review, complete drawings showing installation details, materials of construction, arrangement details, loadings, elevations, and all items furnished under this section. All deviations from the Contract Documents shall be identified within the submittal.
2. The Contractor shall submit drawings and descriptive data of the parallel plate gravity settler and chemical feed systems for review. Sufficient data shall be provided to show that the equipment conforms to specification requirements, including:
   a. Flow diagrams of system showing location of equipment and devices.
   b. Elevations of weirs, troughs, and operating water levels.
   c. Materials of construction.
   d. Pertinent manufacturer's data.
   e. Head loss, loading rate, and hydraulic calculations.
   f. Equipment weight and load distributions.
   g. Plan and section view of equipment, platforms and stairs, and hand railings showing all important dimensions and details of construction.

B. The Manufacturer shall provide the Owner with four (4) copies of Installation, Operation & Maintenance Manuals. Manuals shall include:

1. Field erection instructions, unloading, handling and storage instructions at least 30 days prior to the scheduled delivery date of equipment.
2. Brief description of parallel plate components.
3. Start-up and shutdown procedures.
4. Special operating procedures.
5. Routine maintenance and cleaning procedures.
6. Operation and maintenance instructions, parts list, illustrations, and diagrams.
7. Safety instructions for operating personnel.

1.04 PRODUCT DELIVERY, STORAGE, AND HANDLING

A. The equipment shall be handled and stored at the jobsite in accordance with the manufacturer's recommendations. The equipment shall be suitably covered and protected at all times. Sufficient blocking shall be provided to prevent noticeable sagging of stored materials between supports and to prevent permanent distortion of the equipment.

1.05 WARRANTY

A. The Manufacturer shall warrant the Owner against defects in workmanship and materials, including parts and labor for twelve months from the placement of the equipment into service or eighteen months from the original date of shipment whichever expires first. The Manufacturer's warranty shall exclude loss, injury or damage resulting from improper installation, wiring, piping, care, maintenance, operation, supervision, or use of equipment.

PART 2 PRODUCTS

2.01 DESIGN REQUIREMENTS, EACH SETTLER UNIT

A. Design Flow: 400 gpm.

B. Influent Solids Concentration: 1,500 mg/L peak; 100 mg/L typical.

C. Effluent Solids Concentration: <30 mg/L.

D. Effective Loading Rate: 0.40 gpm/sq ft.

E. Projected Settling Area: 1,500 sq ft minimum.

F. Plate usage Efficiency: 80 percent.

G. Effective Settling Area: 1,200 sq ft.

H. Parkson Model: LGS 1500/55 FD.

2.02 DETENTION TANK

A. Furnish and install two detention tanks, 1,800 gallons each, 48 inches in diameter, approximately 20 feet of liquid depth, fabricated from welded steel pipe in conformance with AWWA M1 and coated with epoxy paint. Square bottom plate (54 by 54 inches) shall be filet-welded to tank with sufficient space for four anchor bolts, sized by manufacturer. Furnish nozzles as located on Drawings and as follows:

Name	Diameter, Inches	End Joint
Inlet	6	ANSI/AWWA C110/A21.10 flange
Outlet	8	ANSI/AWWA/C110/A21.10 flange
Drain	1-1/2	Threaded with plug valve and 1-1/2 inch hose fitting downstream of valve

B. The inlet nozzle shall be positioned 6 inches below the normal water surface as determined by the water surface in the plate settler unit. The outlet and drain nozzles shall be located flush with tank bottom. The flanged nozzles shall be extended 6 inches from edge of tank to face of flange. The top of tank shall be 12 inches above the normal water surface and equipped with a welded-on annular plate to serve as a platform for standing.

2.03 RAPID MIXING

A. The rapid mixing tank shall have a minimum volume of 140 gallons, and 2'-0" (L) by 2'-0" (W) by 6'-0" (H) dimensions. The tank shall be fabricated from ASTM A-36 steel having a thickness of 1/4-inch minimum. The flash tank shall have a single 3/4" FPT chemical injection port, and 10" feed inlet port with 150# ANSI slip-on raise face flange.

B. The rapid mixer shall be fixed speed comprised of a propeller mixer with a Nord hollow shaft gear reducer, 1/2 hp. Motor enclosure shall be TEFC rated for 200-230/460 volts, three-phase, 60 Hz.

C. The drive unit for the mixer shall consist of a cast iron heavy-duty speed reducer. The speed reducer shall be of parallel helical design. All gears shall be constructed of AGMA Quality 10 level, or better. The gear reducer shall have an AGMA Service factor of at least 1.5. Minimum B10 life for all bearings shall be 100,000 hours. Gear-tooth misalignment under full load conditions shall be less than 1/20 for the allowable gear-tooth error by AGMA standards. The speed reducer shall be capable of maintenance without removing the motor.

D. The mixer shaft shall be constructed of solid 1 1/4-inch diameter Aquamet 22 stainless steel. The mixer propeller shall be constructed of 316 SS.

2.04 FLOCCULATION

A. The flocculation tank shall have a minimum operating volume of 900 gallons, and 5'-0" (L) by 5'-0" (W) by 6'-0" (H) dimensions. The flocculation tank shall be constructed of ASTM A-36 carbon steel having a thickness of 1/4-inch, and supported in such a manner as to permit gravity flow directly into the settling unit. The tank and supports shall be structurally sound and stable. The tank shall be fitted with lifting lugs properly sized and placed to permit movement of the entire flocculation equipment unit (when empty) without distortion or damage to any component or surface. The flocculation tank shall have one stage of mixing.

B. The flocculator mixer shall be a mechanical variable slow-speed mixer comprised of paddle type mixer with a Nord helical worm hollow shaft gear reducer, 1/2 hp. Motor shall be TEFC, 200-230/460 volts, three-phase, 60 Hz. All gears shall be constructed of AGMA Quality 10 level, or better. The gear reducer shall have an AGMA Service factor of at least 1.5. Minimum B10 life for all bearings shall be 100,000 hours. Gear-tooth misalignment under full load conditions shall be less than 1/20 for the allowable gear-tooth error by AGMA standards.

C. The flocculator shaft shall be constructed of 304 SS. The paddle type agitator shall be constructed of epoxy-painted carbon steel and fully welded to the shaft. The agitator shall be properly sized to develop the required velocity gradient uniformly throughout the flocculation tank.

2.05 PARALLEL PLATE TANK

A. The parallel plate settling tank and sludge hopper shall be constructed of ASTM A-36 carbon steel having a minimum thickness of 1/4-inch. The influent shall enter through a removable influent box constructed of ASTM A-36, 14-gauge. The tank shall contain an upper clarification section and a single lower solids hopper section. An adjustable epoxy painted carbon steel weir plate shall be included to set the water level within the settling tank. The settling tank and sludge hopper are shop welded and shipped as one unit for field installation. All flanged connections including 12-inch effluent outlet, and 8-inch sludge outlet shall be standard 150# ANSI slip-on flanges. The parallel plate tank shall be installed plumb and level to within plus or minus 1/8". The tank shall include four (4) 1/2-inch sample taps with valves for sampling at different levels in the settled solids hopper. The tank shall be fitted with lifting lugs properly sized and placed to permit movement of the entire tank (when empty) without distortion or damage to any component or surface. The tank shall have no moving parts. The settled solids hopper shall have a 24-inch ID man-way with cover.

2.06 PARALLEL PLATE COMPONENTS

A. The internal plates shall be constructed of 0.09-inch minimum thick Orthophthalic FRP with continuous PVC I-Beam stiffeners, nylon fasteners and inclined at an angle of 55 degrees to the horizontal. The plates shall be flat, 10 feet long by 2 feet wide and have a smooth surface finish. The PVC stiffeners shall run the full length of the plates, forming a minimum flow profile ratio of 8:1, and shall be placed on maximum 12-inch centers. The plates shall be supported in such a manner that facilitates cleaning and maintenance of laminar flow without the development of undue stress or deflection and without production of vibration or movement during operation. All materials are resistant to degradation by UV radiation.

B. The laminar flow develops in the space between the plates and is maintained over the entire settling area of the unit. Plate spacing shall be 2 inches from the face of one plate to the face of the other, measuring perpendicular to both plates. Design shall ensure that the velocity throughout the unit is kept low to provide full utilization of all the plate area and to prevent the shearing of the flocs.

2.07 SLUDGE WASTE AND RECIRCULATION PUMPS

A. Motors shall be TEFC, 200-230/460 volts, three-phase, 60 Hz.

B. Furnish and install Sludge Waste and Recirculation Pumps as specified in Section 11315, Progressing Cavity Pumps.

2.08 EFFLUENT TROUGH

A. An effluent trough with submerged orifices constructed of ASTM A-36 carbon steel 14-gauge shall be provided to ensure a minimum pressure drop of 2 to 3 inches of water at design flow. Individual orifices shall be centered over each individual plate spacing to provide maximum plate utilization.

2.09 ELEVATED PLATFORM AND STAIRS

A. Unless otherwise indicated, meet the following requirements:

Item	ASTM Reference
Aluminum Extruded Shapes	ASTM B221
Aluminum Plates and Structural Shapes	B209 and B308/B308M, Alloy 6061-T6

B. Bolts, Washers, and Nuts: Use stainless steel, hot-dip galvanized steel, zinc-plated steel, or aluminum material types as required for compatibility of joined materials.

C. Design:

1. Uniform Service Load: 100 psf minimum, unless otherwise shown.
2. Maximum Deflection: 1/4-inch, unless otherwise shown.
3. Space bearing bars at 1-3/16 inch center-to-center.
4. Banding: 3/16 inch minimum.

D. Material:

1. Aluminum Plank Style Safety Grating walkway and platform.
2. Regular with serrated openings for slip resistant surface.

3. Manufacturers and Products:
   a. USG Industries, Metal Products Div., Chicago, IL; Grip-Strut.
   b. IKG/Borden, Clark, NJ; IKG/Deck Span.
   c. Morton Manufacturing Co., Libertyville, IL; Open-Grip.
   d. Cressona Aluminum Co., Cressona, PA; Diamondback.

E. Stair Treads:

1. Material and Type: Same as grating material and grating type as furnished for connecting walkway or work surface.
2. Nosings: Integral ribbing and serrated edge on one long axis of tread or nonslip, abrasive on each tread along one long edge.
3. Carrier Plate or Angle: Furnish at each end for connection to stair stringers.
4. Manufacturers: Same as for grating.

F. Accessories:

1. Anchor Rods and Nuts: Stainless Steel, ASTM A193 and ASTM A194, Type 316.
2. Removable Fastener Clips and Bolts:
   a. Removable from above grating walkway surface.
   b. Hat Bracket: Type 304 stainless steel.
   c. Bolt: Type 316 stainless steel.
   d. Manufacturer and Product: Struct-Fast, Wellesley Hills, MA; Gratefast.
3. Epoxy Anchoring System: HILTI HIT HY150 Epoxy System.

G. Fabrication:

1. Exposed Surfaces: Smooth finish and sharp, well-defined lines.
2. Furnish necessary rabbets, lugs, and brackets so work can be assembled in a neat, substantial manner.
3. Conceal fastenings where practical.
4. Drill metalwork and countersink holes as required for attaching hardware or other materials.
5. Weld Connections: Not permitted on grating.
6. Fabricate as shown and in accordance with manufacturer's recommendations.
7. Grind smooth sheared edges exposed in the finished work.
8. Any single grating section, individual plank, or plank assembly shall be not less than 1 foot 6 inches or greater than 3 feet 0 inch in width or weigh more than 150 pounds.

H. Design:

1. Section Length: Sufficient to prevent falling through clear opening when oriented in the span direction when one end is touching either the concrete or the vertical leg of grating support.
2. Minimum Bearing: ANSI/NAAMM MBG 531.
3. Furnish stainless steel Type 316 threaded anchor studs, as fasteners for grating attachment to metal supports either not embedded or partially embedded in concrete, as manufactured by Nelson Studs Welding Co., Lorain, OH.

I. Supports:

1. Seat angles and beams where shown.
2. Same material as rectangular bar grating.
3. Extruded aluminum frame with slot for recessed grating clips, as manufactured by Thompson Fabricating Co., for aluminum I-Bar type grating.
4. Coordinate dimensions and fabrication with grating to be supported.
5. Coordinate dimensions with increased depth due to serrations.

2.10 HAND RAILINGS

A. Structural Performance of Handrails: Design, fabricate, and install handrails to withstand the following structural loads without exceeding allowable design working stress or allowable deflection. Apply each load to produce maximum stress and deflection in each of the respective components comprising handrails.

1. Top Rail of Handrails: Capable of withstanding the following load cases applied in accordance with KBC.
   a. Concentrated load of 200 pounds applied at any point and in any direction.
   b. Uniform load of 50 pounds per lineal foot applied in any direction.
   c. Concentrated load need not be assumed to act concurrently with uniform loads in accordance with KBC.
2. In-Fill Area of Railing Systems:
   a. Capable of withstanding a horizontal concentrated load of 50 pounds applied to 1 square foot at any point in the system including panels, intermediate rails, balusters, or other elements composing the in-fill area.
   b. Horizontal concentrated load need not be assumed to act concurrently with loads on top rails of handrails.
3. Concrete Anchors: Allowable load values for size, length, embedment, spacing, and edge distance to match required loads shown in calculations.

4. General:
    a. Pop rivets and glued railing construction not permitted.

B. Manufacturers:

1. Thompson Fabricating Co., Birmingham, AL.
2. Moultrie Manufacturing, Moultrie, GA; Wesrail II.

C. Rails, Posts, and Formed Elbows: Extruded Alloy 6105-T5 or 6061-T6, minimum tensile strength of 38,000 psi and minimum yield strength of 35,000 psi.

1. Miscellaneous Aluminum Parts: 6063-T6 or 6061-T6 extruded aluminum of adequate strength for all loads.
2. Post and Railing: Nominal 1-1/2 inch diameter.
    a. Rails: 1.900-inch outside diameter by 0.145-inch wall thickness, Schedule 40.
    b. Posts: 1.900-inch outside diameter by 0.200-inch wall thickness, Schedule 80.
    c. Solid dowel interconnectors of 6105-T5 or 6061-T6 aluminum.

D. Fittings:

1. Handrail and Post Fittings: Extruded, machined bar stock, permanent mold castings, or die castings of sufficient strength to meet load requirements. Fittings shall match color of pipe in handrails. Sand cast parts not permitted.
2. Handrail Connections for Metal Stairway Stringers:
    a. Extruded aluminum bracket, Alloy 6063-T6.
    b. *Brackets bolts 1/2-inch diameter Type 304 or Type 316 stainless* steel bolts.
    c. Offset Adjustable Stair Fitting:
        1) Thompson Fabricating Co.; Part No. ASF of cast Al-mag.
        2) Moultrie Manufacturing Co.; Standard and custom elbow angles, Part No. W51XXX (numbers vary based on angle).
    d. Additional Offset Adjustable Fitting for Picket Railing System: Thompson Fabricating Co.; Part No. APF of cast Al-mag.
    e. Base connection:
        1) Manufacturers and Products:
            a) Thompson Fabricating Co.; Part Nos. SMB-2 or SMB-3, ASF, APF.
            b) Moultrie Manufacturing Co.; Part No. WIISMBEXT.
3. Handrail Connections for Metal Beams:
    a. Extruded aluminum bracket, Alloy 6063-T6.
    b. Bracket bolts 1/2-inch diameter Type 304 stainless steel bolts.

c. Manufacturers and Products:
   1) Thompson Fabricating Co.; Part Nos. SMB-2 or SMB-3. Use Part No. TSM-1.5 if bracket is attached to flat side of channel.
   2) Moultrie Manufacturing Co.; Part No. WIISMBEXT. Use Part No. WIISMB if bracket is attached to flat side of channel.

4. Miscellaneous Rail to Post Fittings:
   a. Aluminum Tee Fittings:
      1) Manufacturers and Products:
         a) Thompson Fabricating Co.; Part Nos. TF-1 and TX-1.
         b) Moultrie Manufacturing Co.; Part Nos. WIIT40, WIIT40/05, WIIT80, and WIIT80/05.
   b. Aluminum Ell Fittings:
      1) Manufacturers and Products:
         a) Thompson Fabricating Co.; Part Nos. TE-1, TE-2, and TE-3.
         b) Moultrie Manufacturing Co.; Part No. 51900.
   c. Aluminum Splice Lock:
      1) Manufacturers and Products:
         a) Thompson Fabricating Co.; Part No. SL-1.
         b) Moultrie Manufacturing Co.; Part No. WIIS40.
   d. Aluminum Expansion Joint Splice:
      1) Manufacturers and Products:
         a) Thompson Fabricating Co.; Part No. ES-1.
         b) Moultrie Manufacturing Co.; Part No. WII 40, omit set screws on one side.
   e. Formed Aluminum Wall Flange:
      1) Manufacturers and Products:
         a) Thompson Fabricating Co.; Part No. CF-2.
         b) Moultrie Manufacturing Co.; Part No. 41250.

5. Toeboards and Accessories:
   a. Material: Molded or extruded 6063 or 6061 aluminum.
   b. Manufacturers:
      1) Thompson Fabricating Co.
      2) Moultrie Manufacturing Co.; Part No. WIIKP20.

6. Castings for Handrails:
   a. Cast Al-mag with sufficient strength to meet load and test requirements.
   b. Anodizable grade finish with excellent resistance to corrosion when subject to exposure of sodium chloride solution intermittent spray and immersion.

E. Finishes:

1. Handrail Pipe and Post: In accordance with AA 45, designation AA-M32-C22-A41.
2. Cast Fittings and Toeboards: In accordance with AA 45, designation AA-M10-C22-A41.

F. Fabrication of Aluminum Handrails:

1. Shop Assembly:
   a. Post Spacing: Maximum 6-foot horizontal spacing.
   b. Railing Posts Bolted to Metal or Concrete:
      1) In lieu of field cutting, provide approved fitting with sufficient post overlap, containing provisions for vertical adjustment.
      2) Field fit-up is required.
   c. Free of burrs, nicks, and sharp edges when fabrication is complete.
   d. Welding is not permitted.
2. Shop/Factory Finishing:
   a. Use same alloy for uniform appearance throughout fabrication for railings.
   b. Handrail and Post Fittings: Match fittings with color of pipe in handrail.
   c. Sand cast parts not permitted.
3. Tolerances:
   a. Shop assemble rails, posts, and formed elbows with a close tolerance for tight fit.
   b. Fit dowels tightly inside posts.

2.11 CHLORINE RESIDUAL ANALYZER

A. Chlorine analyzer shall be suitable for continuous online service, using colorimetric DPD chemistry to continuously monitor free or total chlorine residual. Analyzer shall be capable of the following performance characteristics:

Parameter	Requirement
Range	0-5 mg/L
Accuracy	+/- 5% or 0.035 mg/L as Cl_2, whichever is greater
Precision	+/- 5% or 0.005 mg/L as Cl_2, whichever is greater
Minimum Detection Limit	0.035 mg/L
Maximum Cycle Time	2.5 minutes

Parameter	Requirement
Range	0-5 mg/L
Minimum Sample Inlet Pressure	1 psi
Sample Flow Rate	200-500 mL/min
Signal Outputs	4-20 ma, programmable over output span; two selectable alarms, each equipped with SPDT relays having 5-amp rated contacts
Enclosure	ABS plastic with digital display window
Power Requirements	120 VAC

B. Analyzer shall be HACH Model CL-17, or approved equal.

2.12 TURBIDIMETER

A. Turbidimeter shall be suitable for continuous online service, using the nephelometric process to continuously monitor turbidity. Analyzer shall be capable of the following performance characteristics:

Parameter	Requirement
Range	0.001 to 100 NTU
Accuracy	+/- 2% of reading or +/- 0.015 NTU, whichever is greater, from 0 to 10 NTU; +/- 5% of reading from 10 to 40 NTU; +/- 10% of reading from 40 to 100 NTU
Repeatability	Better than 1% of reading or +/- 0.002 NTU, whichever is greater
Signal Time	6-90 seconds, user defined
Minimum Sample Inlet Pressure	1 psi
Sample Flow Rate	200-750 mL/min
Signal Outputs	4-20 ma, programmable over output span; three selectable alarms, each equipped with SPDT relays having 5-amp rated contacts
Enclosure	ABS plastic with digital display window
Power Requirements	120 VAC

B. Analyzer shall be HACH Model 1720E, or approved equal.

2.13 SHOP PAINTING

A. The equipment shall be completely painted in the shop so that no field painting other than touch-up is required. Stainless steel, rubber, plastic, FRP, drives, motors, and fasteners shall not be painted.

1. Exterior Surfaces
   a. The surface shall be sandblasted to Commercial Blast Cleaning condition according to SSPC-SP-6 method, to obtain a surface profile of 1.5-3.0 mils.
   b. Base coat shall be Carboguard 890, Cycloaliphatic Amine Epoxy Mastic (Color White-S800), applied at a spread of 4.0-6.0 mils Dry Film Thickness (DFT).
   c. The finish coat shall be Carbocrylic 3359 DTM, Single Component, Water Based High Gloss Terpolymer Acrylic, or equal.
   d. Provide (Color Safety Blue-S150), or equal, applied at 3.0-5.0 mils DFT. Total DFT shall be 7.0-11.0 mils (7.0 mils minimum average). Base coat requires Carboline Thinner #2 for thinning and clean-up. Finish coat shall require no thinner. Clean potable water can be used.
2. Interior Surfaces
   a. The surface shall be sandblasted to White Metal Blast Cleaning condition according to SSPC-SP-5 method, to obtain a surface profile of 2.0-4.0 mils. Prime coat shall be Phenoline 373 Primer High Cross-Linked Modified Phenolic Epoxy, (Color White-0810), or equal, applied at 4.0-6.0 mils DFT. The finish coat shall be Phenoline 373 Finish, High Cross-Linked Modified Phenolic Epoxy (Color Gray-C703), or equal, applied at 4.0-6.0 mils DFT. Total DFT shall be 8.0-12.0 mils (8.0 mils minimum average). Phenoline 373 requires Phenoline Thinner for thinning and Carboline Thinner #2 for clean-up.

2.14 CONTROL SYSTEM

A. Control System Overview:

1. Equipment supplier shall provide Plate Settler Control Panels (PSCPs) for control of plate settler equipment units, associated chemical feed equipment, and associated sludge pumps. One panel shall be provided per settler equipment unit. Each PSCP shall house the control logic for controlling its associated equipment and communicate with plant SCADA control system as shown on drawings and in the specifications.
2. Control logic for the system shall follow the manufacturer's typical control scheme for plate settler equipment while providing functionality as described in the "User Requirements" supplement to this section.

3. Each PSCP will Directly Control:
    a. ON/OFF of the two (2) mixers per unit.
    b. Emergency stop.
    c. Timed automatic sludge wasting.
    d. ON/OFF of the FERION coagulant pumps.
    e. ON/OFF of the coagulant polymer feed pumps.
    f. OPEN/CLOSE of recirculation and effluent control valves.
4. The PSCP will Indirectly Control via Sending a Signal to the Plant SCADA Control System:
    a. ON/OFF for the hypochlorite pump.
    b. ON/OFF of the Spent Backwash Pumps.

B. Hardware:

1. Control Panel:
    a. The System supplier shall furnish electrical control panels as required to safely and efficiently operate the equipment according to the details on the plans and the specifications, and as required by the system supplier.
    b. Each control panel shall be located indoors and shall be sufficiently sized to house all components required.
    c. Each control panel shall be a stainless steel NEMA 4X rated, wall mounted enclosure, with a front panel disconnect and emergency stop push button. Each Control Panel shall comply with NEC Article 409 and UL508A Short-Circuit current rating labeling requirements.
    d. Programmable Logic Controller. For each panel, furnish, program, and install Allen-Bradley CompactLogix 1769-L32E PLC with a built-in interface for Ethernet/IP and a 8-inch color touchscreen operator interface with 512K memory, 512K flash back-up, and a minimum of 640x480 screen pixels. Furnish and install all necessary Ethernet capable communication interfaces to provide full communication capability with OWNER's SCADA system. Design and prepare program documentation to operate parallel plate settler units, pumps, valves, and ancillary equipment as described in "User Requirements" supplement to this section.

       The PLC program interlocks shall trigger a visual and audible alarm. Should the system experience a loss-of-power, the PLC shall remember where in the sequence of operation was interrupted, and continue from that point when power is restored, and the start button pressed. The PLC shall be connected to the plant SCADA system and allow all signals monitored by the PSCP PLC to be communicated to the plant SCADA system for display, trending, and other overall plant functions.

e. Power supply for control panel and motors shall be 208 volts, 60 hertz, three phase. A suitable transformer shall be included to step voltage down from 208 to 115 volts for control functions.

f. The color touchscreen operator interface shall provide the following capabilities at a minimum:
   1) "Process" screen, showing on/open status of all components during system operation.
   2) Continuous level displays for both the tanks.
   3) Alarm acknowledge and reset buttons.
   4) Password protection.
   5) "Alarm" screen showing all possible alarms, noting which alarms are currently present.
   6) Alarm 'history' screen.
   7) "Timers" screen, allowing the operator to set adjust various process timers.
   8) "Switches" screen, including H/O/A switches for all major components.
   9) Local/Remote capability.
   10) Screen contrast adjustment.
   11) Backlight-off screen saver.

2. Protective Devices:
   a. The panel shall be protected using circuit breaker and/or motor circuit protectors as permissible in the NEC and UL. Single phase wiring less than 250VAC/VDC shall be protected using fuses.
   b. Breakers shall be Cutler-Hammer, Square D, or equivalent. The main circuit breaker shall be UL 489 molded case thermal-magnetic type. Provide an external operating handle for the main circuit breaker. Motor branch circuit breakers are to be UL 489 molded case thermal-magnetic circuit breakers or instantaneous.

3. Terminal Blocks:
   a. Terminal blocks shall be vibration proof elastic tension clamp type to compensate for changes in the conductors caused by fluctuations in temperature.
   b. Terminal blocks for control wiring shall be 6mm wide and shall have a conductor cross section of 4 square millimeters.
   c. Terminal blocks shall have only one connection on the field side. provide terminal blocks with machine printed wire markers.
   d. Terminal blocks shall be mounted on DIN35 rail with all required accessories.
   e. Terminal blocks shall be Weidmuller type WDU 4 or equal.

4. Pushbuttons, Switches, and Indicator Lights:
   a. The control panel will have an ON/OFF switch and a running pilot light for each of the mixers.
   b. The control panel will have an E-stop pushbutton.
   c. These devices shall be by 22 mm in size and manufactured by Square D or equivalent.

d. All devices shall be NEMA 4X. Color and configuration of the devices shall be as reflected on the drawings.
e. All indicator lights shall be LED type.

5. Relays:
   a. Relays shall adhere to the following:
      1) General purpose control relays shall be 3PDT.
      2) Relays shall be socket mountable.
      3) Relays shall be Potter-Brumfield, Idec, Omron, or equal.
      4) Latching relays shall be Square D CAD Series.
      5) Relay contacts shall be 10 Amp or greater.
   b. Motor Starters:
      1) Magnetic starters, providing overload protection, shall be provided for each motor controlled from the PSCP. Starters shall be mounted in the same control panel by the equipment supplier and wired to their respective motors. One (1) NEMA motor starter shall be provided for each equipment motor, supplied by the plate settler equipment manufacturer.

PART 3 EXECUTION

3.01 EQUIPMENT INSTALLATION

A. It is the intent of these specifications that the parallel plate gravity settler equipment be installed complete and ready for operation in accordance with the specifications. Install all equipment in accordance with the manufacturer's instructions.

3.02 ELEVATED PLATFORMS, STAIRS AND HAND RAILINGS

A. Electrolytic Protection:

1. Aluminum in contact with dissimilar metals, other than stainless steel, and embedded or in contact with masonry, grout, and concrete, protect surfaces by coating with Bituminous Paint (10 mdft).
2. Allow paint to dry before installation of the material.

B. Installation:

1. Install supports such that grating sections have a solid bearing on both ends, and that rock and wobble grating movement does not occur under traffic loading.
2. Install plumb or level as applicable.
3. Install welded frames with anchors to straight plane without offsets.
4. Anchor grating securely to supports using minimum of four fastener clips and bolts per grating section.
5. Use stainless steel anchors and accessories with aluminum gratings.
6. Completed installation shall be rigid and neat in appearance.

7. Commercially Manufactured Products:
    a. Install in accordance with manufacturer's recommendations.
    b. Secure grating to support members with fasteners.
    c. Welding is not permitted.
    d. Fasteners: Field locate and install.
    e. Permit each grating section or plank style grating assembly to be easily removed and replaced.
8. Protect painted surfaces during installation.
9. Should coating become marred, prepare and touch up surface in accordance with paint manufacturer's instructions.

3.03 HANDRAILING

A. General:

1. Provide railing posts longer than needed and field cut to exact dimensions required in order to satisfy vertical variations on the actual structure. Install railing with a base that provides plus or minus 1/4-inch vertical adjustment inside the base fitting. If adjustment is required in the field and exceeds plus or minus 1/4-inch, reduce post length not to exceed beyond bottom of lowest set-screw or bolt in base fitting.
2. Field fabrication of aluminum railing systems not permitted.
3. Modification to structure not permitted where handrail is attached.
4. Assembly and Installation: Perform in accordance with manufacturer's written recommendations for installation.
5. Protection from Entrapped Water: Make provisions in interior installations.
6. Expansion Joints:
    a. At structural joints.
    b. Slip joint with internal sleeve extending 2 inches beyond each side of joint. Provide 1/2-inch slip joint gap to allow for expansion.
    c. Fasten to one side using 3/8-inch diameter set-screw. Place set-screw at bottom of pipe.
    d. Locate joints within 12 inches of posts. Locate expansion joints in rails that span expansion joints in structural walls and floors supporting the posts.

B. Posts and Rails:

1. Set posts plumb and aligned to within 1/8 inch in 12 feet.
2. Set rails horizontal or parallel to slope of steps to within 1/8 inch in 12 feet.
3. Install posts and rails in same plane. Remove projections or irregularities and provide a smooth surface for sliding hands continuously along top rail. Use offset rail for use on stairs and platforms if post is attached to web of stringers or structural platform supports.

4. Support 1-1/2-inch rails directly above stairway stringers with offset fittings.

C. Toeboard:

1. Provide at all handrails.
2. Accurately measure in field for correct length, after handrail post installation, cut and secure to posts.
3. Dimension between bottom of toeboard and walking surface not to exceed 1/4 inch.
4. Aluminum Toeboards: Provide expansion and contraction connections between each post.

D. Field Finishing:

1. Corrosion Protection: Prevent galvanic action and other forms of corrosion caused from direct contact with concrete and dissimilar metals by coating metal surfaces with bituminous paint.

E. Cleaning:

1. Wash railing system thoroughly using clean water and soap. Rinse with clean water.
2. Do not use acid solution, steel wool, or other harsh abrasive.
3. If stain remains after washing, restore in accordance with manufacturer's recommendations, or replace stained handrails.

3.04 FIELD TESTS

A. Functional Test: Prior to plant start up, all equipment described in this Specification shall be inspected for proper alignment, quiet operation, proper connection, and satisfactory performance by means of a functional test. Notify Owner 10 days in advance of scheduled testing.

B. Vibration Test: The complete assembly, consisting of the driving units, pumps and mixers, connected and in normal operation, shall not develop at any frequency or in any plane, peak-to-peak amplitudes of vibration exceeding 2.0 mils.

C. Performance Test:

1. To demonstrate that the equipment furnished hereunder is installed and performs in accordance with all provisions of this Specification, the Contractor shall conduct a comprehensive equipment conformance test on each parallel plate gravity settler system according to approved test procedures. Coagulant and polymer required for such tests will be supplied by the Owner. Raw water with varying degrees of turbidity will also be supplied by the Owner. Proposed test procedures shall be

submitted to the Engineer for approval 30 days before testing is scheduled to begin. Engineer shall be notified at least 10 days in advance of the actual test dates. A qualified representative of the equipment manufacturer shall direct the equipment test, analyze data, and certify the equipment performance during the test. The Engineer will observe all tests.

2. If, in the opinion of the Engineer, the equipment meets the requirements specified herein, the equipment will be classified as conforming. If, in the opinion of the Engineer, the equipment test performance results do not meet the requirements specified herein, the equipment will be classified as nonconforming.
3. In the case of nonconforming equipment, the Engineer may, at his option, either recommend withholding or making final payment. If final payment is made with the equipment specified herein classified as nonconforming, the guarantee period of 1 year on the nonconforming equipment will not commence until the Contractor has corrected the equipment and retested it as specified above and, in the opinion of the Engineer, the equipment is in conformance with these Specifications.

3.05 MANUFACTURERS' SERVICES

A. A manufacturer's technical representative for the equipment specified herein shall be present at the job site and/or classroom designated by the Owner for the minimum person-days listed for the services below, travel time excluded:

1. 3 person-days for installation assistance, inspection, and certification of the installation.
2. 2 person-days for functional and performance testing.
3. 1 person-day for pre-start up classroom or Job Site training of Owner's personnel.
4. 1 person-day for post-startup training of Owner's personnel.
5. 1 person-day for performance review after 3 months.
6. 1 person-day for performance review after 1 year.

B. Startup and assistance services shall be at such times as requested by the Contractor.

C. Training services for the Owner's personnel shall be at such times as requested by the Owner.

D. See Section 01640, Manufacturers' Services in Division 1, General Requirements.

3.06 SUPPLEMENTS

A. The supplement listed below, following "End of Section," are a part of this Specification.

1. 11229-1: User Requirements.

END OF SECTION

11229-1
USER REQUIREMENTS

A. Manual 4-position selector hand switch (Bypass – No.1 – No.2 – No. 1 and 2) bypass enables either or both units to operate.

B. On preset rising level HIGH in Spent BW Tank (SBWT) [T=0].

1. Lead pump (of two) starts. (Pumps alternate when in AUTO).
2. Jet mixing header valve FV 1008 also opens.

C. On preset elapsed time T1 (adjustable 0 to 30 minutes, but initially set at 2 minutes after SBWT pump startup):

1. Plate Settler Unit (PSU) TM-WW-M-1006 or TM-WW-M-1007 influent valves FV 1006A or FV 1007A open to make unit "active".
2. Sludge recycle valve FV 1006C or FV 1007C opens (normal position).
3. Sludge pump of active PSU starts. (This may be a solenoid valve on a compressed air supply line to this pump.)
4. Mixers of active PSU start.
5. Chemical feed pumps TM-WW-P-1001, TM-WW-P-1005 or TM-WW-P-1003, and TM-WW-P-1004 or TM-WW-P-1002 start and apply chemical to active PSUs.

D. On preset elapsed time T2 (adjustable 0 to 30 minutes, but initially set equal to 5 minutes):

1. PSU effluent FTW valve FV 1010A opens.
2. After fully opened, PSU effluent recycle valve FV 1010B closes.

E. On an adjustable preset reoccurring time interval:

1. Sludge waste valve FV 1006B or FV 1007B opens.
2. Sludge recycle valve FV 1006C or FV 1007C closes.
3. After adjustable preset elapsed time sludge recycle valve FV 1006C or FV 1007C opens.
4. Sludge waste valve FV 1006B or FV 1007B closes.

F. On rising HIGH HIGH level in SBWT, lag pump starts.

G. On preset falling level LOW in SBWT, lead pump stops.

H. On preset falling level LOW LOW in SBWT:

1. Lag pump stops.
2. Chemical pumps stop and solenoid valve opens to flush line with clear water.
3. Mixers shut off.

4. Sludge pump stops.
5. Sludge drain valve opens.
6. PSU effluent recycle valve opens.

NOTE: In normal operation above only one treatment unit is in operation. The second unit can be activated by opening influent valves FV 1006A or FV 1007A.

I. Emergency Shutdown:

1. In an emergency shutdown condition, PLC shall shutdown the plate settler equipment motors, associated chemical feed pumps, and spent backwash pumps.
2. Annunciate emergency shutdown condition locally and to the Plant SCADA system.

SECTION 11240
CHEMICAL FEED EQUIPMENT

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
2. Hydraulic Institute Standards.
3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

1.02 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Make, model, weight, and horsepower of each equipment assembly.
   b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   c. Performance data on pumps, including curves showing flow rate verses pump stroke or speed setting (in percent) at specified maximum speed in strokes per minute or rpm.
   d. Pump data sheet confirming pump capacity in gallons per hour and pressure in psig, required backpressure valve setting, pumped chemical characteristics, pipe connection sizes, stroke rate, materials, testing requirements, intermediate fluid type, and appurtenances to be provided with pumps.
   e. Detailed dimensional drawings for pump and driver, including mounting requirements and piping connection sizes and locations.
   f. Power and control wiring diagrams, including terminals and numbers.
   g. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
   h. Manufacturer's materials compatibility information, confirming compatibility of wetted parts with specified pumped chemicals.
   i. Factory finish system.

B. Informational Submittals:

1. Test reports.
2. Special shipping, storage and protection, and handling instructions.
3. Manufacturer's printed installation instructions.
4. Manufacturer's Certificate of Proper Installation.
5. Suggested spare parts list to maintain the equipment in service for a period of 1 year. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
6. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
7. Operation and Maintenance Data: As specified in Section 01430, Operation and Maintenance Data.

1.04 EXTRA MATERIALS

A. Furnish for each pump:

1. One complete set of any special tools required to dismantle pump.

PART 2 PRODUCTS

2.01 GENERAL

A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

B. Furnish a coordinated operating system complete with pump, drive, and speed controller.

2.02 SUPPLEMENTS

A. Some specific requirements are attached to this section as supplements.

2.03 MOTOR DRIVEN DIAPHRAGM PUMPS

A. Positive displacement self-compensating hydraulically activated diaphragm type consisting of simplex or duplex pumping heads with internal automatic pressure relief valve, and external manually adjustable stroke positioner. Pump shall be able to receive ON-OFF control signal from plant SCADA system or plate settler control panel PLC.

B. Diaphragm shall be compression-molded Teflon or compression-molded Teflon composite with internal O-ring seal.

C. Bearings, tapered roller or needle type. Gearing, polished steel or bronze worm type. Mount bearings and internal working parts in weather-resistant gear box with moving parts oil flooded.

D. Lubricant, nontoxic food grade quality.

E. Pump leakage shall be prevented through hydraulically actuated balanced diaphragm design.

F. Pump shall include adjustable, spring-loaded internal pressure relief valve to protect pump against excessive hydraulic pressure.

2.04 PERISTALTIC METERING PUMP

A. Positive displacement peristaltic type, complete with spring-loaded pump head, self-contained variable speed drive, and flexible extruded tube. Drive unit shall be reversible, brush-less motor with 100 to 1 minimum turndown capability. Housing shall be ABS plastic. Provide safety valve and back pressure valve. Pump shall be able to receive ON-OFF control signal from plant SCADA system or plate settler control panel PLC.

2.05 TANKS AND MIXERS

A. Tanks, stands, and mixers shall be furnished from one supplier. Provide two Cone Bottom Tanks with nominal capacity of 200 gallons each. Tanks shall be capable of completely draining contents with flanged bottom outlet nozzles. Tanks shall be suitable for a 0.5 percent solution of Ciba MAGNAFLOC LT22S flocculant polymer, or equivalent, with a solution pH of 3.5. Tanks shall be equipped with Type 316 stainless steel or FRP stands to support the conical bottoms. Tanks and lids shall be manufactured from medium- or high-density polyethylene with UV inhibitors and designed for containment of liquids of up to 1.7 specific gravity. Tank walls shall be translucent for level viewing and equipped with gallon indicators.

B. Furnish and install two 350-RPM, gear-driven mixers with Type 316 stainless steel shafts and propellers, and 1.0 pitch ratio marine propellers. Flow coefficient and power consumption characteristics shall be equal to those of the best hydrofoil impeller designs, and shall be suitable for the tank volume and solution with a viscosity of 700 cp. Provide adjustable shaft angle to achieve optimum mixing for various processing needs. Motors shall be enclosed, fan cooled (TEFC). Mixers shall be permanently greased gears and mixer shaft bearings shall be permanently lubricated. Mixer stands, supports, and fittings shall be constructed of Type 316 stainless steel.

C. Furnish two low-profile containment tubs for the 200-gallon tanks and two low-profile containment tubs for the 400-gallon carboys that will hold coagulant product. Tubs shall be constructed of 100 percent polyethylene, each designed and sized for the capacity of tank or carboy being supported. Tubs shall not obstruct bottom tank outlets.

D. Tanks, stands, and mixers shall be as manufactured by Chem-Tainer Industries, JC series, or approved equal.

2.06 DRY POLYMER PROCESSING SYSTEM

A. Dry Polymer Processing System shall be a complete skid-mounted package unit, Acrison Model 515 or equal, consisting of dry solids Acrison Model W-105 Series feeder with 2.0-cubic-foot Type 304 stainless steel (SST) hopper, Type 316 SST cyclone wetting chamber, solution transfer pump, water supply appurtenances (pressure regulating valve, pressure switch, pressure gage, solenoid valve and flow meter), 100 gallon, 11-gauge Type 304 SST mix tank with SST mixer, motorized transfer valve, 200 gallon, 11-gauge Type 304 SST aging tank, tank level sensors, and NEMA 4X control panel that provides a complete system capable of wetting, mixing and ageing 2.5 pounds of dry polymer per 100 gallons of water. Solution metering will occur at an average rate of 120 gallons per hour.

B. Dry polymer will be loaded into the feeder hopper and then accurately metered within +/-2 percent error, or better, at a preset rate by feeder into the wetting chamber where it mixes with either cold or tempered water. A low level switch shall be included and installed in the feeder's hopper to energize a visual and audible alarm in the control panel when material reaches a predetermined low level.

C. Within wetting chamber turbulently flowing water shall effectively and efficiently wet the polymer without clumping, agglomeration or "fisheyes." (Polymer will be SALFLOC 6950, manufactured by Neo-Solutions, Inc. in Beaver, PA, or similar product.) The completely wetted polymer will then drop directly into the solution transfer pump and immediately and continuously transferred into a mixing tank without damaging the polymer chains. The transfer pump shall be attached directly to the outlet of the wetting chamber for transferring the wetted polymer to the mixing tank. The transfer pump shall be Type 316 SST in construction, shall have a mechanical shaft seal, and be directly coupled to a 3/4 horsepower, totally enclosed, constant speed motor. The transfer pump shall have a minimum capacity of 30 gpm at 40 feet. TDH. A check valve shall be mounted on the discharge side of the pump to prevent backflow of polymer solution. Connection between pump outlet and check valve shall be clear to allow for visual inspection of the process.

D. A low level probe, located in the mixing tank, shall initiate startup of the system; a high level probe will shut off the processing module. A slow speed mixer is shall be installed in this tank. Logic for the automatic transfer of solution to the age tank, through a transfer valve, is provided upon command from a level probe in the age tank.

E. The entire System operation shall be performed from a NEMA 4X control panel. The Control Panel shall comply with NEC Article 409 and UL508A Short-Circuit current rating labeling requirements. An Allen-Bradley CompactLogix 1769-L32E PLC with a built-in interface for Ethernet/IP connectivity shall be provided as standard. Operator interface shall be a 8-inch color touch screen display with 512K memory, 512K flash back-up, and a minimum of 640x480 screen pixels. The panel shall also include a main disconnect and an emergency stop push-button. The PLC program shall include an interlock to prevent feeding of dry polymer unless water is being supplied to the wetting chamber and all motors are operational. Interlocks shall trigger a visual and audible alarm. Should the system experience a loss-of-power, the PLC shall remember where in the sequence of operation the polymer preparation module was interrupted, and continue from that point when power is restored, and the start button pressed. The PLC shall be connected to the plant SCADA system and allow all signals monitored by the polymer system PLC to be communicated to the plant SCADA system for display, trending, and other overall plant functions.

1. Magnetic starters, providing overload protection, shall be provided for each motor. Starters shall be mounted in the same control panel by the equipment supplier and wired to their respective motors. Power supply for motors shall be 208 volts, 60 Hertz, three phase. A suitable transformer shall be included to step voltage down from 208 to 115 volts for control functions.
2. The color touchscreen operator interface shall provide the following capabilities at a minimum:
    a. "Process" screen, showing ON/OPEN status of all components during system operation.
    b. Continuous level displays for both the mixing and aging tanks.
    c. Resettable batch counter.
    d. Alarm acknowledge and reset buttons.
    e. Password protection.
    f. "Alarm" screen showing all possible alarms, noting which alarms are currently present.
    g. Alarm 'history' screen.
    h. "Timers" screen, allowing the operator to set feeder, mixer, and emulsion pump timers, in addition to various system delay timers.
    i. "Switches" screen, including H/O/A switches for all major components.
    j. Local/Remote capability.

k. Liquid/Dry Mode Switch – Switching from one mode to the other will only require setting this switch to the proper position.
l. "Levels" screen, allowing the operator to set mixing and aging tank control and alarm levels.
m. Screen contrast adjustment.
n. Backlight-off screen saver.

3. The control panel shall be mounted to the same skid as the dry polymer feeder and pre-wired.
4. Prepared polymer solution shall then be fed into the process at the desired rate by one of two metering pumps as specified elsewhere in this Specification Section.

2.07 PULSATION DAMPENERS

A. Single-diaphragm type mounted on discharge piping as shown for pneumatic-hydraulic pulsation dampening. Size for pump stroke volume. Body and diaphragm material shall be manufacturer's standard for service conditions.

B. Air charging valve and pressure gauge.

2.08 VALVES

A. Adjustable diaphragm backpressure sustaining type installed on pump discharge as shown on Drawings and set as recommended by pump manufacturer.

B. Adjustable pressure relief type installed on pump discharge as shown on Drawings and set as recommended by pump manufacturer.

2.09 PUMP OUTPUT CONTROL

A. Manual Stroke Adjustment: Provide manual stroke length adjustment through adjustment knob on unit that provides adjustment accuracy of 1 percent. Adjustment shall be self-locking, and shall be operable whether or not pump is running.

B. Adjustable Speed (Stroke Frequency) Adjustment: Provide adjustable speed operation of pump using DC SCR drive unless otherwise specified on Pump Data Sheet. Coordinate pump motor type with drive unit provided. DC SCR drive shall not cause more than 1 percent harmonic distortion into power supply voltage waveform, as defined by IEEE Standard 519. Furnish isolation transformers or filtering devices as necessary to meet this requirement. Drive unit shall include integral or separate control panel with speed indication in percent, HAND/OFF/AUTO selector switch, and manual adjustable potentiometer for adjustment of pump speed when in HAND position. Drive

shall accept external 4-20 mA dc control signal to provide linear adjustment of pump speed from zero to 100 percent when in AUTO position. Provide DRIVE FAIL and ON/OFF discrete output signals. Provide 4-20 mA analog output signal for drive speed.

2.10 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05500, Metal Fabrications and Castings.

D. Gauge Connections: Tapped and plugged suction and discharge gauge connections on piping headers adjacent to pumps.

E. Screens or Guards: Mesh size of less than 0.5 inch, exposed rotating shafts, rotors, couplings, pulley, wheel, bolts, chains, or similar components. Where guards/screens are over grease fittings, couplings, or other items requiring maintenance, provide a means for ready access.

F. Calibrated Cylinder: Constructed of clear polypropylene and PVC with ball type shutoff valve. Provide calibration column as specified on Pump Data Sheet.

2.11 FACTORY FINISHING

A. Manufacturer's standard baked enamel finish.

2.12 SOURCE QUALITY CONTROL

A. Factory Test Report: Include test data sheets.

B. Functional Test: Perform manufacturer's standard test on equipment.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions .

B. Anchor Bolts: Accurately place using equipment templates and as specified in Section 05500, Metal Fabrications and Castings.

3.02 FIELD QUALITY CONTROL

A. Conduct tests on each pump.

B. Functional Test:

1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.

C. Performance Test:

1. Perform under actual or approved simulated operating conditions.
2. Test for a continuous 3-hour period without malfunction.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. One (1) person-days for installation assistance, inspection, functional and performance testing, and completion of Manufacturer's Certificate of Proper Installation.
2. One (1) person-days for prestartup classroom or Site training and facility startup.

B. See Section 01640, Manufacturers' Services and Section 01810, Equipment Testing and Facility Startup.

3.04 SUPPLEMENTS

A. Supplement listed below, following "END OF SECTION," are part of this Specification.

1. Data Sheets: Pump and motor.

END OF SECTION

CHEMICAL METERING PUMP DATA SHEET, 11240-01

Tag Numbers: TM-WW-D-1001

Pump Name: SODIUM HYPOCHLORITE PERISTALTIC PUMP

Manufacturer and Model Number: (1) WATSON-MARLOW, MODEL 520 DUN/R2
(2) COLE PARMER, MODEL MASTERFLEX L/S

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): SODIUM HYPOCHLORITE, 15 TRADE PERCENT

Pumping Temperature (Fahrenheit): Normal: 65 Max: 80 Min: 50

Liquid pH: 11.2 Specific Gravity: 1.21

Abrasive (Y/N): N Possible Scale Buildup (Y/N): Y

Suction Pressure (psig): Minimum: 0

Altitude (ft msl): 520 Area Classification: _____ Location (indoor/outdoor): INDOOR

PERFORMANCE REQUIREMENTS

Capacity (US gph): Maximum: 2.5 GAL/HOUR Minimum: 0.025 GAL/HOUR

Maximum Discharge Pressure (psig): 20

Internal Bypass Valve Setting (psig): 30

Relief Valve Setting (psig/as recommended): AS RECOMMENDED

Back Pressure Valve Setting (psig/as recommended): N/A

Max. Speed Rate (rpm): Mfr. (1) 220 RPM Mfr. (2) 220 RPM

DESIGN AND MATERIALS

Pump Type: PERISTALTIC

Tubular Material: MARPRENE OR TYGON

Wet End Material: N/A Tubular Diaphragm Housing Material: _____

Check Valve Material: N/A Configuration(Single/Double): _____

Diaphragm Material: N/A Primary: _____ Tubular: _____

Calibration Cylinder: Quantity: 1 Material: PVC Units: 0.001 GAL Capacity: 0.1 GAL

Diaphragm Actuation Type: Mechanical: N/A Hydraulic: N/A

Stroke Position Adjustment: Manual: N/A Automatic: N/A

Pump Speed Control: Constant: _____ Variable: PWM

CHEMICAL METERING PUMP DATA SHEET, 11240-01

Tag Numbers: TM-WW-P-1001

DRIVE MOTOR (See Section 16220, Low Voltage AC Induction Motors)

Horsepower: 1/10 Voltage: 115 Phase: 1 Synchronous Speed (rpm)_____

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC _X_ CISD-TEFC _____
TENV _____WPI _____ WPII _____ SUBM _____

TESTING

Pump Tests: Factory Functional (Y/N) N Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) N Other _____

REMARKS

PROVIDE 50 FEET OF SPARE TUBING.

PROVIDE FOR 4-20 MA INPUT SPEED CONTROL AND 4-20 MA TACHOMETER

OUTPUT SIGNALS.

PWM PUMP SPEED CONTROL: PROVIDE MANUFACTURER'S STANDARD UNIT.

CHEMICAL METERING PUMP DATA SHEET, 11240-02

Tag Numbers: TM-WW-P-1004 and -1005

Pump Name: PRIMARY COAGULANT PUMP

Manufacturer and Model Number: (1) MILTON ROY; CENTRAC S
(2) PULSAFEEDER; CHEM-TECH SERIES 150
(3) PROMINENT; ALPHA/B

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): FER+ION 305, GENERAL CHEMICAL (FERRIC SULFATE MIXTURE

Pumping Temperature (Fahrenheit): Normal: 65 Max: 80 Min: 50

Liquid pH: 3.5 Viscosity at 25°C: 122 cp

Abrasive (Y/N): N Possible Scale Buildup (Y/N): N

Suction Pressure (psig): Minimum -3

Altitude (ft msl): 520 Area Classification: 36 Location (indoor/outdoor): INDOOR

PERFORMANCE REQUIREMENTS

Capacity (US gph): Maximum: 1.5 GAL/HOUR Minimum: 0.03 GAL/HOUR

Maximum Discharge Pressure (psig): 30 PSI

Internal Bypass Valve Setting (psig): 40 PSI

Relief Valve Setting (psig/as recommended): AS RECOMMENDED

Back Pressure Valve Setting (psig/as recommended): AS RECOMMENDED

Max. Stroke Rate (spm): Mfr. (1) 100 Mfr. (2) 100

DESIGN AND MATERIALS

Pump Type: Single Diaphragm (Y/N) Y

Tubular (double) Diaphragm (Y/N) N Other

Wet End Material: PVDF Tubular Diaphragm Housing Material: N/A

Check Valve Material: CERAMIC Configuration(Single/Double): DOUBLE

Diaphragm Material: PTFE Primary: N/A Tubular: N/A

Calibration Cylinder: Quantity: 2 Material: PVC Units: 0.001 GAL

Capacity: 0.1 GAL

Diaphragm Actuation Type: Mechanical: Hydraulic: X

Stroke Position Adjustment: Manual: X Automatic:

Pump Speed Control: Constant: Variable: SCR

CHEMICAL METERING PUMP DATA SHEET, 11240-02

Tag Numbers: TM-WW-P-1004 AND -1005

DRIVE MOTOR

Horsepower: 1/4 Voltage: 115 Phase: 1 Synchronous Speed (rpm): _____

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

TESTING

Pump Tests: Factory Functional (Y/N) N Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) N Other _____

REMARKS

PROVIDE SUCTION TUBING AND FOOT VALVES FOR CARBOY SUPPLY.

DC SCR CONTROLLER – PROVIDE MANUFACTURER'S STANDARD UNIT.

CHEMICAL METERING PUMP DATA SHEET, 11240-03

Tag Numbers: TM-WW-P-1002 and -1003

Pump Name: COAGULANT AID POLYMER PUMP

Manufacturer and Model Number: (1) MILTON ROY; CENTRAC S
(2) PULSAFEEDER; PULSA SERIES 680
(3) PROMINENT; ALPHA/B

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): CIBA MAGNA-FLOC LT22S @ 0.5% OR EQUIVALENT

Pumping Temperature (Fahrenheit): Normal: 65 Max: 80 Min: 45

Liquid pH: 3.5 Solution Viscosity at 25°C: 700 cp

Abrasive (Y/N): N Possible Scale Buildup (Y/N): N

Suction Pressure (psig): Minimum -3

Altitude (ft msl): 520 Area Classification: 60 Location (indoor/outdoor): INDOOR

PERFORMANCE REQUIREMENTS

Capacity (US gph): Maximum: 2.5 GAL/HOUR Minimum: 0.05 GAL/HOUR

Maximum Discharge Pressure (psig): 30 PSI

Internal Bypass Valve Setting (psig): 40 PSI

Relief Valve Setting (psig/as recommended): AS RECOMMENDED

Back Pressure Valve Setting (psig/as recommended): AS RECOMMENDED

Max. Stroke Rate (spm): Mfr. (1) 100 Mfr. (2) 100

DESIGN AND MATERIALS

Pump Type: Single Diaphragm (Y/N) Y

Tubular (double) Diaphragm (Y/N) N Other _____

Wet End Material: PVDF Tubular Diaphragm Housing Material: N/A

Check Valve Material: CERAMIC Configuration(Single/Double): DOUBLE

Diaphragm Material: PTFE Primary: N/A Tubular: N/A

Calibration Cylinder: Quantity: _____ Material: PVC Units: 0.001 GAL

Capacity: 0.1 GAL

Diaphragm Actuation Type: Mechanical: _____ Hydraulic: X

Stroke Position Adjustment: Manual: X Automatic: _____

Pump Speed Control: Constant: _____ Variable: SCR

CHEMICAL METERING PUMP DATA SHEET, 11240-03

Tag Numbers: TM-WW-P-1002 AND -1003

DRIVE MOTOR

Horsepower: 1/4 Voltage: 115 Phase: 1 Synchronous Speed (rpm): _____

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP ____ EXP ____ ODP ____ TEFC X CISD-TEFC ____
TENV ____ WPI ____ WPII ____ SUBM ____

TESTING

Pump Tests: Factory Functional (Y/N) N Factory Performance (Y/N) N
Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) N Other _____

REMARKS

DC SCR CONTROLLER – PROVIDE MANUFACTURER'S STANDARD UNIT.

CHEMICAL METERING PUMP DATA SHEET, 11240-04

Tag Numbers: TM-WW-P-1006 and TM-WW-P-1007

Pump Name: SLUDGE CONDITIONING POLYMER PUMP

Manufacturer and Model Number: (1) MILTON ROY, MILROYAL C
(2) PULSAFEEDER; PULSA SERIES 7440
(3) PROMINENT

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): SALFLOC 6950, MANUFACTURED BY NEO-SOLUTIONS, INC. IN BEAVER, PA, OR SIMILAR PRODUCT, AT 0.3% SOLUTION STRENGTH

Pumping Temperature (Fahrenheit): Normal: 65 Max 80 Min 50

Liquid pH: 4.0 MINIMUM Viscosity at 25°C: 900 CP

Abrasive (Y/N) N Possible Scale Buildup (Y/N): N

Suction Pressure (psig): Minimum 0

Altitude (ft msl): 520 Area Classification: 36 Location (indoor/outdoor):INDOOR

PERFORMANCE REQUIREMENTS

Capacity (US gpm): Maximum: 2.5 Minimum: 0.25

Maximum Discharge Pressure (psig): 25

Internal Bypass Valve Setting (psig): AS RECOMMENDED

Relief Valve Setting (psig/as recommended): AS RECOMMENDED

Back Pressure Valve Setting (psig/as recommended): AS RECOMMENDED

Max. Stroke Rate (spm): Mfr. (1) 70 Mfr. (2) 70

DESIGN AND MATERIALS

Pump Type: Single Diaphragm (Y/N) Y

Tubular (double) Diaphragm (Y/N) N Other _____

Wet End Material: PVC Tubular Diaphragm Housing Material: N/A

Check Valve Material: CERAMIC Configuration(Single/Double): DOUBLE

Diaphragm Material: PTFE Primary: N/A Tubular: N/A

Calibration Cylinder: Quantity: 2 Material: PVC Units: 0.01 GAL
Capacity: 1.5 GAL

Diaphragm Actuation Type: Mechanical ____ Hydraulic X

Stroke Position Adjustment: Manual X Automatic _____

Pump Speed Control: Constant _____ Variable SCR

CHEMICAL METERING PUMP DATA SHEET, 11240-04___

Tag Numbers: TM-WW-P-1006 and TM-WW-P-1007

DRIVE MOTOR

Horsepower: 2 Voltage: 115 Phase: 1 Synchronous Speed (rpm)_____

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on pump curve.

Enclosure: DIP __ EXP __ ODP __ TEFC X CISD-TEFC __
TENV __WPI __ WPII __ SUBM __

TESTING

Pump Tests: Factory Functional (Y/N) N Factory Performance (Y/N) N

Field Functional (Y/N) Y Field Performance (Y/N) Y

Motor Test: Short Commercial (Y/N) N Other _____

REMARKS

DC SCR CONTROLLER—PROVIDE MANUFACTURER'S STANDARD UNIT

SECTION 11315
PROGRESSING CAVITY PUMPS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American Bearing Manufacturers' Association (ABMA).
2. Institute of Electrical and Electronics Engineers (IEEE): 112, Standard Test Procedure for Polyphase Induction Motors and Generators.
3. National Electrical Manufacturer's Association (NEMA): MG 1, Motors and Generators.

B. Pumps specified in this section shall be provided by plate settler equipment supplier. See Section 11229, Parallel Plate Gravity Settler Equipment.

1.02 DEFINITIONS

A. Terminology pertaining to pumping unit performance and construction shall conform to the ratings and nomenclature of the Hydraulic Institute Standards.

1.03 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Make, model, weight, and horsepower of each equipment assembly.
   b. Complete catalog information, descriptive literature, specifications, and identification of materials of construction.
   c. Performance data curves showing head, capacity, horsepower demand, and pump efficiency over the entire operating range of the pump, from shutoff to maximum capacity. Indicate separately the head, capacity, horsepower demand, overall efficiency, and minimum submergence required at the guarantee point.
   d. Pump maximum downthrust or upthrust in pounds.
   e. Detailed mechanical and electrical drawings showing the equipment dimensions, size, and locations of connections and weights of associated equipment.
   f. Power and control wiring diagrams, including terminals and numbers.
   g. Complete motor nameplate data, as defined by NEMA, motor manufacturer, and including any motor modifications.
   h. Factory finish system.

B. Informational Submittals:

1. Test Reports.
2. Manufacturer's Certification of Compliance that the factory finish system is identical to the requirements specified herein.
3. Special shipping, storage and protection, and handling instructions.
4. Manufacturer's printed installation instructions.
5. Manufacturer's Certificate of Proper Installation.
6. Suggested spare parts list to maintain the equipment in service for a period of 5 years. Include a list of special tools required for checking, testing, parts replacement, and maintenance with current price information.
7. List special tools, materials, and supplies furnished with equipment for use prior to and during startup and for future maintenance.
8. Operation and Maintenance Data: As specified in Section 01430, Operation and Maintenance Data.

1.04 EXTRA MATERIALS

A. Furnish for each set of pumps:

1. Complete set of mechanical seals.
2. Complete set of bearings.
3. Complete set gaskets and O-ring seals.
4. Complete set rod bushings.
5. Complete set keys, dowels, pins, etc.
6. Three (3) stators.
7. One (1) rotors.
8. One (1) connecting rod with one (1) pair of universal joint(s), as required by pump type.
9. One (1) complete set of any special tools required to dismantle pump.
10. One (1) ATLS-T1 controller.

PART 2 PRODUCTS

2.01 GENERAL

A. Coordinate pump requirements with drive manufacturer and be responsible for pump and drive requirements.

B. Where adjustable speed drives are required, furnish a coordinated operating system complete with pump, drive, and speed controller.

2.02 SUPPLEMENTS

A. Some specific requirements are attached to this section as supplements.

2.03 ACCESSORIES

A. Equipment Identification Plate: 16-gauge stainless steel with 1/4-inch die-stamped equipment tag number securely mounted in a readily visible location.

B. Lifting Lugs: Equipment weighing over 100 pounds.

C. Anchor Bolts: Type 316 stainless steel, sized by equipment manufacturer, and as specified in Section 05500, Metal Fabrications and Castings.

D. Provide seal water supply accessories including pressure regulator, 2 1/2 inch pressure gage with snubber, y-strainer, and needle valve, all constructed of stainless steel or brass.

2.04 FACTORY FINISHING

A. Manufacturer's standard baked enamel finish, consistent with service requirements.

2.05 SOURCE QUALITY CONTROL

A. Factory Inspections: Inspect control panels for required construction, electrical connection, and intended function.

B. Factory Tests and Adjustments: Test all equipment and control panels actually furnished.

C. Factory Test Report: Include test data sheets and performance test logs.

D. Functional Test: Perform manufacturer's standard motor test on equipment.

E. Performance Test:

1. Conduct on each pump.
2. Perform under simulated operating conditions.
3. Test for a continuous 3-hour period without malfunction.
4. Test Log: Record the following:
   a. Total head.
   b. Capacity.
   c. Horsepower requirements.
   d. Flow measured by factory instrumentation and storage volumes.
5. Adjust, realign, or modify units and retest if necessary.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install in accordance with manufacturer's printed instructions.

B. Level base by means of steel wedges (steel plates and steel shims). Wedge taper not greater than 1/4 inch per foot. Use double wedges to provide a level bearing surface for the pump and driver base. Accomplish wedging so that there is no change of level or springing of the baseplate when the anchor bolts are tightened.

C. Adjust pump assemblies such that the driving units are properly aligned, plumb, and level with the driven units and all interconnecting shafts and couplings. Do not compensate for misalignment by use of flexible couplings.

D. After the pump and driver have been set in position, aligned, and shimmed to the proper elevation, grout the space between the bottom of the baseplate and the concrete foundation with a poured, nonshrinking grout of the proper category. Remove wedges after grout is set and pack void with grout.

E. Connect suction and discharge piping without imposing strain to pump flanges.

F. Anchor Bolts: Accurately place using equipment templates.

G. Pipe pump drain(s) to hub drain.

3.02 FIELD QUALITY CONTROL

A. Functional Tests: Conduct on each pump.

1. Alignment: Test complete assemblies for correct rotation, proper alignment and connection, and quiet operation.
2. Flow Output: Measured by plant instrumentation and storage volumes.

B. Performance Test: In accordance with Hydraulic Institute Standards.

3.03 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. One (1) person-days for installation assistance and inspection.
2. One (1) person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. One (1) person-days for prestartup classroom or Site training and facility startup.
4. One (1) person-days for post-startup training of Owner's personnel. Training shall not commence until an accepted detailed lesson plan for each training activity has been reviewed by Owner.

B. See Section 01640, Manufacturers' Services and Section 01810, Equipment Testing and Facility Startup.

3.04 SUPPLEMENTS

A. The supplements listed below, following "End of Section," are a part of this Specification.

1. Data Sheets:
   a. Positive Displacement Progressing Cavity Pump.
   b. Induction Motor.

END OF SECTION

POSITIVE DISPLACEMENT PROGRESSING CAVITY PUMP DATA SHEET

Tag Numbers: **To Be Determined**

Pump Name: Sludge Wasting Pump

Manufacturer and Model Number: (1) Allweiler; Model AEIE 0750
(2) Moyno

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Sludge, up to 4% solids

Pumping Temperature (Fahrenheit): Normal: 60 Max: 80 Min: 40

Specific Gravity at 60 Degrees F: 1.04 Viscosity Range: 400 cp

pH: 6.5 to 7.5

Abrasive (Y/N): N Possible Scale Buildup (Y/N): N

Inlet Pressure at Pump (psig): 5

Min. Net Positive Inlet Pressure Available (psia): 0

PERFORMANCE REQUIREMENTS

Rated Capacity: 120 US gpm at 20 psi differential pressure.

Range (US gpm): 12 to 120

Max. Pump Speed (rpm): 250 Constant (Y/N): N Adjustable (Y/N): Y

DESIGN AND MATERIALS

Pump Body Material: Cast iron Drive Housing Material: Cast iron

Pump Stages: 1

Connections:
Suction: Flanged: 5" Flange Type: 125/150# Open-Throat: Screwed:
Discharge: Flanged: 5" Flange Type: 125/150# Screwed:

Suction Port:

Stator Material: Buna N Rotor Material: Type 316 SST with Duktil

Connecting Rod Material: Type 316 SST Drive Shaft Material: AISI 4120

Joints: Gear Type Universal (Y/N): N Pin Type Universal (Y/N): Y Other:

Shaft Sleeve (Y/N): N Material:

POSITIVE DISPLACEMENT PROGRESSING CAVITY PUMP DATA SHEET

Tag Numbers: To Be Determined

Shaft Seal: Packing (Y/N): _____ Material: _____
Lantern Ring (Y/N): _____ Material: _____
Mechanical (Y/N): Y Type: Burgmann MG1
Lubrication: _____

AFBMA B-10 Bearing Life (hrs): 10,000 Lubrication: Oil

Coupling: Falk (Y/N): _____ Fast (Y/N): _____
Gear Type (Y/N): _____ Manufacturer Standard (Y/N): Y

Baseplate: Design: Structural Channel Material: Steel

Drive Type: Direct-Coupled: _____ Belt: _____ Hydrostatic Adjustable Speed: _____
Close Coupled Gear Reducer: Yes Other: _____

DRIVE MOTOR

VFD Drive Input Voltage: 208 3 phase

Horsepower: 7.5 min. Voltage: 208 Phase: 3 Base Speed (rpm): 1800

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure:
DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

Drive Arrangement: In-Line: Yes Vertical "Z": _____ Piggy Back: _____
Horizontal Offset: _____ C-Face Mounted: _____

Nonreverse Ratchet (Y/N) : N

TESTING

Pump Tests:
Factory Functional (Y/N): Y Field Performance (Y/N): Y
Factory Hydrostatic Casing Pressure Test (Y/N): N Other: _____
Field Functional (Y/N): Y Field Performance (Y/N): Y Field Vibration (Y/N): Y

Motor Test: Short Commercial (Y/N): Y Other: _____

REMARKS: PROVIDE OVER-PRESSURE PROTECTION SYSTEM CONSISTING OF SST PRESSURE SENSOR, PRESSURE SWITCH, AND 4" GAGE TO ACTIVATE ALARM AND SHUTDOWN ON HIGH PRESSURE. PROVIDE RUN DRY PROTECTION WITH ROTOR-MOUNTED SENSOR SLEEVE AND THERMISTOR SENSOR TO MONITOR TEMPERATURE AND ACTIVATE A SHUTDOWN AND ALARM ON HIGH TEMPERATURE.

POSITIVE DISPLACEMENT PROGRESSING CAVITY PUMP DATA SHEET

Tag Numbers: **To Be Determined By Plate Settler Manufacturer**

Pump Name: Sludge Recirculation Pump

Manufacturer and Model Number: (1) Allweiler; Model AEIE 0100
(2) Moyno

SERVICE CONDITIONS

Liquid Pumped (Material and Percent): Sludge, up to 4% solids

Pumping Temperature (Fahrenheit): Normal: 60 Max: 80 Min: 40

Specific Gravity at 60 Degrees F: 1.04 Viscosity Range: 400 cp

pH: 6.5 to 7.5

Abrasive (Y/N): N Possible Scale Buildup (Y/N): N

Inlet Pressure at Pump (psig): 5

Min. Net Positive Inlet Pressure Available (psia): 0

PERFORMANCE REQUIREMENTS

Rated Capacity: 10 US gpm at 20 psi differential pressure.

Range (US gpm): 4to 20

Max. Pump Speed (rpm): 200 Constant (Y/N): N Adjustable (Y/N): Y

DESIGN AND MATERIALS

Pump Body Material: Cast iron Drive Housing Material: Cast iron

Pump Stages: 1

Connections:
Suction: Flanged: 3" Flange Type: 125/150# Open-Throat: Screwed:
Discharge: Flanged: 3" Flange Type: 125/150# Screwed:

Suction Port:

Stator Material: Buna N Rotor Material: Type 316 SST with Duktil

Connecting Rod Material: Type 316 SST Drive Shaft Material: AISI 4120

Joints: Gear Type Universal (Y/N): N Pin Type Universal (Y/N): Y Other:

Shaft Sleeve (Y/N): N Material:

POSITIVE DISPLACEMENT PROGRESSING CAVITY PUMP DATA SHEET

Tag Numbers: To Be Determined By Plate Settler Manufacturer

Shaft Seal: Packing (Y/N): _____ Material: _____
Lantern Ring (Y/N): _____ Material: _____
Mechanical (Y/N): Y Type: Burgmann MG1
Lubrication: _____

AFBMA B-10 Bearing Life (hrs): 10,000 Lubrication: Oil

Coupling: Falk (Y/N): _____ Fast (Y/N): _____
Gear Type (Y/N): _____ Manufacturer Standard (Y/N): Y

Baseplate: Design: Structural Channel Material: Steel

Drive Type: Direct-Coupled: _____ Belt: _____ Hydrostatic Adjustable Speed: _____
Close Coupled Gear Reducer: Yes Other: _____

DRIVE MOTOR

VFD Drive Input Voltage: 208 3 phase

Horsepower: 2 min. Voltage: 208 Phase: 3 Base Speed (rpm): 1800

Service Factor: 1.15

Motor nameplate horsepower shall not be exceeded at any head-capacity point on the pump curve.

Enclosure:
DIP _____ EXP _____ ODP _____ TEFC X CISD-TEFC _____
TENV _____ WPI _____ WPII _____ SUBM _____

Drive Arrangement: In-Line: Yes Vertical "Z": _____ Piggy Back: _____
Horizontal Offset: _____ C-Face Mounted: _____

Nonreverse Ratchet (Y/N) : N

TESTING

Pump Tests:
Factory Functional (Y/N): Y Field Performance (Y/N): Y
Factory Hydrostatic Casing Pressure Test (Y/N): N Other: _____
Field Functional (Y/N): Y Field Performance (Y/N): Y Field Vibration (Y/N): Y

Motor Test: Short Commercial (Y/N): Y Other: _____

REMARKS: PROVIDE OVER-PRESSURE PROTECTION SYSTEM CONSISTING OF SST PRESSURE SENSOR, PRESSURE SWITCH, AND 4" GAGE TO ACTIVATE ALARM AND SHUTDOWN ON HIGH PRESSURE. PROVIDE RUN DRY PROTECTION WITH ROTOR-MOUNTED SENSOR SLEEVE AND THERMISTOR SENSOR TO MONITOR TEMPERATURE AND ACTIVATE A SHUTDOWN AND ALARM ON HIGH TEMPERATURE.

INDUCTION MOTOR DATA SHEET

Project: TMTP Backwash Treatment System

Owner: Northern Kentucky Water District

Equipment Name: Sludge Wasting Pump

Equipment Tag Number(s): To Be Determined

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: 7.5

Voltage: 208 3-Phase

Phase: 3

Frequency: 60 Hz

Synchronous Speed: 1,800 rpm

☐ Thermal Protection: _____

☐ Space Heater: _____ volts, single-phase

Guaranteed Minimum Efficiency at Full Load: 91 percent

Guaranteed Minimum Power Factor at Full Load: 90 percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Enclosure Type: TEFC

☐ Multispeed, Two-Speed: _____ / _____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☒ Horizontal ☐ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up _____ Down _____

☒ Adjustable Speed Drive: VFD

Operating Speed Range: 30 to 110% of Rated Speed

☐ Variable Torque

☒ Constant Torque

Additional Motor Requirements:

Special Features:

Provide supplier's standard VFD as part of the pump control package.

INDUCTION MOTOR DATA SHEET

Project: TMTP Backwash Treatment System

Owner: Northern Kentucky Water District

Equipment Name: Sludge Recirculation Pump

Equipment Tag Number(s): To Be Determined

Type: Squirrel-cage induction meeting requirements of NEMA MG 1

Manufacturer: For multiple units of the same type of equipment, furnish motors and accessories of a single manufacturer.

Hazardous Location: ☐ Furnish motors for hazardous (classified) locations that conform to UL 674 and have an applied UL listing mark.

Motor Horsepower: 2

Voltage: 208 3-Phase

Phase: 3

Frequency: 60 Hz

Synchronous Speed: 1,800 rpm

☐ Thermal Protection: _____

☐ Space Heater: _____ volts, single-phase

Guaranteed Minimum Efficiency at Full Load: 91 percent

Guaranteed Minimum Power Factor at Full Load: 90 percent

Service Factor (@ rated max. amb. temp.): ☐ 1.0 ☒ 1.15

Enclosure Type: TEFC

☐ Multispeed, Two-Speed: _____ / _____ rpm

Winding: ☐ One ☐ Two

Mounting Type: ☒ Horizontal ☐ Vertical

☐ Vertical Shaft: ☐ Solid ☐ Hollow

☐ Vertical Thrust Capacity (lb): Up _____ Down _____

☒ Adjustable Speed Drive: VFD

Operating Speed Range: 30 to 110% of Rated Speed

☐ Variable Torque

☒ Constant Torque

Additional Motor Requirements:

Special Features:

Provide supplier's standard VFD as part of the pump control package.

SECTION 13411
INSTRUMENTS AND PANELS SUBSYSTEM (IPS)

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. American National Standards Institute (ANSI).
2. National Electrical Code (NEC).
3. National Electrical Manufacturers Association (NEMA): ICS 1, Industrial Control and Systems General Requirements.
4. Underwriters Laboratories Inc. (UL): 508, Standard for Safety Industrial Control Equipment.

1.02 DEFINITIONS

A. IPS Components: Equipment listed under Component Specifications referenced in Article Supplements.

1.03 SUBMITTALS

A. Action Submittals:

1. Bill of Materials: List of required IPS equipment.
   a. Group equipment items as follows:
      1) IPS Components: By component identification code.
      2) Other IPS Equipment: By equipment type.
   b. Data Included:
      1) Equipment tag number.
      2) Description.
      3) Manufacturer, complete model number and all options not defined by model number.
      4) Quantity supplied.
      5) Component identification code where applicable.
2. Catalog Cuts: IPS components, electrical devices, and mechanical devices:
   a. Catalog information.
   b. Descriptive literature.
   c. External power and signal connections.
   d. Scaled drawings showing exterior dimensions and locations of all electrical and mechanical interfaces.

3. Preliminary Panel Elevation Drawings: Provide prior to submitting Panel Construction Drawings:
   a. Scale Drawings: Show dimensions and location of front of panel devices.
   b. Panel Legend: List front of panel devices by tag number, and including nameplate inscriptions and service legends.
4. Panel Construction Drawings:
   a. Scale Drawings: Show dimensions and locations of panel mounted devices, doors, louvers, subpanels, internal and external.
   b. Panel Legend: List front of panel devices by tag numbers, nameplate inscriptions and service legends.
   c. Bill of Materials: List devices mounted within panel that are not listed in panel legend. Include tag number, description, manufacturer, and model number.
   d. Construction Details: NEMA rating, materials, material thickness, structural stiffeners and brackets, lifting lugs, mounting brackets and tabs, door hinges and latches, and welding and other connection callouts and details.
   e. Construction Notes: Finishes, wire color schemes, wire ratings, wire, terminal block numbering, and labeling scheme.
5. Panel Wiring Diagrams:
   a. Provide Panel Wiring Diagrams that cover all wiring within a panel including, but not limited to, instrumentation, control, power, and communications, and digital networks.
   b. Objectives: For use in wiring panels, making panel connections, and future panel trouble shooting.
   c. Diagram Type:
      1) Ladder diagrams where applicable in a format similar to those shown on Drawings. Include devices that are mounted in or on the panel that require electrical connections. Show unique rung numbers on left side of each rung.
      2) Schematic drawings for wiring of circuits that can not be well represented by ladder diagrams.
   d. Item Identification: Identify each item with attributes listed.
      1) Wires: Wire number and color. Cable number if part of multiconductor cable.
      2) Terminals: Location (enclosure number, terminal junction box number, or MCC number), terminal strip number, and terminal block number.
      3) Components:
         a) Tag number, terminal numbers, and location ("FIELD", enclosure number, or MCC number).
         b) Switching action (open or close) ON, OFF.

4) I/O Points: PLC unit number, I/O tag number, I/O address, terminal numbers, and terminal strip numbers.
5) Relay Coils:
a) Tag number and its function.
b) On right side of run where coil is located, list contact location by ladder number and sheet number. Underline normally closed contacts.
6) Relay Contacts: Coil tag number, function, and coil location (ladder rung number and sheet number).
7) Communications and Networks: Network type, address or node identification, port or channel number, and type of connector.

e. Show each circuit individually. No "typical" diagrams or "typical" wire lists will be allowed.
f. Ground wires, surge protectors, and connections.
g. Wire and Cable Names: Show names and wire color corresponding to Circuit and Raceway Schedule for circuits entering and leaving a panel. Refer to Division 16, Electrical.

6. Communications and Digital Networks Diagrams:
a. Scope: Includes connections to Ethernet network, remote I/O, patch panel, and I/O to Ethernet converter.
b. Format: Network schematic diagrams for each different type of network.
c. Show:
1) Interconnected devices, both passive and active.
2) Device names and numbers.
3) Terminal numbers.
4) Communication Media: Type of cable.
5) Connection Type: Type of connector.
6) Node and device address numbers.
7) Wire and cable numbers and colors.

1.04 ENVIRONMENTAL REQUIREMENTS

A. Standard Environmental Requirements: Unless otherwise noted, in Control Panel Schedule located in Article Supplements at end of this section, design IPS equipment for continuous operation in these environments:

1. Smaller Panels and Assemblies (that are not Freestanding): Inside: NEMA 4.

B. Special Environmental Requirements: Design following panels for continuous operation in environments listed.

1.05 EXTRA MATERIALS

A. Spare Parts:

Description	Percent of Each Type and Size Used	No Less Than
Fuses	20	5
Relays	20	2
Terminal Blocks	10	10

PART 2 PRODUCTS

2.01 NAMEPLATES AND TAGS

A. Panel Nameplates: Enclosure identification located on the enclosure face.

1. Location and Inscription: As shown on Drawings.
2. Materials: Laminated plastic attached to panel with stainless steel screws.
3. Letters: 1/2 inch white on black background, unless otherwise noted.

B. Component Nameplates—Panel Face: Component identification located on panel face under or near component.

1. Location and Inscription: As shown on panel drawing.
2. Materials: Adhesive backed, laminated plastic.
3. Letters: 3/16 inch white on black background, unless otherwise noted.

C. Component Nameplates—Back of Panel: Component identification located on or near component inside of enclosure.

1. Inscription: Component tag number.
2. Materials: Adhesive backed, laminated plastic.
3. Letters: 3/16 inch white on black background, unless otherwise noted.

D. Legend Plates for Panel Mounted Pushbuttons, Lights, and Switches.

1. Inscription:
   a. Refer to table under paragraph Standard Pushbutton Colors and Inscriptions.
   b. Refer to table under paragraph Standard Light Colors and Inscriptions.
   c. Refer to P&IDs on Drawings.

2. Materials: Stainless steel, keyed legend plates. Secured to panel by mounting nut for pushbutton, light, or switch.
3. Letters: Black on gray or white background.

2.02 PANEL FABRICATION

A. General:

1. Maximum Panel Dimensions: As shown on Drawings.
2. Component Arrangements: As shown on Drawings.
3. Panel Component Schedule: Refer to Control Panel Drawing. Provides a list by local control panel of most panel-mounted components and some internal components for each panel. In case of a conflict between this list and Instrument List, Instrument list takes precedence.
4. Panel Construction and Interior Wiring: In accordance with the National Electrical Code (NEC), state and local codes, and applicable sections of NEMA, ANSI, UL, and ICECA.
5. Fabricate panels, install instruments, wire, and plumb, all at the PICS Subcontractor's factory.
6. Electrical Work: In accordance with the applicable requirements of Division 16, Electrical.

B. Nonfreestanding Panel Construction:

1. Based on environmental design requirements and referenced in Article Environmental Requirements, provide the following unless otherwise noted in Control Panel Schedule in Article Supplements:
   a. For panels listed as inside:
      1) Enclosure Type: NEMA 4.
      2) Materials: Steel.
2. Metal Thickness: 14-gauge, minimum.
3. Doors:
   a. Rubber-gasketed with continuous hinge.
   b. Stainless steel lockable quick-release clamps.
4. Manufacturers:
      1) Hoffman Engineering Co.
      2) Rittal.

C. Control Panel Electrical:

1. Power Distribution within Panels:
   a. Feeder Circuits:
      1) One or more 120V ac, 60-Hz feeder circuits as shown on Drawings.
      2) Make provisions for feeder circuit conduit entry.

3) Furnish terminal board for termination of wires.

b. Power Panel: Furnish main circuit breaker and circuit breaker on each individual branch circuit distributed from power panel.
   1) Locate to provide clear view of and access to breakers when door is open.
   2) Breaker Sizes: Coordinate such that fault in branch circuit will blow only branch breaker but not trip the main breaker.
      a) Branch Circuit Breakers: 15 amps at 250V ac.
   3) Breaker Manufacturers and Products: Square D; Type QO.

c. Circuit Wiring: P&IDs and Control Diagrams on Drawings show function only. Use following rules for actual circuit wiring:
   1) Devices on Single Circuit: 20, maximum.
   2) Multiple Units Performing Parallel Operations: To prevent failure of any single branch circuit from shutting down entire operation, do not group all units on same branch circuit.
   3) Branch Circuit Loading: 12 amperes continuous, maximum.
   4) Panel Lighting and Service Outlets: Put on separate 15-amp 120V ac branch circuit.
   5) Provide 120V ac plugmold for panel components with line cords.

2. Signal Distribution:
   a. Within Panels: 4 to 20 mA dc signals may be distributed as 24V dc.
   b. Outside Panels: Isolated 4 to 20 mA dc 24V dc.
   c. All signal wiring shall be twisted shielded pairs.
3. Signal Switching:
   a. Use dry circuit type relays or switches.
   b. No interruption of 4 to 20 mA loops during switching.
   c. Switching Transients in Associated Signal Circuit:
      1) 4 to 20 mA dc Signals: 0.2 mA, maximum.
      2) 24V dc Signals: 0.05V, maximum.
4. Relays:
   a. General:
      1) Relay Mounting: Plug-in type socket.
      2) Relay Enclosure: Furnish dust cover.
      3) Socket Type: Screw terminal interface with wiring.
      4) Socket Mounting: Rail.
      5) Provide holddown clips.
   b. Signal Switching Relay:
      1) Type: Dry circuit.
      2) Contact Arrangement: 2 Form C contacts.
      3) Contact Rating: 0 to 5 amps at 28V dc or 120V ac.
      4) Contact Material: Gold or silver.

5) Coil Voltage: As noted or shown.
6) Coil Power: 0.9 watts (dc), 1.2VA (ac).
7) Expected Mechanical Life: 10,000,000 operations.
8) Expected Electrical Life at Rated Load: 100,000 operations.
9) Indication Type: Neon or LED indicator lamp.
10) Seal Type: Hermetically sealed case.
11) Manufacturer and Product: Potter and Brumfield; Series KH/KHA.

c. Control Circuit Switching Relay, Nonlatching:
1) Type: Compact general purpose plug-in.
2) Contact Arrangement: 3 Form C contacts.
3) Contact Rating: 10A at 28V dc or 240V ac.
4) Contact Material: Silver cadmium oxide alloy.
5) Coil Voltage: As noted or shown.
6) Coil Power: 1.8 watts (dc), 2.7VA (ac).
7) Expected Mechanical Life: 10,000,000 operations.
8) Expected Electrical Life at Rated Load: 100,000 operations.
9) Indication Type: Neon or LED indicator lamp.
10) Push-to-test button.
11) Manufacturer and Product: Potter and Brumfield; Series KUP.

d. Control Circuit Switching Relay, Latching:
1) Type: Dual coil mechanical latching relay.
2) Contact Arrangement: 2 Form C contacts.
3) Contact Rating: 10A at 28V dc or 120V ac.
4) Contact Material: Silver cadmium oxide alloy.
5) Coil Voltage: As noted or shown.
6) Coil Power: 2.7 watts (dc), 5.3VA (ac).
7) Expected Mechanical Life: 500,000 operations.
8) Expected Electrical Life at Rated Load: 50,000 operations.
9) Manufacturer and Product: Potter and Brumfield; Series KB/KBP.

e. Control Circuit Switching Relay, Time Delay:
1) Type: Adjustable time delay relay.
2) Contact Arrangement: 2 Form C contacts.
3) Contact Rating: 10A at 240V ac.
4) Contact Material: Silver cadmium oxide alloy.
5) Coil Voltage: As noted or shown.
6) Operating Temperature: Minus 10 to 55 degrees C.
7) Repeatability: Plus or minus 2 percent.
8) Delay Time Range: Select range such that time delay set point fall between 20 to 80 percent of range.
9) Time Delay Set Point: As noted or shown.
10) Mode of Operation: As noted or shown.

11) Adjustment Type: Integral potentiometer with knob external to dust cover.
12) Manufacturer and Products: Potter and Brumfield; Series CB for 0.1 second to 100 minute delay time ranges, Series CK for 0.1 to 120 second delay time ranges.

5. Power Supplies:
   a. Furnish as required to power instruments requiring external dc power, including two-wire transmitters and dc relays.
   b. Convert 120V ac, 60-Hz power to dc power of appropriate voltage(s) with sufficient voltage regulation and ripple control to assure that instruments being supplied can operate within their required tolerances.
   c. Provide output over voltage and over current protective devices to:
      1) Protect instruments from damage due to power supply failure.
      2) Protect power supply from damage due to external failure.
   d. Enclosures: NEMA 1.
   e. Mount such that dissipated heat does not adversely affect other components.
   f. Fuses: For each dc supply line to each individual two-wire transmitter.
      1) Type: Indicating.
      2) Mount so fuses can be easily seen and replaced.

D. Factory Finishing:

1. Steel Panels:
   a. Sand panel and remove all mill scale, rust, grease, and oil.
   b. Fill all imperfections and sand smooth.
   c. Paint panel interior and exterior with one coat of epoxy coating metal primer, two finish coats of two-component type epoxy enamel.
   d. Sand surfaces lightly between coats.
   e. Dry Film Thickness: 3 mils, minimum.
   f. Color: Manufacturer's standard.

PART 3 EXECUTION

3.01 GENERAL

A. Drawings for PICS Mechanical Systems are diagrammatic and not intended to specifically define element locations or piping and tubing run lengths. Base materials and installations on field measurements.

B. Coordinate Work with Division 15, Mechanical.

END OF SECTION

SECTION 13431
FIBER OPTIC COMMUNICATION SUBSYSTEM

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards that may be referenced in this section:

1. Institute of Electrical & Electronic Engineers, Inc. (IEEE): 802.3, Telecommunication and Information Exchange Between Systems.
2. International Organization for Standardization (ISO).
3. National Electrical Code (NEC).
4. Telecommunications Industry Association (TIA); Electronics Industry Association (EIA):
   a. 492, Specifications for Optical Waveguide Fibers.
   b. 568, Commercial Building Telecommunications Cabling Standard.
   c. 569, Commercial Building Standards for Telecommunications Pathways and Spaces.
   d. 607, Commercial Building Grounding and Bonding Requirements for Telecommunications.

1.02 ABBREVIATIONS

A.	ATM	asynchronous transfer mode.
B.	AUI	attachment unit interface.
C.	dB	decibel.
D.	DNI	desktop network interface.
E.	FDDI	fiber distributed data interface.
F.	FIM	Facilities Information Management.
G.	FOCS	Fiber Optic Communication Subsystem.
H.	FOIRL	Fiber Optic Inter Repeater Link.
I.	LAN	local area network.
J.	LIMS	Laboratory Information Management System.
K.	MHz	megahertz.

L.	micro	x 10^{-6}.
M.	MIS	Management Information System.
N.	Mbps	megabits per second.
O.	N	newton.
P.	n, nano	x 10^{-9}.
Q.	nm	nanometer.
R.	OTDR	optical time-domain reflectometer.
S.	PICS	Process Instrumentation and Control System.
T.	µm	micrometer.
U.	UPS	uninterruptible power supply.
V.	V ac	volts alternating current.
W.	WAN	wide area network.

1.03 SYSTEM DESCRIPTION

A. This section covers requirements for Fiber Optic Communication Subsystem (FOCS).

B. Function of FOCS is to transmit digital data between network nodes. Requirements listed identify minimum acceptable system performance.

C. Provide a FOCS based on referenced standards for use in the following local and wide area networks:

1. Ethernet.
2. Fast Ethernet.

D. Network(s) will be used by PICS to distribute data and coordinate Owner's operations.

1.04 SUBMITTALS

A. Action Submittals:

1. Site layout diagram showing:
   a. Access holes, with identification.
   b. Abovegrade cable routings, with pole and cable identification.
   c. Belowgrade conduit routings between access holes and buildings, with conduit counts and identification.
   d. Belowgrade innerduct routings through conduits, with innerduct counts and identification.
   e. Cable routings through innerducts and to patch panels, fiber centers, or network nodes, with cable and node identification.
2. Cable schedule showing:
   a. Cable identification.
   b. Fiber counts for each cable and identification of used fiber pairs.
   c. Cable length and attenuation, with 2 connector pairs and no splices, based on TIA/EIA 568, Annex H.
3. Component Data:
   a. Manufacturer and model number.
   b. General data and description.
   c. Scaled drawings and mounting arrangements.

B. Informational Submittals:

1. Manufacturer's statement that installer is certified to perform installation Work.
2. Subcontractor Qualifications:
   a. FOCS Subcontractor: Minimum of 5 years' experience providing, integrating, installing, and commissioning of similar systems.
   b. FOCS Subcontractor's Site Representative: Minimum of 5 years' experience installing similar systems.
   c. Owner acceptance of FOCS Subcontractor does not exempt FOCS Subcontractor or Contractor from meeting Contract Document requirements nor does it give prior acceptance of subsystems, equipment, materials, or services.
      1) Statement of Experience: List of at least 3 fiber optic data communications systems comparable to system specified which have been furnished and placed into operation by prospective FOCS Subcontractor. For each system, provide following information:
         a) Owner's name, address, telephone number, and name of current operations supervisor or other contact.

b) Description of system hardware configuration, including major equipment items, number of nodes, and communication standards implemented.
c) System block diagram.
d) Dates when contract was signed, equipment was delivered, and system was accepted by Owner. Also, include originally scheduled completion date and if different from actual date, explain why.
e) Approximate value of listed FOCS provided in dollars.

2) Qualification of Personnel:
a) Resumes giving management and technical qualifications of supervisory, local service representative, and key personnel.
b) For each maintenance organization, identify location of base of service and how required coverage will be achieved.

3. Manufacturer's Certificate of Compliance, in accordance with Section 01640, Manufacturers' Services.
4. Manufacturer's suggested installation practice.
5. Testing related submittals.
6. Operation and Maintenance Data: As specified in Section 01430, Operation and Maintenance Data.

1.05 ENVIRONMENTAL REQUIREMENTS

A. Optical Fiber Cable and Cable Splice Centers:

1. Outside, Underground/Submerged: Minus 20 to 40 degrees C.
2. Outside, Overhead: Minus 40 to 80 degrees C.
3. Outside, Aboveground in Conduit: Minus 40 to 80 degrees C.
4. Inside: 0 to 40 degrees C.

B. Equipment:

1. Outside, Aboveground: Minus 40 to 80 degrees C.
2. Control Rooms, Equipment Rooms and Telecommunications Closets: 30 to 55 percent relative humidity, 18 to 24 degrees C.
3. Other Interior Areas: 0 to 100 percent relative humidity, 5 to 35 degrees C.

1.06 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts, special tools, and materials:

Item	Quantity
Jumpers 18" in length	12 Fibers
Jumpers 2' in length	One Cable
Connectors	Complete set

B. Delivery: In accordance with Section 01600, Materials and Equipment.

PART 2 PRODUCTS

2.01 MATERIALS

A. Fiber Optic Cable:

1. Fiber Characteristics: Multimode
   a. Comply with TIA/EIA 568.
   b. 62.5/125 μm graded-index glass.
   c. Tight-Buffered, 900 μm buffer:
      1) Inner buffer: Acrylate, UV-cured, soft.
      2) Outer buffer: PVC, elastomeric, hard.
   d. Maximum Attenuation:
      1) 850 nm: 3.0 dB/km.
      2) 1300 nm: 1.0 dB/km.
   e. Minimum Bandwidth:
      1) 850 nm: 200 MHz-km.
      2) 1300 nm: 500 MHz-km.
   f. Color-coded buffer.
   g. Minimum Bend Radius, Buffered Fiber: 1 inch.
   h. Proof Testing: 100 kpsi.
2. Cable:
   a. Fiber Count:
      1) Multimode: 12 fibers per cable, minimum.
   b. All Dielectric Construction: No electrically conductive components in fiber optic cable are allowed.
   c. Helically Wound: Buffered fibers helically wound; approximately 5 turns per meter.
   d. Gel-Free: Fibers tight-buffered, not in gel-filled loose-tube.
   e. Core-Locked with no separator tape.
   f. Style: Break-out.

g. Strength Member:
   1) Nonconductive; integral part of cable; supports stress of installation and load during use.
   2) Fiberglass epoxy rod, aramid fiber, kevlar.
   3) Minimum Tensile Strength: 600 pounds.
h. Protective Covering:
   1) Polyvinylchloride (PVC); riser rated.
   2) Continuous and free from holes, splices, blisters, and other imperfections.
i. Minimum Bend Radius:
   1) Short-term Under Tension: 20 times cable diameter.
   2) Long-term Without Tension: 15 times cable diameter.
j. Identification:
   1) Identify with tags shown and in accordance with Section 13400, Process Information and Control (PICS).
   2) Use waterproof tags and identifications.
k. Special Features:
   1) Plenum rated flame-retardant.
   2) Tray rated.
   3) Trafficable.
l. Manufacturer: Optical Cable Corporation.

B. Innerduct:

1. Function: Installs into conduit system provided by others, to provide smooth, low-friction path through conduit, with only one cable per path to facilitate changing individual cables.
2. Features:
   a. Size and Count, in 4-inch conduit: As shown on Drawings.
   b. Type: Annular, corrugated innerduct.
   c. Material: HDPE.
   d. Color: Color code innderducts Orange, Blue, Green, Brown, White, or Grey.
   e. Strength: Minimum 600 pounds tensile strength, with no more than 5 percent ovalization at 600 pounds tension.
   f. Lubrication: Prelubricated.
3. Manufacturers:
   a. Endocor.
   b. Dura-Line.

C. Fiber Centers:

1. Function: Provides a secure place to terminate fiber optic cables.
2. Features:
   a. Compartments: Two; one for fiber optic cable, one for jumpers to individual equipment.
   b. Coil Former: Former to wind slack cable. Provides controlled long-radius bends.
   c. Connectors: Minimum 24 ST connectors for entry and exit.
   d. Size: Maximum 18 inches by 12 inches by 4 inches.
   e. Construction: 1.5-millimeter steel with noncorrosive finish.
   f. Mountings: Suitable for permanent attachment as shown, or provide separate mountings that do not obscure covers and doors.
3. Manufacturer: Leviton.

D. Connectors

1. Features:
   a. In accordance with requirements of TIA/EIA 568, Section 12.4.3 or Annex F.
   b. ST connectors with 12.7 millimeter spacing between ferrules.
   c. Pull Strength: 0.2 N minimum.
   d. Durability: Sustain minimum 500 mating cycles without violating other requirements.
      1) Ferrules: Free-floating low loss ceramic.
      2) Polarizing key on duplex connector systems.
2. Quantity: Connectorize fibers, minimum per cable:
   a. Multimode: 6, as shown on Drawings.
3. Attenuation:
   a. In accordance with requirements of TIA/EIA 568, Section 12.4.4.
   b. Maximum of 0.75 dB per connector pair.
4. Manufacturer: AMP.

E. Jumper Cables:

1. In accordance with requirements of TIA/EIA 568, Section 12.5.
2. Function: To connect from fiber centers to network nodes, such as computer workstations.
3. Fiber Characteristics: In accordance with requirements for fiber optic cable.
4. Cable Configuration:
   a. Individual tight-buffer thermoplastic, fibers single or multimode, to match fibers being jumpered on.
   b. Protected with kevlar strength members and enclosed in thermoplastic jacket.

5. Length: Standard, to meet requirements shown, plus minimum 3 meters at workstations.
6. Connectors:
   a. As required by Article Connectors.
   b. On-axial Pull Strength: 33 N.
   c. Normal-to-Axial Pull Strength: 22 N.

PART 3 EXECUTION

3.01 PREPARATION

A. Conduits are provided under Division 16, Electrical.

1. Ensure that installed conduit system conforms with fiber optic system requirements, including:
   a. Conduits and Innerducts: Size and number.
   b. Access Holes, Handholes, and Pull Boxes: Location and size, to ensure cables and innerducts can be installed without exceeding manufacturer's limitations.
   c. Outlet Boxes: Size to coordinate with outlet cover plates for adequate volume and bend radius.
2. Spare Conduits:
   a. No cables shall be pulled into spare conduits.
   b. 100 percent spare conduit capacity required for all buried conduits only, i.e., for every conduit with one or more cables in it, there shall be one spare equal-size conduit with no cables.
   c. Spare conduits need not have innerduct installed.
3. Expansion Plugs: Seal conduits to stop ingress of water and grit with fabricated expansion plugs.

B. Innerduct:

1. Installation:
   a. In accordance with manufacturer's recommendations.
   b. In all FOCS fiber optic conduits.
   c. Color Code: Install no more than one innerduct of each color in single conduit.
   d. Terminations: Terminate innerducts in conduit with fabricated termination kits.
2. Sealing:
   a. Cabled Innerducts: Seal cables into innerducts to stop ingress of water and grit with fabricated expansion seals that have separate seals for each cable.

b. Empty Innerducts: Seal empty innerducts immediately after installation to stop ingress of water and grit with fabricated expansion plugs. Remove plugs as required to install cables.
c. Innerduct to Conduit: Seal gaps between innerducts and conduit with sealing compound such as 3M Ductseal.

3. Identification: Identify innerducts at both ends by methods such as color-coding or waterproof tags wired through innerduct wall

C. Fiber Optic Cable:

1. Installation by manufacturer certified installer.
2. Install cables in accordance with manufacturer's requirements
3. Install cable directly from shipping reels. Ensure that cable is not:
   a. Dented, nicked, or kinked.
   b. Subjected to pull stress greater, or bend radius less, than manufacturer's specification.
   c. Subjected to treatment that may damage fiber strands during installation.
4. Cables Per Conduit or Innerduct: One cable maximum.
5. If calculation indicates that cable will attenuate signals more than 8 dB, reroute may be allowed, if approved by Engineer.
6. Splices: Install fiber optic cables in unspliced lengths from fiber centers to switches or hubs.
7. Identification: Identify cable on both ends and in access holes and pull points it goes through.
8. Sealing: Seal cables into innerducts to stop ingress of water and grit with fabricated expansion plugs.
9. Access Holes:
   a. Provide supports for cables in access and handholes as shown.
   b. While maintaining minimum bend radius, lace cables neatly to supports to keep them out of way of personnel.

D. Fiber Centers:

1. Install securely in field panels as shown.
2. Minimum, one per facility having one or more network nodes.

E. Cable Terminations:

1. Terminate cables in accordance with TIA/EIA 568.
2. Slack:
   a. Fiber Centers, Hubs, and Switches: Minimum, 3-meter slack fiber at each end, coiled neatly in cable management equipment.
   b. Communications Management Outlets: Minimum, 1-meter slack fiber, coiled neatly in outlet box.

3. Connectors:
   a. Terminate six fibers in each cable to specified connectors.
   b. Connect into fiber management system.

F. Ethernet Fiber-to-Copper Transceivers:

1. Install transceivers in accordance with manufacturer's instructions.
2. Location: Install transceivers securely in field panels, close to network nodes and fiber centers.
3. Power: Energize each transceiver from its field panel's UPS, if applicable.
4. Connections:
   a. Connect transceiver to fiber optics and network node.
   b. Lace fiber optics neatly in place, routed through wireways.

3.02 FIELD QUALITY CONTROL

A. Test components of installation in accordance with standards and specifications.

B. Provide equipment, instrumentation, supplies and skilled staff necessary to perform testing.

C. Advise Engineer at least 24 hours in advance of each test. Engineer shall have option to witness and participate actively in tests.

D. Document test results of each cable to confirm that at least specified number of fibers meet standards, in accordance with Supplement titled As-Built Fiber Optic Cable Installation.

E. For each conduit and innerduct, complete As-Built Conduit/ Innerduct Installation form included as Supplement to this section.

F. Document results of tests.

3.03 TESTS AND INSPECTION

A. In accordance with Section 01810, Equipment Testing and Facility Startup.

B. Conduit:

1. Testing and Sealing of Spare Conduits.
2. Conduit and Innerduct Testing:
   a. Blow full-diameter mouse through each spare conduit and innerduct to verify they are unrestricted over full length.
   b. If any conduit is not unrestricted over full length, advise Engineer.

3. Documentation: Confirm that conduit test As-Built Conduit/Innerduct Installation form documentation includes details of innerducts.

C. Cable Testing:

1. TIA/EIA 568: Demonstrate that 100 percent fibers in each cable meet requirements of TIA/EIA 568, Annex H as modified here:
   a. Maximum attenuation as specified in Part II, Fiber Optic Cable.
   b. Measure attenuation in both directions, not in one direction only.
   c. For multimode fibers only: Measure attenuation at both 850 nm and 1,300 nm.
2. Replace and retest cables that do not have specified number of fibers that meet attenuation standards.

3.04 MANUFACTURER'S SERVICES

A. Manufacturer's Representative: Present at Site or classroom designated by Owner, for minimum person-days listed below, travel time excluded:

1. One (1) person-days for inspection.
2. One (1) person-days for functional and performance testing and completion of Manufacturer's Certificate of Proper Installation.
3. One (1) person-days for facility startup.

3.05 SUPPLEMENTS

A. Supplements listed below, following "End of Section," are part of this Specification.

1. As-Built Fiber Optic Cable Installation Form.
2. As-Built Conduit/Innerduct Installation Form.

END OF SECTION

PROJECT: TAYLOR MILL TREATMENT PLANT

Contractor:

Signed by:

AS-BUILT FIBER OPTIC CABLE INSTALLATION

Cable Identification:
Routing: From: In:
(Identify field panel, control room, etc. in building)

Through: 1
(Identify access hole, building, gallery, etc.)
Through: 2 Through: 5
Through: 3 Through: 6
Through: 4 Through: 7
To: In:
See As-Built Conduit/Innerduct Installation forms for identification of conduits/innerducts cable is routed through.

Acceptable Attenuation:
Multimode Fibers

		cable length*	
850 nm:	3.0 dB/km x	km + 1.5 dB =	dB
1300 nm:	1.0 dB/km x	km + 1.5 dB =	dB

*Contractor to provide actual length installed, within ±0.1 km.

Fiber ID	Use/Spare	Measured Attenuation (dB)			
		Hub-to-Node		Node-to-Hub	
		850 nm	1,300 nm	850 nm	1,300 nm

Single-mode Fibers

cable length*

1300 nm: 1.0 dB/km x km + 1.5 dB = dB

*Contractor to provide actual length installed, within ±0.1 km.

Fiber ID	Use/Spare	Measured Attenuation (dB)			
		Hub-to-Node		Node-to-Hub	
			1,300 nm		1,300 nm

Project: Taylor Mill Treatment Plant

Contractor:

Signed by:

AS-BUILT CONDUIT/INNERDUCT INSTALLATION

From: To:

(Identify building, access hole, field panel, etc.) Sheet 1 of 1

Conduits:
Used: 4 inches; 2 inches
Spare: 4 inches; 2 inches Confirm all spares unrestricted: Yes/No
(Provide number of conduits in each category)

Innerducts:

Conduit ID*	Innerduct ID	Cable ID / Spare

(Continued overleaf delete if not applicable)

*Provide conduit ID if required to identify innerduct uniquely in the access hole, if for example, color-coded innerduct is used in more than one conduit. If innerducts are tagged uniquely, leave this column blank.

END OF SUPPLEMENT

SECTION 15060
PIPING SUPPORT SYSTEMS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A123/A123M, Standard Specification for Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products.
   b. A653/A653M, Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvanealed) by the Hot-Dip Process.
2. International Code Council (ICC):
   a. Kentucky Building Code (KBC).
   b. International Mechanical Code (IMC).
3. Manufacturers' Standardization Society (MSS):
   a. SP-58, Pipe Hangers and Supports - Materials, Design and Manufacture.
   b. SP-69, Pipe Hangers and Supports - Selection and Application.
   c. SP-89, Pipe Hangers and Supports - Fabrication and Installation Practices.

1.02 DEFINITIONS

A. Wetted or Submerged: Submerged, less than 1 foot above liquid surface, below top of channel wall, under cover or slab of channel or tank, or in other damp locations.

1.03 DESIGN REQUIREMENTS

A. General:

1. Design, size, and locate piping support systems throughout facility, whether shown or not.
2. Piping Smaller than 30 Inches: Supports are shown only where specific types and locations are required; additional pipe supports may be required.
3. Meet requirements of MSS SP-58, MSS SP-69, and MSS SP-89 or as modified by this section.

B. Pipe Support Systems:

1. Pipe Support Systems shall be designed for gravity loads imposed by weight of pipes including the weight of fluid in pipes and insulation.
2. Maximum Support Spacing and Minimum Rod Size:
   a. Mild Steel or Ductile Iron Piping (Note that this spacing may require the use of higher load pipe clamps and more than a single point anchor point in concrete):

Pipe Size	Maximum Support/Hanger Spacing	Minimum Rod Size Single Rod Hangers
1" & smaller	6 feet	1/4"
1-1/2" through 2-1/2"	8 feet	1/4"
3" & 4"	10 feet	3/8"
6"	12 feet	3/8"
8"	12 feet	1/2"
10" & 12"	14 feet	5/8"
14"	16 feet	3/4"
16" & 18"	16 feet	7/8"
20"	18 feet	1"
24"	18 feet	1-1/4"
30" & larger	As shown on Drawings	As shown on Drawings

   b. Copper Piping:
      1) Maximum Support Spacing: 2 feet less per size than listed for steel pipe, with 1 inch and smaller pipe supported every 5 feet.
      2) Minimum Hanger Rod Sizing: Same as listed for steel pipe.
   c. Plastic and Fiberglass Piping:
      1) Maximum support spacing: As recommended by manufacturer for flow temperature in pipe.
      2) Minimum Hanger Rod Sizing: Same as listed for steel pipe.

C. Framing Support System:

1. Beams: Size such that beam stress does not exceed 25,000 psi and maximum deflection does not exceed 1/240 of span.
2. Column Members: Size in accordance with manufacturer's recommended method.

3. Support Loads: Calculate using weight of pipes filled with water plus insulation.
4. Maximum Spans:
   a. Steel and Ductile Iron Pipe, 3-Inch Diameter and Larger: 10-foot centers, unless otherwise shown.
   b. Other Pipelines and Special Situations: May require supplementary hangers and supports.
5. Electrical Conduit Support: Include in design of framing support system.

D. Anchoring Devices: Design, size, and space support anchoring devices, including anchor bolts, inserts, and other devices used to anchor support, to withstand shear and pullout loads imposed by loading and spacing on each particular support.

E. Existing Support Systems: Use existing supports systems to support new piping only if Contractor can show that they are adequate for additional load, or if they are strengthened to support additional load.

PART 2 PRODUCTS

2.01 GENERAL

A. When specified items are not available, fabricate pipe supports of correct material and to general configuration indicated by catalogs.

B. Special support and hanger details are shown for cases where standard catalog supports are inapplicable.

C. Materials: In accordance with Tables 1 and 2, attached as supplements to this section.

2.02 HANGERS

A. Clevis Type: MSS SP-58 and SP-69, Type 1.

1. Anvil; Figure 104 or 260, sizes 1/2 inch through 30 inches.
2. B-Line; Figure B3198H or Figure B3100, sizes 3/8 inch through 30 inches.

B. Hinged Split-Ring Pipe Clamp: MSS SP-58 and MSS SP-69, Type 6 or Type 12.

1. Anvil; Figure 104, sizes 3/4 inch through 8 inches.
2. B-Line; Figure B3171, sizes 3/4 inch through 8 inches.

C. Hanger Rods, Clevises, Nuts, Sockets, and Turnbuckles: In accordance with MSS SP-58.

D. Attachments:

1. I-Beam Clamp: Concentric loading type, MSS SP-58 and MSS SP-69, Type 21, 28, 29, or 30 which engage both sides of flange.
2. Concrete Insert: MSS SP-58 and MSS SP-69, Type 18, continuous channel insert with load rating not less than that of hanger rod it supports.
3. Welded Beam Attachment: MSS SP-58 and MSS SP-69, Type 22.
   a. Anvil; Figure 66.
   b. B-Line; Figure B3083.

2.03 WALL BRACKETS

A. Welded Steel Bracket: MSS SP-58 and MSS SP-69, Type 33 (heavy-duty).

1. Anvil; Figure 199, 3,000-pound rating.
2. B-Line; Figure B3067, 3,000-pound rating.

B. One-Hole Clamp: Anvil; Figure 126, sizes 3/8 inch through 4 inches.

C. Channel Type:

1. Unistrut.
2. Anvil; Power-Strut.
3. B-Line; Strut System.

2.04 PIPE CLAMPS

A. Riser Clamp: MSS SP-58 and MSS SP-69, Type 8.

1. Anvil; Figure 261, sizes 3/4 inch through 24 inches.
2. B-Line; Figure B3373, sizes 1/2 inch through 30 inches.

2.05 CHANNEL TYPE SUPPORT SYSTEMS

A. Channel Size: 12-gauge, 1-5/8-inch wide minimum steel, 1-1/2-inch wide, minimum FRP.

B. Members and Connections: Design for all loads with safety factor of 5.

C. Manufacturers:

1. B-Line; Strut System.
2. Unistrut.
3. Anvil; Power-Strut.
4. Aickinstrut (FRP System).

2.06 ACCESSORIES

A. Insulation Shields:

1. Type: Galvanized steel or stainless steel, MSS SP-58 and MSS SP-69, Type 40.
2. Manufacturers and Products:
   a. Anvil; Figure 167, sizes 1/2 inch through 24 inches.
   b. B-Line; Figure B3151, sizes 1/2 inch through 24 inches.

2.07 INTERMEDIATE PIPE GUIDES

A. Piping 6 Inches and Smaller:

1. Type: Pipe clamp with oversized pipe sleeve to provide minimum 1/8-inch clearance.
2. Manufacturers and Products:
   a. B-Line; B3148 or B3180.
   b. Anvil; Figure 103.

B. Piping 8 Inches and Larger:

1. Type: Specially formed U-bolts with double nuts to provide 1/4-inch minimum clearance around pipe.
2. U-Bolt Stock Size:
   a. 8-Inch Pipe: 5/8 inch.
   b. 10-Inch Pipe: 3/4 inch.
   c. 12-Inch Through 16-Inch Pipe: 7/8 inch.
   d. 18-Inch Through 30-Inch Pipe: 1 inch.

2.08 PIPE ALIGNMENT GUIDES

A. Type:

1. Piping 8 Inches and Smaller: Spider or sleeve type.
2. Piping 10 Inches and Larger: Roller type.

B. Manufacturers:

1. Flexonics.
2. Anvil.
3. B-Line.

PART 3 EXECUTION

3.01 INSTALLATION

A. General:

1. Install support systems in accordance with MSS SP-69 and MSS SP-89, unless shown otherwise.
2. Install pipe hanger rods plumb, within 4 degrees of vertical during shut down, start up or operations.
3. Support piping connections to equipment by pipe support and not by equipment.
4. Support large or heavy valves, fittings, and appurtenances independently of connected piping.
5. Support no pipe from pipe above it.
6. Support pipe at changes in direction or in elevation, adjacent to flexible joints and couplings, and where shown.
7. Do not install pipe supports and hangers in equipment access areas or bridge crane runs.
8. Brace hanging pipes against horizontal movement by both longitudinal and lateral sway bracing and to reduce movement after startup.
9. Install pipe anchors where required to withstand expansion thrust loads and to direct and control thermal expansion.
10. Repair mounting surfaces to original condition after attachments are made.

B. Standard Pipe Supports:

1. Horizontal Suspended Piping:
   a. Single Pipes: Adjustable swivel-ring, split-ring, or clevis hangers.
   b. Grouped Pipes: Trapeze hanger systems.
   c. Furnish galvanized steel protection shield and oversized hangers for insulated pipe.
   d. Furnish precut sections of rigid insulation with vapor barrier at hangers for insulated pipe.
2. Horizontal Piping Supported from Walls:
   a. Single Pipes: Wall brackets or wall clips attached to wall with anchors. Clips attached to wall mounted framing also acceptable.
   b. Stacked Piping: Wall mounted framing system and clips acceptable for piping smaller than 3-inch minimal diameter.
   c. Piping clamps that resist axial movement of pipe through support are not acceptable. Use cast iron hanging rolls supported from wall bracket. Furnish galvanized steel protection shield and oversized hangers Wall mounted piping clips not acceptable for insulated piping.

3. Horizontal Piping Supported from Floors:
    a. Stanchion Type:
        1) Pedestal type; adjustable with stanchion, saddle, and anchoring flange.
        2) Use yoked saddles for piping whose centerline elevation is 18 inches or greater above floor and for exterior installations.
        3) Provide neoprene waffle isolation pad under anchoring flanges, adjacent to equipment or where otherwise required to provide vibration isolation.
    b. Floor Mounted Channel Supports:
        1) Use for piping smaller than 3-inch nominal diameter running along floors and in trenches at piping elevations lower than can be accommodated using pedestal pipe supports.
        2) Attach channel framing to floors with anchor bolts.
        3) Attach pipe to channel with clips or pipe clamps.
4. Vertical Pipe: Support with wall brackets and base elbow or riser clamps on floor penetrations.
5. Standard Attachments:
    a. To Concrete Ceilings: Concrete inserts.
    b. To Steel Beams: I-beam clamp or welded attachments.
    c. To Concrete Walls: Concrete inserts or brackets or clip angles with anchor bolts.
6. Existing Walls and Ceilings: Install as specified for new construction, unless shown otherwise.

C. Accessories:

1. Insulation Shield: Install on insulated nonsteel piping. Oversize rollers and supports.
2. Dielectric Barrier: Install between carbon steel members and copper or stainless steel pipe.
3. Electrical Isolation: Install 1/4-inch by 3-inch neoprene rubber wrap between submerged metal pipe and oversized clamps.

END OF SECTION

SECTION 15200
PROCESS PIPING—GENERAL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section and any supplemental Data Sheets:

1. American Petroleum Institute (API): SPEC 5L, Specification for Line Pipe.
2. American Society of Mechanical Engineers (ASME):
   a. Boiler and Pressure Vessel Code, Section VIII, Rules for Construction of Pressure Vessels.
   b. Boiler and Pressure Vessel Code, Section IX, Qualification Standard for Welding and Brazing Procedures, Welders, Brazers, and Welding and Brazing Operators.
   c. B1.20.1, Pipe Threads, General Purpose (Inch).
   d. B16.1, Cast Iron Pipe Flanges and Flanged Fittings Classes 25, 125, and 250.
   e. B16.21, Nonmetallic Flat Gaskets for Pipe Flanges.
   f. B16.42, Ductile Iron Pipe Flanges and Flanged Fittings Classes 150.
   g. B31.3, Process Piping.
   h. B31.9, Building Services Piping.
3. American Society for Nondestructive Testing (ASNT): SNT-TC-1A, Personnel Qualification and Certification in Nondestructive Testing.
4. American Water Works Association (AWWA):
   a. C104/A21.4, Cement-Mortar Lining for Ductile-Iron Pipe and Fittings for Water.
   b. C110/A21.10, Ductile-Iron and Gray-Iron Fittings for Water.
   c. C111/A21.11, Rubber-Gasket Joints for Ductile-Iron Pressure Pipe and Fittings.
   d. C115/A21.15, Flanged Ductile-Iron Pipe with Ductile-Iron or Gray-Iron Threaded Flanges.
   e. C151/A21.51, Ductile-Iron Pipe, Centrifugally Cast, for Water.
   f. C153/A21.53, Ductile-Iron Compact Fittings, for Water Service.
   g. C200, Steel Water Pipe—6 Inches (150 mm) and Larger.
   h. C205, Cement-Mortar Protective Lining and Coating for Steel Water Pipe—4 Inches (100 mm) and Larger—Shop Applied.
   i. C207, Steel Pipe Flanges for Waterworks Service, Sizes 4 In. through 144 In. (100 mm through 3,600 mm).
   j. C208, Dimensions for Fabricated Steel Water Pipe Fittings.

k. C210, Liquid-Epoxy Coating Systems for the Interior and Exterior of Steel Water Pipelines.
l. M11, Steel Pipe—A Guide for Design and Installation.

5. American Welding Society (AWS): QC 1, Standard for AWS Certification of Welding Inspectors.
6. ASTM International (ASTM):
   a. A47/A47M, Standard Specification for Ferritic Malleable Iron Castings.
   b. A183, Standard Specification for Carbon Steel Track Bolts and Nuts.
   c. A193/A193M, Standard Specification for Alloy-Steel and Stainless Steel Bolting Materials for High-Temperature Service.
   d. A307, Standard Specification for Carbon Steel Bolts and Studs, 60,000 psi Tensile Strength.
   e. A536, Standard Specification for Ductile Iron Castings.
   f. A563, Standard Specification for Carbon and Alloy Steel Nuts.
   g. D1330, Standard Specification for Rubber Sheet Gaskets.
   h. D1784, Standard Specification for Rigid Poly(Vinyl Chloride) (PVC) Compounds and Chlorinated Poly(Vinyl Chloride) (CPVC) Compounds.
   i. D1785, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe, Schedules 40, 80, and 120.
   j. D2464, Standard Specification for Threaded Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   k. D2466, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 40.
   l. D2467, Standard Specification for Poly(Vinyl Chloride) (PVC) Plastic Pipe Fittings, Schedule 80.
   m. D2564, Standard Specification for Solvent Cements for Poly(Vinyl Chloride) (PVC) Plastic Piping Systems.
   n. D2837, Standard Test Method for Obtaining Hydrostatic Design Basis for Thermoplastic Pipe Materials or Pressure Design Basis for Thermoplastic Pipe Products.
   o. F439, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe Fittings, Schedule 80.
   p. F441, Standard Specification for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe, Schedules 40 and 80.
   q. F491, Standard Specification for Poly(Vinylidene Fluoride) (PVDF) Plastic-Lined Ferrous Metal Pipe and Fittings.
   r. F493, Standard Specification for Solvent Cements for Chlorinated Poly(Vinyl Chloride) (CPVC) Plastic Pipe and Fittings.
   s. F656, Standard Specification for Primers for Use in Solvent Cement Joints of Poly(Vinyl Chloride) (PVC) Plastic Pipe and Fittings.

7. Manufacturers Standardization Society of the Valve and Fittings Industry, Inc. (MSS): SP43, Wrought Stainless Steel Butt-Welding Fittings Including Reference to Other Corrosion Resistant Materials.

1.02 DEFINITIONS

A. Submerged or Wetted:

1. Zone below elevation of: Top face of channel walls and cover slabs.

1.03 DESIGN REQUIREMENTS

A. Where pipe diameter, thickness, pressure class, pressure rating, or thrust restraint is not shown or specified, design piping system in accordance with the following:

1. Building Service Piping: ASME B31.9, as applicable.
2. Buried Piping: H20-S16 traffic load with 1.5 impact factor, AASHTO HB-17, as applicable.
3. Thrust Restraints:
   a. Design for test pressure shown in Piping Schedule.
   b. Allowable Soil Pressure: 1,000 pounds per square foot.
   c. Low Pressure Pipelines:
      1) When bearing surface of the fitting against soil provides an area equal to or greater than area required for thrust restraint, concrete thrust blocks will not be required.
      2) Determine bearing area for fittings without thrust blocks by projected area of 70 percent of internal diameter multiplied by chord length for fitting centerline curve.

1.04 DELIVERY, STORAGE, AND HANDLING

A. In accordance with Section 01600, Material and Equipment, and:

1. Flanges: Securely attach metal, hardboard, or wood protectors over entire gasket surface.
2. Threaded or Socket Welding Ends: Fit with metal, wood, or plastic plugs or caps.
3. Linings and Coatings: Prevent excessive drying.
4. Cold Weather Storage: Locate products to prevent coating from freezing to ground.
5. Handling: Use heavy canvas or nylon slings to lift pipe and fittings.

PART 2 PRODUCTS

2.01 PIPING

A. As specified on Piping Data Sheet(s) located at the end of this section as Supplement.

2.02 JOINTS

A. Flanged Joints:

1. Flat-faced, carbon steel, or alloy flanges when mating with flat-faced cast or ductile iron flanges.
2. Higher pressure rated flanges as required to mate with equipment when equipment flange is of higher pressure rating than required for piping.

B. Threaded Joints: NPT taper pipe threads in accordance with ASME B1.20.1.

C. Mechanical connections of high density polyethylene pipe to auxiliary equipment such as valves, pumps, tanks, and other piping systems shall be through flanged connections consisting of the following:

1. Bolts and nuts of sufficient length to show a minimum of three complete threads when the joint is made and tightened to manufacturer's standard. Retorque nuts after 4 hours.
2. Gaskets as specified on Data Sheet.

2.03 GASKET LUBRICANT

A. Lubricant shall be supplied by pipe manufacturer and no substitute or "or-equal" will be allowed.

2.04 PIPE CORROSION PROTECTION

A. Coatings: See Section 09902, Painting for details of coating requirements.

B. Heat Shrink Wrap:

1. Type: Cross-linked polyolefin wrap or sleeve with mastic sealant.
2. Manufacturer and Product: Raychem.

C. Polyethylene Encasement (Bagging):

1. Encasement Tube: Black polyethylene encasement tube, 8 mils minimum thickness, conforming to AWWA C105/A21.5, Class C, free of gels, streaks, pinholes, foreign matter, undispersed raw materials, and visible defects such as tears, blisters, and thinning at folds.

2. Securing Tape: Thermoplastic tape, 8 mils minimum thickness, 1 inch wide, pressure sensitive adhesive face capable of bonding to metal, bituminous coating, and polyethylene encasement tube.

2.05 FABRICATION

A. Flanged pipe shall be fabricated in the shop, not in the field, and delivered to the Site with flanges in place and properly faced. Threaded flanges shall be individually fitted and machine tightened on matching threaded pipe by the manufacturer.

2.06 FINISHES

A. Factory prepare, prime, and finish coat in accordance with Pipe Data Sheet(s) and Piping Schedule.

PART 3 EXECUTION

3.01 EXAMINATION

A. Verify size, material, joint types, elevation, horizontal location, and pipe service of existing pipelines to be connected to new pipelines or new equipment.

B. Inspect size and location of structure penetrations to verify adequacy of wall pipes, sleeves, and other openings.

C. Welding Electrodes: Verify proper grade and type, free of moisture and dampness, and coating is undamaged.

3.02 PREPARATION

A. See Piping Schedule and Section 09902, Painting for additional requirements.

B. Inspect pipe and fittings before installation, clean ends thoroughly, and remove foreign matter and dirt from inside.

C. Damaged Coatings and Linings: Repair using original coating and lining materials in accordance with manufacturer's instructions.

3.03 INSTALLATION—GENERAL

A. Join pipe and fittings in accordance with manufacturer's instructions, unless otherwise shown or specified.

B. Remove foreign objects prior to assembly and installation.

C. Flanged Joints:

1. Install perpendicular to pipe centerline.
2. Bolt Holes: Straddle vertical centerlines, aligned with connecting equipment flanges or as shown.
3. Use torque-limiting wrenches to ensure uniform bearing and proper bolt tightness.
4. Plastic Flanges: Install annular ring filler gasket at joints of raised-face flange.
5. Raised-Face Flanges: Use flat-face flange when joining with flat-faced ductile or cast iron flange.
6. Verify compatibility of mating flange to adapter flange gasket prior to selecting grooved adapter flanging.
7. Flange fillers are to be avoided, but if necessary, may be used to make up for small angles up to 6 degrees and for filling gaps up to 2 inches between flanges. Stacked flange fillers shall not be used.
8. Threaded flanged joints shall be shop fabricated and delivered to Site with flanges in-place and properly faced.
9. Manufacturer:
   a. Same as pipe manufacturer.
   b. Victaulic flange adapter.
   c. Anvil International, Inc., Gruvlok.

D. Threaded and Coupled Joints:

1. Conform to ASME B1.20.1.
2. Produce sufficient thread length to ensure full engagement when screwed home in fittings.
3. Countersink pipe ends, ream and clean chips and burrs after threading.
4. Make connections with not more than three threads exposed.
5. Lubricate male threads only with thread lubricant or tape as specified on Piping Data Sheets.

E. Pipe Connections at Concrete Structures: As specified in Article Piping Flexibility Provisions in Section 15205, Process Piping Specialties.

F. PVC and CPVC Piping:

1. Provide Schedule 80 threaded nipple where necessary to connect to threaded valve or fitting.
2. Use strap wrench for tightening threaded plastic joints. Do not overtighten fittings.
3. Do not thread Schedule 40 pipe.

G. Ductile Iron Piping:

1. Cutting Pipe: Cut pipe with milling type cutter, rolling pipe cutter, or abrasive saw cutter. Do not flame cut.
2. Dressing Cut Ends:
   a. General: As required for the type of joint to be made.
   b. Rubber Gasketed Joints: Remove sharp edges or projections.
   c. Push-On Joints: Bevel, as recommended by pipe manufacturer.
   d. Flexible Couplings, Flanged Coupling Adapters, and Grooved End Pipe Couplings: As recommended by the coupling or adapter manufacturer.

3.04 INSTALLATION—EXPOSED PIPING

A. Piping Runs:

1. Parallel to building or column lines and perpendicular to floor, unless shown otherwise.
2. Piping upstream and downstream of flow measuring devices shall provide straight lengths as required for accurate flow measurement.

B. Supports: As specified in Section 15060, Piping Support Systems.

C. Group piping wherever practical at common elevations; install to conserve building space and not interfere with use of space and other work.

D. Unions or Flanges: Provide at each piping connection to equipment or instrumentation on equipment side of each block valve to facilitate installation and removal.

E. Install piping so that no load or movement in excess of that stipulated by equipment manufacturer will be imposed upon equipment connection; install to allow for contraction and expansion without stressing pipe, joints, or connected equipment.

F. Piping clearance, unless otherwise shown:

1. Over Walkway and Stairs: Minimum of 7 feet 6 inches, measured from walking surface or stair tread to lowest extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
2. Between Equipment or Equipment Piping and Adjacent Piping: Minimum 3 feet, measured from equipment extremity and extremity of piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.

3. From Adjacent Work: Minimum 1 inch from nearest extremity of completed piping system including flanges, valve bodies or mechanisms, insulation, or hanger/support systems.
4. Do not route piping in front of or to interfere with access ways, ladders, stairs, platforms, walkways, openings, doors, or windows.
5. Headroom in front of openings, doors, and windows shall not be less than the top of the opening.
6. Do not install piping containing liquids or liquid vapors in transformer vaults or electrical equipment rooms.
7. Do not route piping over, around, in front of, in back of, or below electrical equipment including controls, panels, switches, terminals, boxes, or other similar electrical work.

3.05 PIPE CORROSION PROTECTION

A. Ductile Iron Pipe:

1. Exposed: As specified in Section 09902, Painting and as shown in Piping Schedule.
2. Submerged or Embedded: Coat with coal-tar epoxy as specified in Section 09902, Painting.

B. PVC and CPVC Pipe, Exposed: As specified in Section 09902, Painting.

C. Piping Accessories:

1. Exposed:
   a. Field paint black and galvanized steel, brass, copper, and bronze piping components as specified in Section 09902, Painting as applicable to base metal material.
   b. Accessories include, but are not limited to, pipe hangers, supports, expansion joints, pipe guides, flexible couplings, vent and drain valves, and fasteners.
2. Buried:
   a. Ferrous Metal and Stainless Steel Components: Coat with coal-tar epoxy as specified in Section 09902, Painting.
   b. Bolts, Nuts, and Similar Items: Coat with bituminous paint.
   c. Flexible Couplings , Grooved Couplings, and Similar Items: Wrap with heat shrink wrapor coat with cement.
   d. Buried Valves and Similar Elements on Wrapped Pipelines: Coat with bituminous paint and wrap entire valve in polyethylene encasement.
   e. Cement-Coated Pipelines: Cement coat appurtenances same as pipe.

D. Polyethylene Encasement: Install in accordance with AWWA C105/A21.5 and manufacturer's instructions.

E. Tape Coating System: As specified in Section 09902, Painting.

F. Heat Shrink Wrap: Apply in accordance with manufacturer's instructions to surfaces that are cleaned, prepared, and primed.

G. Insulating Flanges, Couplings, and Unions:

1. Applications:
   a. Dissimilar metal piping connections.
   b. Cathodically protected piping penetration to buildings and watertight structures.
   c. Submerged to unsubmerged metallic piping connections.
   d. Where required for electrically insulated connection.
2. Pipe Installation:
   a. Insulating joints connecting immersed piping to nonimmersed piping shall be installed above maximum water surface elevation.
   b. Submerged carbon steel, ductile iron, or galvanized piping in reinforced concrete shall be isolated from the concrete reinforcement steel.
   c. Align and install insulating joints according to manufacturer's recommendations to avoid damaging insulating materials.

3.06 SLAB, FLOOR, WALL, AND ROOF PENETRATIONS

A. Application and Installation: As specified in Section 15205, Process Piping Specialties.

3.07 VENTS AND DRAINS

A. Vents and drains at high and low points in piping required for completed system may or may not be shown. Install vents on high points and drains on low points of pipelines at all low and high point locations.

3.08 PIPE IDENTIFICATION

A. As specified in Section 09902, Painting.

3.09 FIELD QUALITY CONTROL

A. Pressure Leakage Testing: As specified in Section 15955, Piping Leakage Testing.

3.10 SUPPLEMENTS

A. Data Sheets.

Number	Title
-01	Cement-Mortar, Glass and Asphaltic-Lined Ductile Iron Pipe and Fittings
-10	Polyvinyl Chloride (PVC) Pipe and Fittings

END OF SECTION

SECTION 15200-01 CEMENT-MORTAR-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
General	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	Buried Liquid Service Using Push-On, Mechanical, or Proprietary Restrained Joints: AWWA C111/A21.11, and AWWA C151/A21.51, pressure class conforming to Tables 5 and 7 for Type 4 trench, 250 psi minimum working pressure. Follower glands shall be ductile iron. Buried Fuel Gas or Air Service Using Push-On, Mechanical, or Proprietary Restrained Joints: AWWA C151/A21.51, pressure class in conforming to Tables 5 and 7 for Type 4 trench, 250 psi minimum working pressure. Follower glands shall be ductile iron. Exposed Pipe Using Grooved End and Flange Joints: AWWA C115/A21.15, thickness Class 53 minimum, 250 psi minimum working pressure.
Lining	Asphaltic: AWWA C104/A21.4. Cement-Mortar: AWWA C104/A21.4. Glass: Completely fused above 1,400 degrees F, 6 to 10 mils thick, defects which expose base metal not greater than 0.01% of total lined surface, hardness greater than 5 on the Mohs scale, lining bonded sufficiently to withstand a metal strain of 0.001 inch/inch without damage to the glass lining, finished lined pipe not to deviate more than 0.0125 inch per foot of length from a centerline perpendicular to the flange face or square end of the pipe. Fast Fabricators, Inc., Ferrock MEH-32; Ceramic Coating Co., SL-31; VITCO Corp., SG-14.
Fittings	Lined and coated same as pipe. Push-On: AWWA C110/A21.10 and C111/A21.11, gray or ductile iron, 250 psi minimum working pressure. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint. Mechanical: AWWA C110/A21.10, C111/A21.11, and C153/A21.53 gray or ductile iron, 250 psi minimum working pressure. Follower glands shall be ductile iron.

SECTION 15200-01 CEMENT-MORTAR-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
	Proprietary Restrained: AWWA C111/A21.11 and C153/A21.53, ductile iron, 250 psi minimum working pressure. Clow Corp., Super-Lock Joint; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring Joint; U.S. Pipe, TR Flex. Grooved End: AWWA C606 and C110/A21.10, ductile iron, 250 psi minimum working pressure. Victaulic. Flange: AWWA C110/A21.10 ductile iron, faced and drilled, 125-pound flat face. Gray cast iron will not be allowed.
Joints	Push-On: 250 psi minimum working pressure, AWWA C110/A21.10 and C111/A21.11. American Cast Iron Pipe Co., Fastite Joint; U.S. Pipe and Foundry, Tyton Joint. Mechanical: 250 psi minimum working pressure. Proprietary Restrained: 150 psi minimum working pressure. Clow Corp., Super-Lock; American Cast Iron Pipe Co., Flex-Ring or Lok-Ring; U.S. Pipe, TR Flex. Grooved End: Rigid type radius cut conforming to AWWA C606, 250 psi minimum working pressure. Victaulic. Flange: 125-pound flat face, ductile iron, threaded conforming to AWWA C115/A21.15. Gray cast iron will not be allowed.
Bolting	Mechanical, Proprietary Restrained, and Grooved End Joints: Manufacturer's standard. 125-Pound Flat-Faced Flange: ASTM A307, Grade A carbon steel hex head bolts and ASTM A563, Grade A carbon steel hex head nuts.
Gaskets	Push-On, Mechanical, and Proprietary Restrained Joints; Water and Sewage Service: Rubber conforming to AWWA C111/A21.11. Push-On, Mechanical, and Proprietary Restrained Joints; Hot Air and Fuel Gas Service: EPDM or Viton and conforming to AWWA C111/A21.11. *Grooved End Joints: Halogenated butyl conforming to* ASTM D2000 and AWWA C606.

SECTION 15200-01 CEMENT-MORTAR-LINED DUCTILE IRON PIPE AND FITTINGS	
Item	**Description**
	Flanged, Water and Sewage Service: 1/8-inch-thick, red rubber (SBR), hardness 80 (Shore A), rated to 200 degrees F, conforming to ASME B16.21, AWWA C207, and ASTM D1330, Grades 1 and 2. Flanged, Hot Air, and Fuel Gas Service: 1/8-inch-thick, homogeneous black rubber (EPDM), hardness 60 (Shore A), rated to 300 degrees F, conforming to ASME B16.21 and ASTM D1330 Steam Grade. Full face for 125-pound flat-faced flanges, flat-ring type for 250-pound raised-face flanges. Blind flanges shall be gasketed covering the entire inside face with the gasket cemented to the blind flange. Gasket pressure rating to equal or exceed the system hydrostatic test pressure.
Joint Lubricant	Manufacturer's standard.

END OF SECTION

SECTION 15200-10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	**Size**	**Description**
General	All	Materials in contact with potable water shall conform to NSF 61 acceptance.
Pipe	All	Schedule 80 PVC: Type I, Grade I or Class 12454-B conforming to ASTM D1784 and ASTM D1785. Pipe shall be manufactured with titanium dioxide for ultraviolet protection. Threaded Nipples: Schedule 80 PVC.
Fittings	All	Schedule to Match Pipe Above: ASTM D2466 and ASTM D2467 for socket weld type and Schedule 80 ASTM D2464 for threaded type. Fittings shall be manufactured with titanium dioxide for ultraviolet protection.
Joints	All	Solvent socket weld except where connection to threaded valves and equipment may require future disassembly.
Flanges	All	One piece, molded hub type PVC flat face flange in accordance with Fittings above, 125-pound ASME B16.1 drilling
Bolting	All	Flat Face Mating Flange and In Corrosive Areas: ASTM A193/A193M, Type 316 stainless steel Grade B8M hex head bolts and ASTM A194/A194M Grade 8M hex head nuts. With Raised Face Mating Flange: Carbon steel ASTM A307 Grade B square head bolts and ASTM A563 Grade A heavy hex head nuts.
Gaskets	All	Flat Face Mating Flange: Full faced 1/8-inch thick ethylene propylene (EPR) rubber. Raised Face Mating Flange: Flat ring 1/8-inch ethylene propylene (EPR) rubber, with filler gasket between OD of raised face and flange OD to protect the flange from bolting moment.

SECTION 15200-10 POLYVINYL CHLORIDE (PVC) PIPE AND FITTINGS		
Item	**Size**	**Description**
Solvent Cement	All	Socket type joints shall be made employing solvent cement that meets or exceeds the requirements of ASTM F493 and primer that meets or exceeds requirements of ASTM F656 and as recommended by pipe and fitting manufacturer, except solvent weld cement for PVC pipe joints in sodium hypochlorite service shall be free of silica filler and shall be certified by the manufacturer to be suitable for that service. Certification shall be submitted.
Thread Lubricant	All	Teflon Tape.

END OF SECTION

SECTION 16050
BASIC ELECTRICAL MATERIALS AND METHODS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. ASTM International (ASTM):
   a. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   b. A1011/A1011M, Standard Specification for Steel, Sheet, and Strip, Hot-Rolled, Carbon, Structural, High-Strength Low Alloy and High-Strength Low Alloy Formability.
   c. E814, Method of Fire Tests of Through-Penetration Fire Stops.
2. Canadian Standards Association (CSA).
3. Institute of Electrical and Electronics Engineers, Inc. (IEEE): 18, Standard for Shunt Power Capacitors.
4. Instrumentation, Systems, and Automation Society (ISA): RP12.06.01, Wiring Practices for Hazardous (Classified) Locations Instrumentation–Part 1: Intrinsic Safety.
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
   b. AB 1, Molded Case Circuit Breakers, Molded Case Switches, and Circuit-Breaker Enclosures.
   c. C12.1 Code for Electricity Metering
   d. C12.6 Phase-Shifting Devices Used in Metering, Marking and Arrangement of, Terminals for
   e. CP 1, Shunt Capacitors.
   f. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   g. ICS 5, Industrial Control and Systems: Control Circuit and Pilot Devices.
   h. KS 1, Enclosed and Miscellaneous Distribution Switches (600 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
   a. 98, Standard for Enclosed and Dead-Front Switches.
   b. 248, Standard for Low Voltage Fuses.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.

e. 508, Standard for Industrial Control Equipment.
f. 810, Standard for Capacitors.
g. 943, Standard for Ground-Fault Circuit-Interrupters.
h. 1059, Standard for Terminal Blocks.
i. 1479, Fire Tests of Through-Penetration Fire Stops.

1.02 SUBMITTALS

A. Action Submittals:

1. Provide manufacturers' data for the following:
   a. Control devices.
   b. Circuit breakers.
   c. Fused switches.
   d. Nonfused switches.
   e. Fuses.
   f. Magnetic contactors.
   g. Firestopping.
   h. Enclosures: Include enclosure data for products having enclosures.

1.03 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts and special tools:

1. Fuses, 0 to 600 Volts: Three of each type and each current rating installed.

PART 2 PRODUCTS

2.01 MOLDED CASE CIRCUIT BREAKER THERMAL MAGNETIC, LOW VOLTAGE

A. General:

1. Type: Molded case.
2. Trip Ratings: 15-200 amps.
3. Voltage Ratings: 120 and 240V ac.
4. Suitable for mounting and operating in any position.
5. NEMA AB 1 and UL 489.

B. Operating Mechanism:

1. Overcenter, trip-free, toggle type handle.
2. Quick-make, quick-break action.
3. Locking provisions for padlocking breaker in open position.

4. ON/OFF and TRIPPED indicating positions of operating handle.
5. Operating handle to assume a center position when tripped.

C. Trip Mechanism:

1. Individual permanent thermal and magnetic trip elements in each pole.
2. Variable magnetic trip elements with a single continuous adjustment 3X to 10X for frames greater than 100 amps.
3. Two and three pole, common trip.
4. Automatically opens all poles when overcurrent occurs on one pole.
5. Test button on cover.
6. Calibrated for 40 degrees C ambient, unless shown otherwise.
7. Do not provide single-pole circuit breakers with handle ties where multi-pole circuit breakers are shown.

D. Short Circuit Interrupting Ratings: Equal to, or greater than, available fault current or interrupting rating shown.

E. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).

1. Ground fault sensor shall be rated same as circuit breaker.
2. Push-to-test button.

F. Connections:

1. Supply (line side) at either end.
2. Mechanical wire lugs, except crimp compression lugs where shown.
3. Lugs removable/replaceable for breaker frames greater than 100 amperes.
4. Suitable for 75 degrees C rated conductors without derating breaker or conductor ampacity.

G. Enclosures for Independent Mounting:

1. See Article Enclosures.
2. Interlock: Enclosure and switch shall interlock to prevent opening cover with switch in the ON position. Provide bypass feature for use by qualified personnel.

2.02 FUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. UL 98 listed for use and location of installation.

B. NEMA KS 1.

C. Short Circuit Rating: 200,000 amps RMS symmetrical with Class R fuses installed.

D. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

E. Connections:

1. Mechanical lugs, except crimp compression lugs where shown.
2. Lugs removable/replaceable.
3. Suitable for 75 degrees C rated conductors at NEC 75 degrees C ampacity.

F. Fuse Provisions: 30-amp to 600-amp rated shall incorporate rejection feature to reject all fuses except Class R.

G. Enclosures: See Article Enclosures.

H. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.03 NONFUSED SWITCH, INDIVIDUAL, LOW VOLTAGE

A. NEMA KS 1.

B. Quick-make, quick-break, motor rated, load-break, heavy-duty (HD) type with external markings clearly indicating ON/OFF positions.

C. Lugs: Suitable for use with 75 degrees C wire at NEC 75 degrees C ampacity.

D. Enclosures: See Article Enclosures.

E. Interlock: Enclosure and switch to prevent opening cover with switch in ON position. Provide bypass feature for use by qualified personnel.

2.04 FUSE, 250-VOLT AND 600-VOLT

A. Power Distribution, General:

1. Current-limiting, with 200,000 ampere rms interrupting rating.
2. Provide to fit mountings specified with switches.
3. UL 248.

B. Power Distribution, Ampere Ratings 1 Amp to 600 Amps:

1. Class: RK-1.
2. Type: Dual element, with time delay.

3. Manufacturers and Products:
   a. Bussmann; Types LPS-RK (600 volts) and LPN-RK (250 volts).
   b. Littelfuse; Types LLS-RK (600 volts) and LLN-RK (250 volts).

C. Cable Limiters:

1. 600V or less; crimp to copper cable, bolt to bus or terminal pad.
2. Manufacturer and Product: Bussmann; K Series.

D. Ferrule:

1. 600V or less, rated for applied voltage, small dimension.
2. Ampere Ratings: 1/10 amp to 30 amps.
3. Dual-element time-delay, time-delay, or nontime-delay as required.
4. Provide with blocks or holders as indicated and suitable for location and use.
5. Manufacturers:
   a. Bussmann.
   b. Littlefuse, Inc.

2.05 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Contact Rating: 7,200VA make, 720VA break, at 600V, NEMA ICS 5 Designation A600.

B. Selector Switch Operating Lever: Gloved hand.

C. Indicating Light: Transformer.

D. Pushbutton Color:

1. ON or START: Black.
2. OFF or STOP: Red.

E. Legend Plate:

1. Material: Aluminum.
2. Engraving: Enamel filled in high contrasting color.
3. Text Arrangement: 11-character/spaces on one line, 14-character/spaces on each of two lines, as required, indicating specific function.
4. Letter Height: 7/64-inch.

F. Manufacturers and Products:

1. Heavy-Duty, Oil-Tight Type:
   a. General Electric Co.; Type CR 104P.
   b. Square D Co.; Type T.
   c. Eaton/Cutler-Hammer; Type 10250T.

2. Heavy-Duty, Watertight, and Corrosion-Resistant Type:
   a. Square D Co.; Type SK.
   b. General Electric Co.; Type CR 104P.
   c. Eaton/Cutler-Hammer; Type E34.
   d. Crouse-Hinds; Type NCS.

2.06 TERMINAL BLOCK, 600 VOLTS

A. UL 486E and UL 1059.

B. Size components to allow insertion of necessary wire sizes.

C. Capable of termination of control circuits entering or leaving equipment, panels, or boxes.

D. Screw clamp compression, dead front barrier type, with current bar providing direct contact with wire between compression screw and yoke.

E. Yoke, current bar, and clamping screw of high strength and high conductivity metal.

F. Yoke shall guide all strands of wire into terminal.

G. Current bar shall ensure vibration-proof connection.

H. Terminals:

1. Capable of wire connections without special preparation other than stripping.
2. Capable of jumper installation with no loss of terminal or rail space.
3. Individual, rail mounted.

I. Marking system, allowing use of preprinted or field-marked tags.

J. Manufacturers:

1. Weidmuller, Inc.
2. Ideal.
3. Electrovert USA Corp.

2.07 MAGNETIC CONTACTOR

A. UL listed.

B. Electrically operated, electrically held.

C. Main Contacts:

1. Power driven in one direction with mechanical spring dropout.
2. Silver alloy with wiping action and arc quenchers.
3. Continuous-duty, rated as shown.
4. Poles: As shown.

D. Control: As shown.

E. Auxiliary Contacts: One normally open and one normally closed, rated 7200VA make, 720VA break, at 600V, A600 per NEMA ICS 5.

F. Enclosures: See Article Enclosures.

G. Manufacturers and Products:

1. Eaton/Cutler-Hammer; Class A201.
2. General Electric Co.; CR 353.
3. Square D Co.; Class 8910.

2.08 SUPPORT AND FRAMING CHANNELS

A. PVC Coated Framing Channel: Carbon steel framing channel with 40-mil polyvinyl chloride coating.

B. Manufacturers:

1. B-Line Systems, Inc.
2. Unistrut Corp.
3. Aickinstrut.

2.09 FIRESTOPS

A. General:

1. Provide UL 1479 classified hourly fire-rating equal to, or greater than, the assembly penetrated.
2. Prevent the passage of cold smoke, toxic fumes, and water before and after exposure to flame.
3. Sealants and accessories shall have fire-resistance ratings as established by testing identical assemblies in accordance with ASTM E814, by Underwriters Laboratories Inc., or other testing and inspection agency acceptable to authorities having jurisdiction.

B. Firestop System:

1. Formulated for use in through-penetration firestopping around cables, conduit, pipes, and duct penetrations through fire-rated walls and floors.

2.10 ENCLOSURES

A. Finish: Sheet metal structural and enclosure parts shall be completely painted using an electrodeposition process so interior and exterior surfaces as well as bolted structural joints have a complete finish coat on and between them.

B. Color: Manufacturer's standard color (gray) baked-on enamel, unless otherwise shown.

C. Barriers: Provide metal barriers within enclosures to separate wiring of different systems and voltage.

D. Enclosure Selections: Except as shown otherwise, provide electrical enclosures according to the following table:

ENCLOSURES			
Location	**Finish**	**Environment**	**NEMA 250 Type**
Indoor and Outdoor	Any	Wet and Corrosive	4X

PART 3 EXECUTION

3.01 GENERAL

A. Install equipment in accordance with manufacturer's recommendations.

3.02 PUSHBUTTON, INDICATING LIGHT, AND SELECTOR SWITCH

A. Unless otherwise shown, install heavy-duty, watertight and corrosion-resistant type in nonhazardous, outdoor, or normally wet areas.

3.03 SUPPORT AND FRAMING CHANNEL

A. Install where required for mounting and supporting electrical equipment and raceway systems.

B. Paint cut ends prior to installation with the following: PVC-Coated Channel: PVC patch.

3.04 FIRESTOPS

A. Sealant: Install sealant, including forming, packing, and other accessory materials, to fill openings around electrical services penetrating floors and walls, to provide firestops with fire-resistance ratings indicated for floor or wall assembly in which penetration occurs.

END OF SECTION

SECTION 16060
GROUNDING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. Institute of Electrical and Electronics Engineers (IEEE): C2, National Electrical Safety Code (NESC).
2. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC).

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings: Product data for the following:
   a. Exothermic weld connectors.
   b. Mechanical connectors.
   c. Compression connectors.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 GROUND ROD

A. Material: Copper-clad.

B. Diameter: Minimum 3/4 inch.

C. Length: 10 feet.

2.02 GROUND CONDUCTORS

A. As specified in Section 16120, Conductors.

2.03 CONNECTORS

A. Exothermic Weld Type:

1. Outdoor Weld: Suitable for exposure to elements or direct burial.
2. Indoor Weld: Utilize low-smoke, low-emission process.
3. Manufacturers:
   a. *Erico Products, Inc.; Cadweld and Cadweld Exolon.*
   b. Thermoweld.

B. Compression Type:

1. Compress-deforming type; wrought copper extrusion material.
2. Single indentation for conductors 6 AWG and smaller.
3. Double indentation with extended barrel for conductors 4 AWG and larger.
4. Barrels prefilled with oxide-inhibiting and antiseizing compound and sealed.
5. Manufacturers:
   a. Burndy Corp.
   b. Thomas and Betts Co.
   c. ILSCO.

2.04 GROUNDING WELLS

A. Ground rod box complete with cast iron riser ring and traffic cover marked GROUND ROD.

B. *Manufacturers and Products:*

1. Christy Co.
2. Lightning and Grounding Systems, Inc.

PART 3 EXECUTION

3.01 GENERAL

A. Grounding shall be in compliance with NFPA 70 and IEEE C2.

B. Ground each separately derived system neutral to nearest effectively grounded building structural steel member or separate grounding electrode.

C. Bond together system neutrals, service equipment enclosures, exposed noncurrent-carrying metal parts of electrical equipment, metal raceways, ground conductor in raceways and cables, receptacle ground connections, and metal piping systems.

D. Shielded Power Cables: Ground shields at each splice or termination in accordance with recommendations of splice or termination manufacturer.

E. Shielded Instrumentation Cables:

1. Ground shield to ground bus at power supply for analog signal.
2. Expose shield minimum 1 inch at termination to field instrument and apply heat shrink tube.
3. Do not ground instrumentation cable shield at more than one point.

3.02 WIRE CONNECTIONS

A. Ground Conductors: Install in conduit containing power conductors and control circuits above 50 volts.

B. Nonmetallic Raceways and Flexible Tubing: Install equipment grounding conductor connected at both ends to noncurrent-carrying grounding bus.

C. Connect ground conductors to raceway grounding bushings.

D. Extend and connect ground conductors to ground bus in all equipment containing a ground bus.

E. Connect enclosure of equipment containing ground bus to that bus.

F. Bolt connections to equipment ground bus.

G. Bond grounding conductors to metallic enclosures at each end, and to intermediate metallic enclosures.

H. Junction Boxes: Furnish materials and connect to equipment grounding system with grounding clips mounted directly on box, or with 3/8-inch machine screws.

3.03 MOTOR GROUNDING

A. Extend equipment ground bus via grounding conductor installed in motor feeder raceway; connect to motor frame.

B. Motors Less Than 10 hp: Furnish compression, spade-type terminal connected to conduit box mounting screw.

C. Motors 10 hp and Above: Tap motor frame or equipment housing; furnish compression, one-hole, lug type terminal connected with minimum 5/16-inch brass threaded stud with bolt and washer.

D. Circuits 20 Amps or Above: Tap motor frame or equipment housing; install solderless terminal with minimum 5/16-inch diameter bolt.

3.04 GROUND RODS

A. Install with connection point below finished grade, unless otherwise shown.

3.05 GROUNDING WELLS

A. Install riser ring and cover flush with surface.

B. Place 6 inches of crushed rock in bottom of each well.

3.06 CONNECTIONS

A. General:

1. Abovegrade Connections: Install exothermic weld, mechanical, or compression-type connectors; or brazing.
2. Belowgrade Connections: Install exothermic weld or compression type connectors.
3. Remove paint, dirt, or other surface coverings at connection points to allow good metal-to-metal contact.

B. Exothermic Weld Type:

1. Wire brush or file contact point to bare metal surface.
2. Use welding cartridges and molds in accordance with manufacturer's recommendations.
3. Avoid using badly worn molds.
4. Mold to be completely filled with metal when making welds.
5. After completed welds have cooled, brush slag from weld area and thoroughly clean joint.

C. Compression Type:

1. Install in accordance with connector manufacturer's recommendations.
2. Install connectors of proper size for grounding conductors and ground rods specified.
3. Install using connector manufacturer's compression tool having proper sized dies.

3.07 METAL STRUCTURE GROUNDING

A. Ground metal sheathing and exposed metal vertical structural elements to grounding system.

B. Bond electrical equipment supported by metal platforms to the platforms.

C. Provide electrical contact between metal frames and railings supporting pushbutton stations, receptacles, and instrument cabinets, and raceways carrying circuits to these devices.

END OF SECTION

SECTION 16080
ELECTRICAL TESTING

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. ASTM International (ASTM): D665, Standard Test Method for Rust-Preventing Characteristics of Inhibited Mineral Oil in the Presence of Water.
2. Institute of Electrical and Electronics Engineers (IEEE):
   a. 43, Recommended Practice for Testing Insulating Resistance of Rotating Machinery.
   b. 81, Guide for Measuring Earth Resistivity, Ground Impedance, and Earth Surface Potentials of a Ground System (Part 1): Normal Measurements.
   c. C2, National Electrical Safety Code.
3. National Electrical Manufacturers Association (NEMA): AB 4, Guidelines for Inspection and Preventive Maintenance of Molded Case Circuit Breakers Used in Commercial and Industrial Applications.
4. InterNational Electrical Testing Association (NETA): Acceptance Testing Specifications for Electrical Power Distribution Equipment and Systems (ATS).
5. National Fire Protection Association (NFPA):
   a. 70, National Electrical Code (NEC).
   b. 70E, Standard for Electrical Safety Requirements for Employee Workplaces.
   c. 101, Life Safety Code.
6. Occupational Safety and Health Administration (OSHA): CFR 29, Part 1910, Occupational Safety and Health Standards.

1.02 SUBMITTALS

A. Informational Submittals:

1. Submit 30 days prior to performing inspections or tests:
   a. Sample copy of equipment and materials inspection form(s).
   b. Sample copy of individual device test form.
   c. Sample copy of individual system test form.
2. Submit test or inspection reports and certificates for each electrical item tested within 10 days after completion of test:

1.03 SEQUENCING AND SCHEDULING

A. Perform inspection and electrical tests after equipment has been installed.

B. Perform tests with apparatus de-energized whenever feasible.

C. Inspection and electrical tests on energized equipment shall be:

1. Scheduled with Owner prior to de-energization.
2. Minimized to avoid extended period of interruption to the operating plant equipment.

D. Notify Owner at least 48 hours prior to performing tests on energized electrical equipment.

PART 2 PRODUCTS (NOT USED)

PART 3 EXECUTION

3.01 GENERAL

A. Tests and inspections shall establish:

1. Electrical equipment is operational within industry and manufacturer's tolerances and standards.
2. Installation operates properly.
3. Equipment is suitable for energization.
4. Installation conforms to requirements of Contract Documents and NFPA 70, NFPA 70E, NFPA 101, and IEEE C2.

B. Perform inspection and testing in accordance with NETA ATS, industry standards, and manufacturer's recommendations.

C. Adjust mechanisms and moving parts of equipment for free mechanical movement.

D. Adjust and set electromechanical electronic relays and sensors to correspond to operating conditions, or as recommended by manufacturer.

E. Verify nameplate data for conformance to Contract Documents and approved Submittals.

F. Realign equipment not properly aligned and correct unlevelness.

G. Properly anchor electrical equipment found to be inadequately anchored.

H. Tighten accessible bolted connections, including wiring connections, with calibrated torque wrench/screw driver to manufacturer's recommendations, or as otherwise specified in NETA ATS.

I. Clean contaminated surfaces with cleaning solvents as recommended by manufacturer.

J. Provide proper lubrication of applicable moving parts.

K. Inform Owner of working clearances not in accordance with NFPA 70.

L. Investigate and repair or replace:

1. Electrical items that fail tests.
2. Active components not operating in accordance with manufacturer's instructions.
3. Damaged electrical equipment.

M. Electrical Enclosures:

1. Remove foreign material and moisture from enclosure interior.
2. Vacuum and wipe clean enclosure interior.
3. Remove corrosion found on metal surfaces.
4. Repair or replace, as determined by Owner, door and panel sections having dented surfaces.
5. Repair or replace improperly operating latching, locking, or interlocking devices.
6. Replace missing or damaged hardware.
7. Finish:
   a. Provide matching paint and touch up scratches and mars.
   b. If required due to extensive damage, as determined by Owner, refinish entire assembly.

N. Replace fuses and circuit breakers that do not conform to size and type required by the Contract Documents or approved Submittals.

3.02 CHECKOUT AND STARTUP

A. Voltage Field Test:

1. Check voltage at point of termination of power company supply system to project when installation is essentially complete and is in operation.
2. Check voltage amplitude and balance between phases for loaded and unloaded conditions.

B. Equipment Line Current Tests:

1. Check line current in each phase for each piece of equipment.
2. If any phase current for any piece of equipment is above rated nameplate current, prepare Equipment Line Phase Current Report that identifies cause of problem and corrective action taken.

3.03 PANELBOARDS

A. Visual and Mechanical Inspection: Include the following inspections and related work:

1. Inspect for defects and physical damage, labeling, and nameplate compliance with requirements of up-to-date drawings and panelboard schedules.
2. Exercise and perform operational tests of mechanical components and other operable devices in accordance with manufacturer's instruction manual.
3. Check panelboard mounting, area clearances, and alignment and fit of components.
4. Check tightness of bolted electrical connections with calibrated torque wrench. Refer to manufacturer's instructions for proper torque values.
5. Perform visual and mechanical inspection for overcurrent protective devices.

B. Electrical Tests: Include the following items performed in accordance with manufacturer's instruction:

1. Insulation Resistance Tests:
   a. Applied megohmmeter dc voltage in accordance with NETA ATS, Table 100.1.
   b. Each phase of each bus section.
   c. Phase-to-phase and phase-to-ground for 1 minute.
   d. With switches and breakers open.
   e. With switches and breakers closed.
   f. Control wiring except that connected to solid state components.
   g. Insulation resistance values equal to, or greater than, ohmic values established by manufacturer.
2. Ground continuity test ground bus to system ground.

3.04 LOW VOLTAGE CABLES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Inspect each individual exposed power cable No. 6 and larger for:
   a. Physical damage.
   b. Proper connections in accordance with single-line diagram.
   c. Cable bends not in conformance with manufacturer's minimum allowable bending radius where applicable.
   d. Color coding conformance with Specifications.
   e. Proper circuit identification.

2. Mechanical Connections For:
   a. Proper lug type for conductor material.
   b. Proper lug installation.
   c. Bolt torque level in accordance with NETA ATS, Table 100.12, unless otherwise specified by manufacturer.
3. Shielded Instrumentation Cables For:
   a. Proper shield grounding.
   b. Proper terminations.
   c. Proper circuit identification.
4. Control Cables For:
   a. Proper termination.
   b. Proper circuit identification.
5. Cables Terminated Through Window Type CTs: Verify neutrals and grounds are terminated for correct operation of protective devices.

B. Electrical Tests for Conductors No. 6 and Larger:

1. Insulation Resistance Tests:
   a. Utilize 1,000-volt dc megohmmeter for 600-volt insulated conductors and 500-volt dc megohmmeter for 300-volt insulated conductors.
   b. Test each conductor with respect to ground and to adjacent conductors for 1 minute.
   c. Evaluate ohmic values by comparison with conductors of same length and type.
   d. Investigate values less than 50 megohms.
2. Continuity test by ohmmeter method to ensure proper cable connections.

3.05 SAFETY SWITCHES, 600 VOLTS MAXIMUM

A. Visual and Mechanical Inspection:

1. Proper blade pressure and alignment.
2. Proper operation of switch operating handle.
3. Adequate mechanical support for each fuse.
4. Proper contact-to-contact tightness between fuse clip and fuse.
5. Cable connection bolt torque level in accordance with NETA ATS, Table 100.12.
6. Proper phase barrier material and installation.
7. Verify fuse sizes and types correspond to one-line diagram or approved Submittals.
8. Perform mechanical operational test and verify electrical and mechanical interlocking system operation and sequencing.

3.06 INSTRUMENT TRANSFORMERS

A. Visual and Mechanical Inspection:

1. Visually check current, potential, and control transformers for:
   a. Cracked insulation.
   b. Broken leads or defective wiring.
   c. Proper connections.
   d. Adequate clearances between primary and secondary circuit wiring.
2. Verify mechanically:
   a. Grounding and shorting connections have good contact.
   b. Withdrawal mechanism and grounding operation, when applicable, operate properly.
3. Verify proper primary and secondary fuse sizes for potential transformers.

3.07 GROUNDING SYSTEMS

A. Visual and Mechanical Inspection:

1. Equipment and circuit grounds in motor control center and panelboard assemblies for proper connection and tightness.
2. Ground bus connections in motor control center and panelboard assemblies for proper termination and tightness.
3. Effective equipment grounding.
4. Accessible connections to grounding electrodes for proper fit and tightness.
5. Accessible exothermic-weld grounding connections to verify that molds were fully filled and proper bonding was obtained.

B. Electrical Tests:

1. Fall-of-Potential Test:
   a. In accordance with IEEE 81, Section 8.2.1.5 for measurement of main ground system's resistance.
   b. Main ground electrode system resistance to ground to be no greater than 5 ohm(s).

3.08 AC INDUCTION MOTORS

A. General: Inspection and testing limited to motors rated 1/2 hp and larger.

B. Visual and Mechanical Inspection:

1. Proper electrical and grounding connections.
2. Shaft alignment.
3. Blockage of ventilating air passageways.

4. Operate motor and check for:
   a. Excessive mechanical and electrical noise.
   b. Overheating.
   c. Correct rotation.
   d. Check vibration detectors, resistance temperature detectors, or motor inherent protectors for functionability and proper operation.
   e. Excessive vibration, in excess of values in NETA ATS Table 100.10.

END OF SECTION

SECTION 16120
CONDUCTORS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. Electronic Industries Alliance (EIA), Telecommunications Industry Association (TIA): TIA-568-B, Commercial Building Telecommunications Cabling Standard.
2. Insulated Cable Engineer's Association, Inc. (ICEA):
   a. S-58-679, Standard for Control Cable Conductor Identification.
   b. S-73-532, Standard for Control Cables.
   c. T-29-520, Conducting Vertical Cable Tray Flame Tests with Theoretical Heat Input of 210,000 Btu/hour.
3. National Electrical Manufacturers' Association (NEMA):
   a. WC 55, Instrumentation Cables and Thermocouple Wire.
   b. WC 70, Standard for Nonshielded Power Cables Rated 2000 Volts or Less for the Distribution of Electrical Energy.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories Inc. (UL):
   a. 13, Standard for Safety Power-Limited Circuit Cables.
   b. 44, Standard for Safety Thermoset-Insulated Wires and Cables.
   c. 62, Standard for Safety Flexible Cord and Fixture Wire.
   d. 486A-486B, Wire Connectors.
   e. 486C, Standard for Splicing Wire Connections.
   f. 510, Standard for Safety Polyvinyl Chloride, Polyethylene, and Rubber Insulating Tape.
   g. 1581, Standard for Safety Reference Standard for Electrical Wires, Cables, and Flexible Cords.

1.02 SUBMITTALS

A. Action Submittals:

1. Wire and cable descriptive product information.
2. Wire and cable accessories descriptive product information.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70. Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories Inc. shall conform to those standards and shall have an applied UL listing mark.

PART 2 PRODUCTS

2.01 CONDUCTORS 600 VOLTS AND BELOW

A. Conform to applicable requirements of NEMA WC 70.

B. Conductor Type:

1. 120-Volt and 277-Volt Lighting, No. 10 AWG and Smaller: Solid copper.
2. 120-Volt Receptacle Circuits, No. 10 AWG and Smaller: Solid copper.
3. All Other Circuits: Stranded copper.

C. Insulation: Type THHN/THWN-2.

D. Direct Burial and Aerial Conductors and Cables:

1. Type USE/RHH/RHW insulation, UL 854 listed, or Type RHW-2/USE-2.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

E. Flexible Cords and Cables:

1. Type SOW-A/50 with ethylene propylene rubber insulation in accordance with UL 62.
2. Conform to physical and minimum thickness requirements of NEMA WC 70.

2.02 600-VOLT RATED CABLE

A. Type 1, Multiconductor Control Cable:

1. Conductors:
   a. No. 14 AWG, seven-strand copper.
   b. Insulation: 15-mil PVC with 4-mil nylon.
   c. UL 1581 listed as Type THHN/THWN rated VW-1.

d. Conductor group bound with spiral wrap of barrier tape.
e. Color Code: In accordance with ICEA S-58-679, Method 1, Table 2.

2. Cable: Passes the ICEA T-29-520 210,000 Btu per hour Vertical Tray Flame Test.
3. Cable Sizes:

No. of Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
3	0.41	45
5	0.48	45
7	0.52	45
12	0.72	60
19	0.83	60
25	1.00	60
37	1.15	80

4. Manufacturers:
   a. Okonite Co.
   b. Southwire.

B. Type 2, Multiconductor Power Cable:

1. General:
   a. Meet or exceed UL 1581 for cable tray use.
   b. Meet or exceed UL 1277 for direct burial and sunlight-resistance.
   c. Overall jacket: PVC.
2. Conductors:
   a. Class B stranded, coated copper.
   b. Insulation: Chemically cross-linked ethylene-propylene or cross-linked polyethylene.
   c. UL rated VW-1 or listed Type XHHW-2.
   d. Color Code:
      1) Conductors, size No. 8 AWG and smaller, colored conductors, ICEA S-58-679, Method 1, Table 1.
      2) Conductors, size No. 6 AWG and larger, ICEA S-73-532, Method 4.
3. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size	No. of Current Carrying Conductors	Max. Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
12	12	2 3 4	0.42 0.45 0.49	45 45 45
10	10	2 3 4	0.54 0.58 0.63	60 60 60
8	10	3 4	0.66 0.75	60
6	8	3 4	0.74 0.88	60
4	6	3 4	0.88 1.04	60 80
2	6	3 4	1.01 1.16	80
1	6	3 4	1.10 1.25	80
1/0	6	3 4	1.22 1.35	80
2/0	4	3 4	1.32 1.53	80
3/0	4	3 4	1.40 1.60	80
4/0	4	3 4	1.56 1.78	80 110

5. Manufacturers:
   a. Okonite Co.
   b. Southwire.

C. Type 3, No. 16 AWG, Twisted, Shielded Pair, Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

1. Outer Jacket: 45-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer overlapped to provide 100 percent coverage.

3. Dimension: 0.31-inch nominal OD.
4. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
    b. 20 AWG, seven-strand tinned copper drain wire.
    c. Insulation: 15-mil nominal PVC.
    d. Jacket: 4-mil nominal nylon.
    e. Color Code: Pair conductors, black and red.
5. Manufacturers:
    a. Okonite Co.
    b. Alpha Wire Corp.
    c. Belden.

D. Type 4, No. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55 requirements.

1. Outer Jacket: 45-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.32-inch nominal OD.
4. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, meeting requirements of ASTM B8.
    b. 20 AWG, seven-strand, tinned copper drain wire.
    c. Insulation: 15-mil nominal PVC.
    d. Jacket: 4-mil nylon.
    e. Color Code: Triad conductors black, red, and blue.
5. Manufacturers:
    a. Okonite Co.
    b. Alpha Wire Corp.
    c. Belden.

E. Type 5, No. 18 AWG, Multi-Twisted, Shielded Pairs with a Common, Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable, meeting NEMA WC 55 requirements.

1. Conductors:
    a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
    b. Tinned copper drain wires.
    c. Pair drain wire size AWG 20, group drain wire size AWG 18.
    d. Insulation: 15-mil PVC.
    e. Jacket: 4-mil nylon.
    f. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.

g. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

3. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	45
8	0.68	60
12	0.82	60
16	0.95	80
24	1.16	80
36	1.33	80
50	1.56	80

4. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

F. Type 6, No. 18 AWG, Multi-Twisted Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 55.

1. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, in accordance with ASTM B8.
   b. Tinned copper drain wire size AWG 18.
   c. Insulation: 15-mil nominal PVC.
   d. Jacket: 4-mil nylon.
   e. Color Code: Pair conductors, black and red with red conductor numerically printed for group identification.

2. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

Cable Sizes: Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	45
8	0.63	60
12	0.75	60
16	0.83	60
24	1.10	80
36	1.21	80
50	1.50	80

3. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

G. Type 7, Multi-Conductor Metal-Clad (UL Type MC) Power Cable:

1. Meeting requirements of UL 44 and UL 1569.
2. Conductors:
   a. Class B stranded, coated copper.
   b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or EPR.
   c. Grounding Conductors: Bare, stranded copper.
3. Sheath:
   a. UL listed Type MC.
   b. Continuous welded, corrugated aluminum sheath.
   c. Suitable for use as grounding conductor.
4. Outer Jacket: PVC per UL 1569.
5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.

6. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	12 or 3x16	3 4	0.79 0.85	50
10 AWG	10 or 3x14	3 4	0.82 0.90	50
8 AWG	10 or 3x14	3 4	0.85 1.00	50
6 AWG	8 or 3x12	3 4	0.99 1.10	50
4 AWG	8 or 3x12	3 4	1.08 1.20	50
2 AWG	6 or 3x10	3 4	1.24 1.45	50
1 AWG	6 or 3x10	3 4	1.40 1.55	50
1/0 KCM	6 or 3x10	3 4	1.52 1.60	50
2/0 AWG	4 or 3x8	3 4	1.67 1.75	50
4/0 AWG	4 or 3x8	3 4	1.93 2.10	60
250 KCM	4 or 3x8	3 4	2.11 2.20	60
350 KCM	3 or 3x8	3 4	2.39 2.50	60
500 KCM	2 or 3x8	3 4	2.80 2.90	75

7. Manufacturers and Products:
   a. Okonite Co.; Type CLX.
   b. Southwire Type MC.
   c. General Cable, CCW Armored Power.

H. Type 8, Multi-Conductor Adjustable Frequency Drive Power Cable:

1. Conductors:
   a. Class B, stranded coated copper.
   b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW-2.
   c. Grounding Conductors: Insulated stranded copper.
2. Sheath:
   a. UL 1277 Type TC, 90 degrees C.
   b. Continuous shield, A1/polyester foil, drain wires, overall copper braid.
3. Outer Jacket: Polyvinyl chloride (PVC) per UL 1569.
4. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	12	4	0.610	50
10 AWG	10	4	0.670	50
8 AWG	8	4	0.910	50
6 AWG	6	4	1.010	50
4 AWG	4	4	1.150	50
2 AWG	2	4	1.310	50

5. Manufacturers and Products:
   a. Alpha Wire, Series V.
   b. Belden, Series 29500.
   c. LAPP USA, OLFLEX VFD Slim.

I. Type 9, Multi-Conductor Metal-Clad (UL Type MC) Power Cable for Adjustable Frequency Drive Applications:

1. Meeting requirements of UL 44 and UL 1569.
2. Conductors:
   a. Class B, stranded coated copper.
   b. Insulation: 600-volt cross-linked polyethylene, UL Type XHHW or EPR.
   c. Grounding Conductors: Bare, stranded copper. Provide three symmetrical grounding conductors.
3. Sheath:
   a. UL listed Type MC.
   b. Continuous welded, corrugated aluminum sheath.
   c. Suitable for use as grounding conductor.
4. Outer Jacket: PVC per UL 1569.

5. Cable shall pass ICEA T-29-520, 210,000 Btu per hour Vertical Tray Flame Test.
6. Cable Sizes:

Conductor Size	Minimum Ground Wire Size (AWG)	No. of Insulated Conductors	Max. Outside Diameter (Inches)	Jacket Thickness (Mils)
12 AWG	3x16	3 4	0.79 0.85	50
10 AWG	3x14	3 4	0.82 0.90	50
8 AWG	3x14	3 4	0.85 1.00	50
6 AWG	3x12	3 4	0.99 1.10	50
4 AWG	3x12	3 4	1.08 1.20	50
2 AWG	3x10	3 4	1.24 1.45	50
1 AWG	3x10	3 4	1.40 1.55	50
1/0 KCM	3x10	3 4	1.52 1.60	50
2/0 AWG	3x8	3 4	1.67 1.75	50
4/0 AWG	3x8	3 4	1.93 2.10	60
250 KCM	3x8	3 4	2.11 2.20	60
350 KCM	3x8	3 4	2.39 2.50	60
500 KCM	3x8	3 4	2.80 2.90	75

7. Manufacturer and Product: Okonite Co.; Type CLX MC-HL.

2.03 300-VOLT RATED CABLE

A. General:

1. Type PLTC, meeting requirements of UL 13 and NFPA 70, Article 725.
2. Permanently and legibly marked with manufacturer's name, maximum working voltage for which cable was tested, type of cable, and UL listing mark.
3. Suitable for installation in open air, in cable trays, or conduit.
4. Minimum Temperature Rating: 105 degrees C.
5. Passes Vertical Tray Flame Test.
6. Outer Jacket: PVC, flame-retardant, sunlight- and oil-resistant.

B. Type 20, No. 16 AWG, Twisted, Shielded Pair Instrumentation Cable: Single pair, designed for noise rejection for process control, computer, or data log applications meeting NEMA WC 55.

1. Outer Jacket: 35-mil nominal.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.26-inch nominal OD.
4. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
   b. 20 AWG, seven-strand tinned copper drain wire.
   c. Insulation: 15-mil PVC.
   d. Color Code: Pair conductors black and white.
5. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.

C. Type 21, No. 16 AWG, Twisted, Shielded Triad Instrumentation Cable: Single triad, designed for noise rejection for process control, computer, or data log applications meeting requirements of NEMA WC 55.

1. Outer Jacket: 35-mil nominal thickness.
2. Individual Pair Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
3. Dimension: 0.28-inch nominal OD.
4. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
   b. 20 AWG, seven-strand tinned copper drain wire.
   c. Insulation: 15-mil PVC.
   d. Color Code: Triad conductors; black, red, and white.

5. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.

D. Type 22, No. 18 AWG, Multi-Twisted, Shielded Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 55.

1. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.
   b. Tinned copper drain wires.
   c. Pair drain wire size AWG 20, group drain wire size AWG 18.
   d. Insulation: 15-mil PVC.
   e. Color Code: Pair conductors black and white, with white conductor numerically printed for group identification.
   f. Individual Pair Shield: 1.35-mil aluminum/mylar.
   g. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.
2. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.50	50
8	0.66	60
12	0.79	60
16	0.91	60
24	1.13	70
36	1.31	70
50	1.55	80

3. Manufacturers:
   a. Okonite Co.
   b. Alpha Wire Corp.
   c. Belden.

E. Type 23, No. 18 AWG, Multi-Twisted Pairs with a Common Overall Shield Instrumentation Cable: Designed for use as instrumentation, process control, and computer cable meeting NEMA WC 55.

1. Conductors:
   a. Bare soft annealed copper, Class B, seven-strand concentric, ASTM B8.

b. Tinned copper.
c. Group drain wire size AWG 20, minimum.
d. Insulation: 15-mil PVC.
e. Color Code: Pair conductors black and white, with white conductor numerically printed for group identification.
f. Cable Shield: 2.35-mil, double-faced aluminum/synthetic polymer, overlapped for 100 percent coverage.

2. Cable Sizes:

Number of Pairs	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Mils)
4	0.48	50
8	0.63	60
12	0.73	60
16	0.77	60
24	0.96	70
36	1.09	70
50	1.45	50

3. Manufacturers:
a. Okonite Co.
b. Alpha Wire Corp.
c. Belden.

F. Type 24, Twisted Pair Fire Alarm Cable, Nonshielded: Power limited fire protective signaling circuit cable meeting requirements of NFPA 70, Article 760.

1. Cable: Pass NFPA 262, 70,000 Btu flame test and listed by State Fire Marshall.
2. Outer Jacket: Red in color, identified along its entire length as fire protective signaling circuit cable.
3. Conductors:
a. Solid, tinned, or bare copper.
b. Insulation: 15-mil PVC.

4. Cable Sizes:

Wire Size	Maximum Outside Diameter (Inches)	Nominal Jacket Thickness (Inches)
12	0.36	0.042
14	0.32	0.042
16	0.26	0.037
18	0.23	0.037

5. Manufacturers:
   a. Alpha Wire Corp.
   b. Triangle PWC, Inc.

2.04 SPECIAL CABLES

A. Type 30, Unshielded Twisted Pair (UTP) Telephone and Data Cable, 300V:

1. Category 6 UTP, UL listed, and third party verified to comply with TIA/EIA 568-B.2-1 Category 6 requirements.
2. Suitable for high speed network applications including gigabit ethernet and video. Cable shall be interoperable with other standards compliant products and shall be backward compatible with Category 5 and Category 5e.
3. Provide four each individually twisted pair, 23 AWG conductors, with FEP insulation and blue PVC jacket.
4. NFPA 70 Plenum (CMP) rated, comply with flammability plenum requirements of NFPA 70 and NFPA 262.
5. Cable shall withstand a bend radius of 1-inch minimum at a temperature of minus 20 degrees C maximum without jacket or insulation cracking.
6. Manufacturer and Product: Belden; 7852A.

B. Type 31, Data Highway Cable:

1. Meet or exceed electrical characteristics of Allen-Bradley Catalog No. 1770-CD.
2. Approved by Allen-Bradley for use with A-B programmable logic controller systems.
3. Outer Jacket: Blue PVC.
4. Shield: 1.35-mil, double-faced aluminum/synthetic polymer, overlapped to provide 100 percent coverage.
5. Drain: 55 percent tinned copper braid and drain wire.
6. Dimension: 0.243-inch nominal OD.

7. Conductors:
   a. One pair #20 AWG, seven-strand tinned copper.
   b. Insulation: Polyethylene.
   c. Color Code: Blue and clear.
8. Manufacturers:
   a. Allen-Bradley.
   b. Belden.

2.05 GROUNDING CONDUCTORS

A. Equipment: Stranded copper with green, Type THHN/THWN, insulation.

B. Direct Buried: Bare stranded copper.

2.06 ACCESSORIES FOR CONDUCTORS 600 VOLTS AND BELOW

A. Tape:

1. General Purpose, Flame Retardant: 7-mil, vinyl plastic, Scotch Brand 33+, rated for 90 degrees C minimum, meeting requirements of UL 510.
2. Flame Retardant, Cold and Weather Resistant: 8.5-mil, vinyl plastic, Scotch Brand 88.
3. Arc and Fireproofing:
   a. 30-mil, elastomer.
   b. Manufacturers and Products:
      1) 3M; Scotch Brand 77, with Scotch Brand 69 glass cloth tapebinder.
      2) Plymouth; 53 Plyarc, with 77 Plyglas glass cloth tapebinder.

B. Identification Devices:

1. Sleeve:
   a. Permanent, PVC, yellow or white, with legible machine-printed black markings.
   b. Manufacturers and Products:
      1) Raychem; Type D-SCE or ZH-SCE.
      2) Brady, Type 3PS.
2. Grounding Conductor: Permanent green heat-shrink sleeve, 2-inch minimum.

C. Connectors and Terminations:

1. Nylon, Self-Insulated Crimp Connectors:
   a. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulug.
      3) ILSCO.

2. Nylon, Self-Insulated, Crimp Locking-Fork, Torque-Type Terminator:
   a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Seamless.
   c. Manufacturers and Products:
      1) Thomas & Betts; Sta-Kon.
      2) Burndy; Insulink.
      3) ILSCO; ILSCONS.
3. Self-Insulated, Freespring Wire Connector (Wire Nuts):
   a. UL 486C.
   b. Plated steel, square wire springs.
   c. Manufacturers and Products:
      1) Thomas & Betts.
      2) Ideal; Twister.
4. Self-Insulated, Set Screw Wire Connector:
   a. Two piece compression type with set screw in brass barrel.
   b. Insulated by insulator cap screwed over brass barrel.
   c. Manufacturers:
      1) 3M Co.
      2) Thomas & Betts.
      3) Marrette.

D. Cable Lugs:

1. In accordance with NEMA CC 1.
2. Rated 600 volts of same material as conductor metal.
3. Uninsulated Crimp Connectors and Terminators:
   a. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.
   b. Manufacturers and Products:
      1) Thomas & Betts; Color-Keyed.
      2) Burndy, Hydent.
      3) ILSCO.

E. Cable Ties:

1. Nylon, adjustable, self-locking, and reusable.
2. Manufacturer and Product: Thomas & Betts; TY-RAP.

F. Heat Shrinkable Insulation:

1. Thermally stabilized cross-linked polyolefin.
2. Manufacturer and Product: Thomas & Betts; SHRINK-KON.

G. Data Cable Accessories: Terminators, connectors, and junctions necessary for a complete system.

2.07 PULLING COMPOUND

A. Nontoxic, noncorrosive, noncombustible, nonflammable, water-based lubricant; UL listed.

B. Suitable for rubber, neoprene, PVC, polyethylene, hypalon, CPE, and lead-covered wire and cable.

C. Approved for intended use by cable manufacturer.

D. Suitable for zinc-coated steel, aluminum, PVC, bituminized fiber, and fiberglass raceways.

E. Manufacturers:

1. Ideal Co.
2. Polywater, Inc.
3. Cable Grip Co.

2.08 WARNING TAPE

A. As specified in Section 16130, Raceways and Boxes.

2.09 SOURCE QUALITY CONTROL

A. Conductors 600 Volts and Below: Test in accordance with UL 44 and UL 854.

PART 3 EXECUTION

3.01 GENERAL

A. Conductor installation shall be in accordance with manufacturer's recommendations.

B. Conductor and cable sizing shown is based on copper conductors, unless noted otherwise.

C. Do not exceed cable manufacturer's recommendations for maximum pulling tensions and minimum bending radii.

D. Terminate conductors and cables, unless otherwise indicated.

E. Tighten screws and terminal bolts in accordance with UL 486A-486B for copper conductors.

F. Cable Lugs: Provide with correct number of holes, bolt size, and center-to-center spacing as required by equipment terminals.

G. Bundling: Where single conductors and cables in manholes, handholes, vaults, cable trays, and other indicated locations are not wrapped together by some other means, bundle conductors from each conduit throughout their exposed length with cable ties placed at intervals not exceeding 12 inches on center.

H. Ream, remove burrs, and clear interior of installed conduit before pulling wires or cables.

I. Concrete-Encased Raceway Installation: Prior to installation of conductors, pull through each raceway a mandrel approximately 1/4 inch smaller than raceway inside diameter.

3.02 POWER CONDUCTOR COLOR CODING

A. Conductors 600 Volts and Below:

1. No. 6 AWG and Larger: Apply general purpose, flame retardant tape at each end, and at accessible locations wrapped at least six full overlapping turns, covering an area 1-1/2 inches to 2 inches wide.
2. No. 8 AWG and Smaller: Provide colored conductors.
3. Colors:

System	Conductor	Color
All Systems	Equipment Grounding	Green
240/120 Volts Single-Phase, Three-Wire	Grounded Neutral One Hot Leg Other Hot Leg	White Black Red
208Y/120 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Black Red Blue
240/120 Volts Three-Phase, Four-Wire Delta, Center Tap Ground on Single-Phase	Grounded Neutral Phase A High (wild) Leg Phase C	White Black Orange Blue
480Y/277 Volts Three-Phase, Four-Wire	Grounded Neutral Phase A Phase B Phase C	White Brown Orange Yellow
NOTE: Phase A, B, C implies direction of positive phase rotation.		

4. Tracer: Outer covering of white with an identifiable colored strip, other than green, in accordance with NFPA 70.

3.03 CIRCUIT IDENTIFICATION

A. Circuits Appearing in Circuit Schedules: Identify power, instrumentation, and control conductor circuits, using circuit schedule designations, at each termination and in accessible locations such as manholes, handholes, panels, switchboards, motor control centers, pull boxes, and terminal boxes.

B. Circuits Not Appearing in Circuit Schedules:

1. Assign circuit name based on device or equipment at load end of circuit.
2. Where this would result in same name being assigned to more than one circuit, add number or letter to each otherwise identical circuit name to make it unique.

C. Method:

1. Conductors No. 3 AWG and Smaller: Identify with sleeves or heat bond markers.
2. Cables, and Conductors No. 2 AWG and Larger:
   a. Identify with marker plates or tie-on cable marker tags.
   b. Attach with nylon tie cord.
3. Taped-on markers or tags relying on adhesives not permitted.

3.04 CONDUCTORS 600 VOLTS AND BELOW

A. Install 10 AWG or 12 AWG conductors for branch circuit power wiring in lighting and receptacle circuits.

B. Do not splice incoming service conductors and branch power distribution conductors No. 6 AWG and larger, unless specifically indicated or approved by customer.

C. Connections and Terminations:

1. Install wire nuts only on solid conductors.
2. Install nylon self-insulated crimp connectors and terminators for instrumentation and control, circuit conductors.
3. Install self-insulated, set screw wire connectors for two-way connection of power circuit conductors No. 12 AWG and smaller.
4. Install uninsulated crimp connectors and terminators for instrumentation, control, and power circuit conductors No. 4 AWG through No. 2/0 AWG.
5. Install uninsulated, bolted, two-way connectors and terminators for power circuit conductors No. 3/0 AWG and larger.
6. Install uninsulated terminators bolted together on motor circuit conductors No. 10 AWG and larger.
7. Place no more than one conductor in any single-barrel pressure connection.

8. Install crimp connectors with tools approved by connector manufacturer.
9. Install terminals and connectors acceptable for type of material used.
10. Compression Lugs:
    a. Attach with a tool specifically designed for purpose. Tool shall provide complete, controlled crimp and shall not release until crimp is complete.
    b. Do not use plier type crimpers.

D. Do not use soldered mechanical joints.

E. Splices and Terminations:

1. Tape insulate all uninsulated connections.
2. Indoors: Use general purpose, flame retardant tape.
3. Outdoors: Use flame retardant, cold- and weather-resistant tape.

F. Cap spare conductors and conductors with UL listed end caps.

G. Cabinets, Panels, and Motor Control Centers:

1. Remove surplus wire, bridle and secure.
2. Where conductors pass through openings or over edges in sheet metal, remove burrs, chamfer edges, and install bushings and protective strips of insulating material to protect the conductors.

H. Control and Instrumentation Wiring:

1. Where terminals provided will accept such lugs, terminate control and instrumentation wiring, except solid thermocouple leads, with insulated, locking-fork compression lugs.
2. Terminate with methods consistent with terminals provided, and in accordance with terminal manufacturer's instructions.
3. Locate splices in readily accessible cabinets or junction boxes using terminal strips.
4. Where connections of cables installed under this section are to be made, leave pigtails of adequate length for bundled connections.
5. Cable Protection:
    a. Maintain integrity of shielding of instrumentation cables.
    b. Ensure grounds do not occur because of damage to jacket over the shield.

I. Extra Conductor Length: For conductors to be connected by others, install minimum 6 feet of extra conductor in freestanding panels and minimum 2 feet in other assemblies.

END OF SECTION

SECTION 16130
RACEWAYS AND BOXES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. American Association of State Highway and Transportation Officials (AASHTO): HB, Standard Specifications for Highway Bridges, Sixteenth Edition.
2. ASTM International (ASTM):
   a. A123/123M, Standard Specification for Zinc (Hot-Dipped Galvanized) Coatings on Iron and Steel Products.
   b. A167, Standard Specification for Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip.
   c. A240/A240M, Standard Specification for Chromium and Chromium-Nickel Stainless Steel Plate, Sheet, and Strip for Pressure Vessels and for General Applications.
   d. C857, Standard Practice for Minimum Structural Design Loading for Underground Precast Concrete Utility Structures.
   e. D149, Test Method for Dielectric Breakdown Voltage and Dielectric Strength of Solid Electrical Insulating Materials at Commercial Power Frequencies.
3. Electronic Industry Alliance (EIA) and Telecommunications Industry Association (TIA): 569, Commercial Building Standard for Telecommunications Pathways and Spaces.
4. National Electrical Contractor's Association, Inc. (NECA):
   a. 101, Standard for Installing Steel Conduit (Rigid, IMC, EMT).
   b. 102, Standard for Installing Aluminum Conduits.
   c. 105, Recommended Practice for Installing Metal Cable Trays.
   d. 111, Standard for Installing Nonmetallic Raceway (RNC, ENT, LFNC).
5. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. C80.1, Specification for Rigid Steel Conduit, Zinc Coated.
   c. C80.3, Specification for Electrical Metallic Tubing, Zinc Coated.
   d. C80.5, Specification for Rigid Aluminum Conduit.
   e. C80.6, Intermediate Metal Conduit (IMC) – Zinc Coated.
   f. RN 1, Polyvinyl-Chloride (PVC) Externally Coated Galvanized Rigid Steel Conduit and Intermediate Metal Conduit.
   g. TC 2, Electrical Polyvinyl Chloride (PVC) Plastic Tubing and Conduit.
   h. TC 3, Polyvinyl-Chloride (PVC) Fittings for Use with Rigid PVC Conduit and Tubing.
   i. TC 6, PVC Plastic Utilities Duct for Underground Installation.

j. TC 14, Reinforced Thermosetting Resin Conduit (RTRC) and Fittings
k. VE 1, Metallic Cable Tray Systems.

6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
7. Underwriters Laboratories Inc. (UL):
   a. 1, Standard for Flexible Metal Conduit.
   b. 5, Standard for Surface Metal Raceways and Fittings
   c. 6, Standard for Electrical Rigid Metal Conduit – Steel.
   d. 6A, Standard for Electrical Rigid Metal Conduit – Aluminum, Bronze, and Stainless.
   e. 50, Standard for Enclosures for Electrical Equipment.
   f. 360, Standard for Liquid-Tight Flexible Steel Conduit.
   g. 514B, Standard for Conduit, Tubing, and Cable Fittings.
   h. 514C, Standard for Nonmetallic Outlet Boxes, Flush-Device Boxes, and Covers.
   i. 651, Standard for Schedule 40 and 80 Rigid PVC Conduit.
   j. 651A, Standard for Type EB and A Rigid PVC Conduit and HDPE Conduit.
   k. 797, Standard for Electrical Metallic Tubing.
   l. 870, Standard for Wireways, Auxiliary Gutters, and Associated Fittings.
   m. 1242, Standard for Intermediate Metal Conduit.
   n. 1660, Standard for Liquid-Tight Flexible Nonmetallic Conduit.
   o. 1684, Standard for Reinforced Thermosetting Resin Conduit (RTRC) and Fittings.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's Literature:
   a. Rigid galvanized steel conduit.
   b. Intermediate metal conduit.
   c. Electric metallic tubing.
   d. PVC Schedule 40 conduit.
   e. Flexible, nonmetallic, liquid-tight conduit.
   f. Conduit fittings.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.

2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.
3. Control Panel: Labeling in accordance with NEC Article 409 requiring short circuit currency ratings.

PART 2 PRODUCTS

2.01 CONDUIT AND TUBING

A. Rigid Galvanized Steel Conduit (RGS):

1. Meet requirements of NEMA C80.1 and UL 6.
2. Material: Hot-dip galvanized, with chromated protective layer.

B. Intermediate Metal Conduit (IMC):

1. Meet requirements of NEMA C80.6 and UL 1242.
2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.

C. Electric Metallic Tubing (EMT):

1. Meet requirements of NEMA C80.3 and UL 797.
2. Material: Hot-dip galvanized, with chromated and lacquered protective layer.

D. PVC Schedule 40 Conduit:

1. Meet requirements of NEMA TC 2 and UL 651.
2. UL listed for concrete encasement, underground direct burial, concealed or direct sunlight exposure, and 90 degrees C insulated conductors.

E. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Material: PVC core with fused flexible PVC jacket.
2. UL 1660 listed for:
   a. Dry Conditions: 80 degrees C insulated conductors.
   b. Wet Conditions: 60 degrees C insulated conductors.
3. Manufacturers and Products:
   a. Carlon; Carflex or X-Flex.
   b. T & B; Xtraflex LTC or EFC.

2.02 FITTINGS

A. Rigid Galvanized Steel and Intermediate Metal Conduit:

1. General:
   a. Meet requirements of UL 514B.
   b. Type: Threaded, galvanized. Set screw and threadless compression fittings not permitted.
2. Bushing:
   a. Material: Malleable iron with integral insulated throat, rated for 150 degrees C.
   b. Manufacturers and Products:
      1) Appleton; Series BU-I.
      2) O-Z/Gedney; Type HB.
3. Grounding Bushing:
   a. Material: Malleable iron with integral insulated throat rated for 150 degrees C, with solderless lugs.
   b. Manufacturers and Products:
      1) Appleton; Series GIB.
      2) O-Z/Gedney; Type HBLG.
4. Conduit Hub:
   a. Material: Malleable iron with insulated throat with bonding screw.
   b. UL listed for use in wet locations.
   c. Manufacturers and Products:
      1) Appleton, Series HUB-B.
      2) O-Z/Gedney; Series CH.
      3) Meyers; ST Series.
5. Conduit Bodies:
   a. Sized as required by NFPA 70.
   b. Manufacturers and Products (For Normal Conditions):
      1) Appleton; Form 35 threaded unilets.
      2) Crouse-Hinds; Form 7 or 8 threaded condulets.
      3) Killark; Series O electrolets.
      4) Thomas & Betts; Form 7 or 8.
   c. Manufacturers (For Hazardous Locations):
      1) Appleton.
      2) Crouse-Hinds.
      3) Killark.
6. Couplings: As supplied by conduit manufacturer.
7. Unions:
   a. Concrete tight, hot-dip galvanized malleable iron.
   b. Manufacturers and Products:
      1) Appleton; Series SCC Bolt-On Coupling or Series EC Three-Piece Union.
      2) O-Z/Gedney; Type SSP split coupling or Type 4 Series, three-piece coupling.

B. Electric Metallic Tubing:

1. Meet requirements of UL 514B.
2. Type: Steel body and locknuts with steel or malleable iron compression nuts. Set screw and drive-on fittings not permitted.
3. Electro zinc-plated inside and out.
4. Raintight.
5. Coupling Manufacturers and Products:
   a. Appleton; Type 95T.
   b. Crouse-Hinds.
   c. Thomas & Betts.
6. Connector Manufacturers and Products:
   a. Appleton; Type 86T.
   b. Crouse-Hinds.
   c. Thomas & Betts.

C. PVC Conduit and Tubing:

1. Meet requirements of NEMA TC-3.
2. Type: PVC, slip-on.

D. Flexible, Nonmetallic, Liquid-Tight Conduit:

1. Meet requirements of UL 514B.
2. Type: High strength plastic body, complete with lock nut, O-ring, threaded ferrule, sealing ring, and compression nut.
3. Body/compression nut (gland) design to assure high mechanical pullout strength and watertight seal.
4. Manufacturers and Products:
   a. Carlon; Type LT.
   b. O-Z/Gedney; Type 4Q-P.
   c. Thomas & Betts; Series 6300.

E. Watertight Entrance Seal Device:

1. New Construction:
   a. Material: Oversized sleeve, malleable iron body with sealing ring, pressure ring, grommet seal, and pressure clamp.
   b. Manufacturer and Product: O-Z/Gedney; Type FSK or WSK, as required.
2. Cored-Hole Application:
   a. Material: Assembled dual pressure disks, neoprene sealing ring, and membrane clamp.
   b. Manufacturer and Product: O-Z/Gedney; Series CSM.

2.03 OUTLET AND DEVICE BOXES

A. Sheet Steel: One-piece drawn type, zinc- or cadmium-plated.

B. Cast Metal:

1. Box: Cast ferrous metal.
2. Cover: Gasketed, weatherproof, cast ferrous metal, with stainless steel screws.
3. Hubs: Threaded.
4. Lugs: Cast Mounting.
5. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS or FD.
   b. Appleton; Type FS or FD.
6. Manufacturers and Products, Hazardous Locations:
   a. Crouse-Hinds; Type GUA or EAJ.
   b. Appleton; Type GR.

C. Cast Aluminum:

1. Material:
   a. Box: Cast, copper-free aluminum.
   b. Cover: Gasketed, weatherproof, cast copper-free aluminum with stainless steel screws.
2. Hubs: Threaded.
3. Lugs: Cast mounting.
4. Manufacturers and Products, Nonhazardous Locations:
   a. Crouse-Hinds; Type FS-SA or FD-SA.
   b. Appleton; Type FS or FD.
5. Manufacturers and Products, Hazardous Locations:
   a. Crouse-Hinds; Type GUA-SA.
   b. Appleton; Type GR.

D. Nonmetallic:

1. Box: PVC.
2. Cover: PVC, weatherproof, with stainless steel screws.
3. Manufacturer and Product: Carlon; Type FS or FD, with Type E98 or E96 covers.

2.04 JUNCTION AND PULL BOXES

A. Outlet Box Used as Junction or Pull Box: As specified under Article Outlet and Device Boxes.

B. Conduit Bodies Used as Junction Boxes: As specified under Article Fittings.

C. Large Sheet Steel Box:

1. NEMA 250, Type 1.
2. Box: Code-gauge, galvanized steel.
3. Cover: Full access, screw type.
4. Machine Screws: Corrosion-resistant.

D. Large Cast Aluminum Box:

1. NEMA 250 Type 4.
2. Box: Cast copper-free aluminum, with drilled and tapped conduit entrances and exterior mounting lugs.
3. Cover: Nonhinged.
4. Gasket: Neoprene.
5. Hardware and Machine Screws: ASTM A167, Type 316 stainless steel.
6. Manufacturers and Products, Surface Mounted Type:
   a. Crouse-Hinds; Series W-SA.
   b. O-Z/Gedney; Series YS-A, YL-A.

2.05 TELEPHONE AND DATA OUTLET

A. Provide outlet boxes and cover plates meeting requirements of EIA/TIA 569.

2.06 TERMINAL JUNCTION BOX

A. Cover: Hinged, unless otherwise shown.

B. Interior Finish: Paint with white enamel or lacquer.

C. Terminal Blocks:

1. Separate connection point for each conductor entering or leaving box.
2. Spare Terminal Points: 25 percent, minimum.

2.07 ACCESSORIES

A. Identification Devices:

1. Raceway Tags:
   a. Material: Permanent, nylon.
   b. Shape: Round.
   c. Raceway Designation: Pressure stamped, embossed, or engraved.
   d. Tags relying on adhesives or taped-on markers not permitted.
2. Warning Tape:
   a. Material: Polyethylene, 4-mil gauge with detectable strip.
   b. Color: Red.
   c. Width: Minimum 3 inches.
   d. Designation: Warning on tape that electric circuit is located below tape.

e. Identifying Letters: Minimum 1-inch high permanent black lettering imprinted continuously over entire length.
f. Manufacturers and Products:
   1) Panduit; Type HTDU.
   2) Reef Industries; Terra Tape.

PART 3 EXECUTION

3.01 GENERAL

A. Conduit and Tubing sizes shown are based on the use of copper conductors. Reference Section 16120, Conductors, concerning conduit sizing for aluminum conductors.

B. All installed Work shall comply with NECA Installation Standards.

C. Crushed or deformed raceways not permitted.

D. Maintain raceway entirely free of obstructions and moisture.

E. Immediately after installation, plug or cap raceway ends with watertight and dust-tight seals until time for pulling in conductors.

F. Avoid moisture traps where possible. When unavoidable in exposed conduit runs, provide junction box and drain fitting at conduit low point.

G. Group raceways installed in same area.

H. Proximity to Heated Piping: Install raceways minimum 12 inches from parallel runs.

I. Follow structural surface contours when installing exposed raceways. Avoid obstruction of passageways.

J. Run exposed raceways parallel or perpendicular to walls, structural members, or intersections of vertical planes.

K. Block Walls: Do not install raceways in same horizontal course or vertical cell with reinforcing steel.

L. Install watertight fittings in outdoor, underground, or wet locations.

M. Paint threads and cut ends, before assembly of fittings, galvanized conduit, PVC-coated galvanized conduit, or IMC installed in exposed or damp locations with zinc-rich paint or liquid galvanizing compound.

N. Metal conduit shall be reamed, burrs removed, and cleaned before installation of conductors, wires, or cables.

O. Install concealed, embedded, and buried raceways so that they emerge at right angles to surface and have no curved portion exposed.

P. Install conduits for fiber optic cables, telephone cables, and Category 5 data cables in strict conformance with the requirements of EIA/TIA 596-A.

3.02 CONDUIT APPLICATION

A. Diameter: Minimum 3/4 inch.

B. Exterior, Exposed:

1. Rigid galvanized steel.
2. Intermediate metal.

C. Interior, Exposed:

1. Rigid galvanized steel.
2. Intermediate metal.

D. Direct Earth Burial: PVC Schedule 40.

3.03 CONNECTIONS

A. For motors, wall or ceiling mounted fans and unit heaters, dry type transformers, electrically operated valves, instrumentation, and other equipment where flexible connection is required to minimize vibration:

1. Conduit Size 4 Inches or Less: Flexible, liquid-tight conduit.
2. Conduit Size Over 4 Inches: Nonflexible.
3. Wet or Corrosive Areas: Flexible, nonmetallic liquid-tight.
4. Dry Areas: Flexible, metallic liquid-tight.
5. Length: 18-inch minimum, 60-inch maximum, sufficient to allow movement or adjustment of equipment.

B. Lighting Fixtures in Dry Areas: Flexible steel, nonliquid-tight conduit.

C. Outdoor Areas, Process Areas Exposed to Moisture, and Areas Required to be Oiltight and Dust-Tight: Flexible metal, liquid-tight conduit.

D. Transition From Underground or Concrete Embedded to Exposed: Rigid galvanized steel conduit.

3.04 PENETRATIONS

A. Make at right angles, unless otherwise shown.

B. Notching or penetration of structural members, including footings and beams, not permitted.

C. Fire-Rated Walls, Floors, or Ceilings: Firestop openings around penetrations to maintain fire-resistance rating as specified in Section 16050, Basic Materials and Methods.

D. Concrete Walls, Floors, or Ceilings (Aboveground): Provide nonshrink grout dry-pack, or use watertight seal device.

E. Entering Structures:

1. General: Seal raceway at the first box or outlet with oakum or expandable plastic compound to prevent the entrance of gases or liquids from one area to another.
2. Concrete Roof or Membrane Waterproofed Wall or Floor:
   a. Provide a watertight seal.
   b. Without Concrete Encasement: Install watertight entrance seal device on each side.
   c. With Concrete Encasement: Install watertight entrance seal device on the accessible side.
   d. Securely anchor malleable iron body of watertight entrance seal device into construction with one or more integral flanges.
   e. Secure membrane waterproofing to watertight entrance seal device in a permanent, watertight manner.
3. Heating, Ventilating, and Air Conditioning Equipment:
   a. Penetrate equipment in area established by manufacturer.
   b. Terminate conduit with flexible nonmetallic conduit at junction box or condulet attached to exterior surface of equipment prior to penetrating equipment.
   c. Seal penetration with Type 5 sealant, as specified in Section 07900, Joint Sealants.
4. Corrosive-Sensitive Areas:
   a. Seal all conduit passing through room walls.
   b. Seal conduit entering equipment panel boards and field panels containing electronic equipment.
   c. Seal penetration with Type 5 sealant, as specified in Section 07900, Joint Sealants.
5. Existing or Precast Wall (Underground): Core drill wall and install a watertight entrance seal device.

6. Nonwaterproofed Wall or Floor (Underground, without Concrete Encasement):
    a. Provide Schedule 40 galvanized pipe sleeve, or watertight entrance seal device.
    b. Fill space between raceway and sleeve with expandable plastic compound or oakum and lead joint, on each side.
7. Manholes and Handholes:
    a. Metallic Raceways: Provide insulated grounding bushings.
    b. Nonmetallic Raceways: Provide bell ends flush with wall.
    c. Install such that raceways enter as near as possible to one end of wall, unless otherwise shown.

3.05 SUPPORT

A. Support from structural members only, at intervals not exceeding NFPA 70 requirements, and in any case not exceeding 10 feet. Do not support from piping, pipe supports, or other raceways.

B. Multiple Adjacent Raceways: Provide ceiling trapeze.

C. Application/Type of Conduit Strap:

1. Rigid Steel or EMT Conduit: Zinc coated steel, pregalvanized steel or malleable iron.
2. Nonmetallic Conduit: Nonmetallic or PVC-coated metal.

D. Provide and attach wall brackets, strap hangers, or ceiling trapeze as follows:

1. Hollow Masonry Units: Toggle bolts.
2. Concrete or Brick: Expansion shields, or threaded studs driven in by powder charge, with lock washers and nuts.
3. Steelwork: Machine screws.
4. Location/Type of Hardware:
    a. Dry, Noncorrosive Areas: Galvanized.
    b. Wet, Noncorrosive Areas: Stainless steel.
    c. Corrosive Areas: Stainless steel.

E. Nails or wooden plugs inserted in concrete or masonry for attaching raceway not permitted. Do not weld raceways or pipe straps to steel structures. Do not use wire in lieu of straps or hangers.

3.06 BENDS

A. Install concealed raceways with a minimum of bends in the shortest practical distance.

B. Make bends and offsets of longest practical radius. Bends in conduits and ducts being installed for fiber optic cables shall be not less than 20 times cable diameter, 15 inches, minimum.

C. Install with symmetrical bends or cast metal fittings.

D. Avoid field-made bends and offsets, but where necessary, make with acceptable hickey or bending machine. Do not heat metal raceways to facilitate bending.

E. Make bends in parallel or banked runs from same center or centerline with same radius so that bends are parallel.

F. Factory elbows may be installed in parallel or banked raceways if there is change in plane of run, and raceways are same size.

G. PVC Conduit:

1. Bends 30 Degrees and Larger: Provide factory-made elbows.
2. Use manufacturer's recommended method for forming smaller bends.

H. Flexible Conduit: Do not make bends that exceed allowable conductor bending radius of cable to be installed or that significantly restricts conduit flexibility.

3.07 EXPANSION/DEFLECTION FITTINGS

A. Provide on all raceways at all structural expansion joints, and in long tangential runs.

B. Provide expansion/deflection joints for 50 degrees F maximum temperature variation.

C. Install in accordance with manufacturer's instructions.

3.08 PVC CONDUIT

A. Solvent Welding:

1. Provide manufacturer recommended solvent; apply to all joints.
2. Install such that joint is watertight.

B. Belled-End Conduit: Bevel the unbelled end of the joint prior to joining.

3.09 TERMINATION AT ENCLOSURES

A. Cast Metal Enclosure: Provide manufacturer's premolded insulating sleeve inside metallic conduit terminating in threaded hubs.

B. Nonmetallic, Cabinets, and Enclosures:

1. Terminate conduit in threaded conduit hubs, maintaining enclosure integrity.

C. Sheet Metal Boxes, Cabinets, and Enclosures:

1. General:
   a. Install insulated bushing on ends of conduit where grounding is not required.
   b. Provide insulated throat when conduit terminates in sheet metal boxes having threaded hubs.
   c. Utilize sealing locknuts or threaded hubs on sides and bottom of NEMA 3R and NEMA 12 enclosures.
   d. Terminate conduits at threaded hubs at the tops of NEMA 3R and NEMA 12 boxes and enclosures.
   e. Terminate conduits at threaded conduit hubs at NEMA 4 and NEMA 4X boxes and enclosures.
2. Rigid Galvanized Intermediate Conduit:
   a. Provide one lock nut each on inside and outside of enclosure.
   b. Install grounding bushing at source enclosure.
   c. Provide bonding jumper from grounding bushing to equipment ground bus or ground pad.
3. Electric Metallic Tubing: Provide gland compression, insulated connectors.
4. Flexible Metal Conduit: Provide two screw type, insulated, malleable iron connectors.
5. Flexible, Nonmetallic Conduit: Provide nonmetallic, liquid-tight strain relief connectors.

3.10 UNDERGROUND RACEWAYS

A. Grade: Maintain minimum grade of 4 inches in 100 feet, either from one manhole, handhole, or pull box to the next, or from a high point between them, depending on surface contour.

B. Cover: Maintain minimum 1-foot cover above conduit and concrete encasement, unless otherwise shown.

C. Make routing changes as necessary to avoid obstructions or conflicts.

D. Couplings: In multiple conduit runs, stagger so couplings in adjacent runs are not in same transverse line.

E. Union type fittings not permitted.

F. Spacers:

1. Provide preformed, nonmetallic spacers, designed for such purpose, to secure and separate parallel conduit runs in a trench or concrete encasement.
2. Install at intervals not greater than that specified in NFPA 70 for support of the type conduit used, but in no case greater than 10 feet.

G. Support conduit so as to prevent bending or displacement during backfilling or concrete placement.

H. Installation with Other Piping Systems:

1. Crossings: Maintain minimum 12-inch vertical separation.
2. Parallel Runs: Maintain minimum 12-inch separation.
3. Installation over valves or couplings not permitted.

I. Concrete Encasement:

1. As specified in Section 03300, Cast-in-Place Concrete.
2. Concrete Color: Red.

3.11 OUTLET AND DEVICE BOXES

A. Install suitable for conditions encountered at each outlet or device in wiring or raceway system, sized to meet NFPA 70 requirements.

B. Size:

1. Depth: Minimum 2 inches, unless otherwise required by structural conditions. Box extensions not permitted.
   a. Hollow Masonry Construction: Install with sufficient depth such that conduit knockouts or hubs are in masonry void space.
2. Ceiling Outlet: Minimum 4-inch octagonal sheet steel device box, unless otherwise required for installed fixture.
3. Switch and Receptacle: Minimum 2-inch by 4-inch sheet steel device box.

C. Locations:

1. Drawing locations are approximate.
2. To avoid interference with mechanical equipment or structural features, relocate outlets as directed by Engineer.
3. Light Switch: Install as indicated on Drawings.
4. Light Fixture: Install in symmetrical pattern according to room layout, unless otherwise shown.

D. Mounting Height:

1. General:
   a. Dimensions given to centerline of box.
   b. Where specified heights do not suit building construction or finish, adjust up or down to avoid interference. Do not straddle CMU block or other construction joints.
2. Light Switch: 48 inches above floor.
3. Thermostat: 54 inches above floor.
4. Wall Mounted Telephone Outlet: 52 inches above floor.

5. Convenience Receptacle:
   a. General Interior Areas: 15 inches above floor.
   b. Industrial Areas, Workshops: 48 inches above floor.
   c. Outdoor, All Areas: 24 inches above finished grade.
6. Special-Purpose Receptacle: 48 inches above floor or as shown.
7. Switch, Motor Starting: 48 inches above floor, unless otherwise indicated on Drawings.

E. Install plumb and level.

F. Support boxes independently of conduit by attachment to building structure or structural member.

G. Install bar hangers in frame construction or fasten boxes directly as follows:

1. Wood: Wood screws.
2. Concrete or Brick: Bolts and expansion shields.
3. Hollow Masonry Units: Toggle bolts.
4. Steelwork: Machine screws.

H. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

I. Install galvanized mounting hardware in industrial areas.

J. Install separate junction boxes for flush or recessed lighting fixtures where required by fixture terminal temperature.

K. Boxes Supporting Fixtures: Provide means of attachment with adequate strength to support fixture.

L. Open no more knockouts in sheet steel device boxes than are required; seal unused openings.

3.12 JUNCTION AND PULL BOXES

A. Install where shown and where necessary to terminate, tap-off, or redirect multiple conduit runs.

B. Install pull boxes where necessary in raceway system to facilitate conductor installation.

C. Install in conduit runs at least every 150 feet or after the equivalent of three right-angle bends.

D. Use outlet boxes as junction and pull boxes wherever possible and allowed by applicable codes.

E. Use conduit bodies as junction and pull boxes where no splices are required and their use is allowed by applicable codes.

F. Installed boxes shall be accessible.

G. Do not install on finished surfaces.

H. Install plumb and level.

I. Support boxes independently of conduit by attachment to building structure or structural member.

J. Install bar hangers in frame construction or fasten boxes directly as follows:

1. Wood: Wood screws.
2. Concrete or Brick: Bolts and expansion shields.
3. Hollow Masonry Units: Toggle bolts.
4. Steelwork: Machine screws.

K. Threaded studs driven in by powder charge and provided with lock washers and nuts are acceptable in lieu of expansion shields.

L. Boxes embedded in concrete or masonry need not be additionally supported.

M. Mounting Hardware:

1. Noncorrosive Dry Areas: Galvanized.
2. Noncorrosive Wet Areas: Stainless steel.
3. Corrosive Areas: Stainless steel.

3.13 IDENTIFICATION DEVICES

A. Raceway Tags:

1. Identify origin and destination.
2. Provide nylon strap for attachment.

B. Warning Tape: Install approximately 12 inches above underground or concrete-encased raceways. Align parallel to, and within 12 inches of, centerline of runs.

3.14 PROTECTION OF INSTALLED WORK

A. Protect products from effects of moisture, corrosion, and physical damage during construction.

B. Provide and maintain manufactured watertight and dust-tight seals over all conduit openings during construction.

C. Touch up painted conduit threads after assembly to cover nicks or scars.

END OF SECTION

SECTION 16140
WIRING DEVICES

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this section:

1. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. WD 1, General Requirements for Wiring Devices.
2. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
3. Underwriters Laboratories Inc. (UL):
   a. 498, Standard for Attachment Plugs and Receptacles.
   b. 508, Standard for Safety for Industrial Control Equipment.
   c. 943, Standard for Ground-Fault Circuit-Interrupters.
   d. 1449, Standard for Transient Voltage Surge Suppressors.

1.02 SUBMITTALS

A. Action Submittals: Manufacturer's product data for wiring devices.

PART 2 PRODUCTS

2.01 SWITCHES

A. Switch, General Purpose:

1. NEMA WD 1 and FS W-S-896F/GEN.
2. Totally enclosed, ac type, with quiet tumbler switches and screw terminals.
3. Rivetless one-piece brass or copper alloy contact arm with silver alloy contacts.
4. Capable of controlling 100 percent tungsten filament and fluorescent lamp loads.
5. Rating: 20 amps, 120/277 volts.
6. Color:
   a. Other Areas: Brown.
7. Automatic grounding clip and integral grounding terminal on mounting strap.
8. Manufacturers and Products, Industrial Grade:
   a. Arrow Hart; 1201/2221Series.
   b. Bryant; 4801/4901 Series.
   c. Hubbell; 1202/1222Series.
   d. Leviton; 1201/1221 Series.

2.02 RECEPTACLES

A. Receptacle, General Purpose:

1. NEMA WD 1 and FS W-C-596.
2. Duplex, two-pole, three-wire grounding type with screw type wire terminals.
3. Impact resistant nylon cover and body.
4. One-piece mounting strap with integral ground contact (rivetless construction).
5. Contact Arrangement: Contact to be made on two sides of each inserted blade without detent.
6. Rating: 125 volts, NEMA WD 1, Configuration 5-20R, 20 amps.
7. Size: For 2-inch by 4-inch outlet boxes.
8. Industrial Grade:
   a. Color:
      1) Other Areas: Brown.
   b. Manufacturers and Products:
      1) Arrow Hart; 5262/5362 Series.
      2) Bryant; 5262/5362 Series.
      3) Hubbell; 5262/5362 Series.
      4) Leviton; 5262/5362 Series.

B. Receptacle, Ground Fault Circuit Interrupter:

1. Meet requirements of general-purpose receptacles.
2. Listed Class A to UL 943, tripping at 5 mA.
3. Color: Brown.
4. Standard Model: NEMA WD 1, with screw terminals and provisions for testing.
5. Manufacturers:
   a. Bryant.
   b. Hubbell.
   c. Arrow Hart.
   d. Leviton.

C. Receptacle, Special-Purpose:

1. Rating and number of poles as indicated or required for anticipated purpose.
2. One matching plug with cord-grip features for each special-purpose receptacle.

2.03 DEVICE PLATES

A. General: Sectional type plates not permitted.

B. Metal:

1. Material: Specification grade, one-piece, 0.040-inch nominal thickness stainless steel.
2. Finish: ASTM A167, Type 302/304, satin.
3. Mounting Screw: Oval-head, finish matched to plate.

C. Weatherproof:

1. Receptacles, Weatherproof Type 1:
   a. Gasketed, cast-aluminum, with in-use cover.
   b. Mounting Screw and Cap Spring: Stainless steel.
   c. Manufacturers and Products:
      1) Crouse-Hinds; Type WLRD-1.
      2) Appleton; Type FSK-WRD.
2. Switches:
   a. Gasketed, cast-metal or cast-aluminum, incorporating external operator for internal switch.
   b. Mounting Screw: Stainless steel.
   c. Manufacturers and Products:
      1) Crouse-Hinds; DS-181 or DS-185.
      2) Appleton; FSK-1VTS or FSK-1VS.

D. Raised Sheet Metal: 1/2-inch high zinc- or cadmium-plated steel designed for one-piece drawn type sheet steel boxes.

E. Sheet Steel: Formed sheet steel or Feraloy designed for installation on cast metal boxes.

PART 3 EXECUTION

3.01 SWITCHES

A. Switch, General Purpose:

1. Mounting Height: See Section 16130, Raceways and Boxes.
2. Install with switch operation in vertical position.
3. Install single-pole, two-way switches so toggle is in up position when switch is on.

3.02 RECEPTACLES

A. Duplex Receptacles:

1. Install with grounding slot up, except where horizontal mounting is shown, in which case install with neutral slot up.
2. Ground receptacles to boxes with grounding wire only.

3. Weatherproof Receptacles:
   a. Install in cast metal box.
   b. Install such that hinge for protective cover is above receptacle opening.
4. Special-Purpose Receptacles: Install in accordance with manufacturer's instructions.

3.03 DEVICE PLATES

A. Securely fasten to wiring device; ensure a tight fit to box.

B. Surface Mounted: Plate shall not extend beyond sides of box, unless plates have no sharp corners or edges.

C. Install with alignment tolerance to box of 1/16 inch.

D. Types (Unless Otherwise Shown):

1. Office: Metal.
2. Exterior:
   a. Switch: Weatherproof.
   b. Receptacle in DAMP location: Weatherproof Type 1.
   c. Receptacle in WET location: Weatherproof Type 2.

E. Interior:

1. Flush Mounted Boxes: Metal.
2. Surface Mounted, Sheet Steel Boxes: Raised sheet steel.
3. Receptacle shown as Weatherproof on Drawings: Weatherproof Type 1.

END OF SECTION

SECTION 16440
LOW VOLTAGE MOTOR CONTROL

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which shall be followed for this Section:

1. American National Standard Institute (ANSI): C2, National Electrical Safety Code (NESC).
2. National Electrical Contractors Association (NECA): 402, Recommended Practice for Installing Motor Control Centers (ANSI).
3. National Electrical Manufacturers Association (NEMA):
   a. AB1, Molded Case Circuit Breakers, Molded Case Switches, and Circuit Breaker Enclosures.
   b. ICS 1, Industrial Control and Systems: General Requirements.
   c. ICS 2, Industrial Control and Systems: Controllers, Contactors, and Overload Relays Rated 600 Volts.
   d. ICS 2.3, Industrial Control and Systems: Instructions for Handling, Installation, Operation, and Maintenance of Motor Control Centers.
   e. ICS 18, Motor Control Centers.
   f. KS 1, Enclosed and Miscellaneous Distribution Equipment Switches (600 Volts Maximum).
   g. 250, Enclosures for Electrical Equipment (1,000 volts maximum).
4. National Fire Protection Association (NFPA): 70, National Electrical Code. (NEC)
5. Underwriters Laboratories, Inc. (UL):
   a. 0098, Enclosed and Dead-Front Switches.
   b. 489, Molded Case Circuit Breakers and Circuit Breaker Enclosures.
   c. 845, Motor Control Centers.

1.02 DEFINITIONS

A. CT: Current Transformer.

B. LCD: Liquid Crystal Display.

C. N.C.: Normally Closed.

D. N.O.: Normally Open.

E. THD: Total Harmonic Distortion.

F. VT: Voltage Transformer.

1.03 SUBMITTALS

A. Informational Submittals:

1. Manufacturer's installation instructions.
2. Operation and Maintenance Data.

1.04 QUALITY ASSURANCE

A. Provide products manufactured within scope of Underwriters Laboratories that conform to UL Standards and have applied UL Listing Mark.

1.05 DELIVERY, STORAGE, AND HANDLING

A. Receive, store, and install equipment to final installation location within building.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Schneider Electric/Square D Services.
2. GE Industrial Systems.
3. Eaton Electrical/Cutler-Hammer.
4. Allen-Bradley.
5. Siemens.

2.02 GENERAL

A. Like Items of Equipment: End product of one manufacturer.

B. Make adjustments necessary to wiring, conduit, disconnect devices, motor starters, branch circuit protection, and other affected material or equipment to accommodate motors actually provided under this Contract.

C. Controllers: NEMA ICS 1, NEMA ICS 2, Class A.

D. Suitable for use with 75 degrees C wire at full NFPA 70, 75 degrees C ampacity.

E. Lifting lugs on all equipment and devices weighing over 100 pounds.

F. Anchor Bolts: Galvanized, 1/2-inch minimum diameter.

G. Operating Conditions:

1. Ambient Temperature: Maximum 45 degrees C.
2. Altitude: 1,000 above sea level.
3. Equipment to be fully rated.

H. Enclosures: In accordance with NEMA 250.

I. Equipment Finish:

1. Electrocoating process applied over rust-inhibiting phosphated base coating.
2. Exterior Color: Manufacturer's standard.

2.03 SEPARATELY MOUNTED MOTOR CONTROL

A. Manually Operated Starter, Fractional Horsepower:

1. Rating: 16 amperes continuous at 277 volts maximum.
2. Toggle operated.
3. Enclosure: NEMA 4.
4. Neon Light: Red.
5. Handle guard/lock-off plate.

B. Manually Operated Starter, Integral Horsepower:

1. Rating: Horsepower rated to maximum of 10 horsepower at 600 volts with overload protection.
2. Single- or three-phase, nonreversing, full voltage.
3. Control: Toggle.
4. Enclosure: NEMA 4.
5. Locking in OFF position.

C. Thermal Motor Overload Protection:

1. Inverse-time-limit characteristic.
2. Heater: Bimetallic overload, adjustable trip, or directly heated melting alloy, ratchet principle type element.
3. Manual reset.
4. Provide in each ungrounded phase.
5. Mount within starter unit.

2.04 SOURCE QUALITY CONTROL

A. Factory Testing:

1. Actual operation shall be performed wherever possible. Otherwise, inspect and perform continuity checks.

2. Verify component devices operated correctly in circuits as shown on diagrams or as called for in Specifications.
3. Instruments, Meters, Protective Relays, and Equipment:
   a. Verify devices functioned by energizing potential to rated values with connection to devices made at outgoing terminal blocks.
   b. Verify protective relays operated for functional checks and trips manually initiated to verify functioning of operation for indicator and associated circuits.
4. Perform dielectric tests on primary circuits and equipment, except potential transformers. Tests shall be made phase-to-phase and phase to around with 60-cycle test voltages applied for 1 second at 2,640 volts.
5. Verify equipment passed tests and inspection.
6. Provide standard factory inspection and test checklists and final certified and signed test report.

PART 3 EXECUTION

3.01 INSTALLATION

A. Install equipment in accordance with NEMA ICS 2.3, ANSI C2, Submittals, and manufacturer's written instructions and recommendations.

B. Install equipment plumb and in longitudinal alignment with pad or wall.

3.02 OVERLOAD RELAY

A. Select and install overload relay heaters and switch settings after actual nameplate full-load current rating of motor has been determined.

END OF SECTION

SECTION 16442
PANELBOARDS

PART 1 GENERAL

1.01 REFERENCES

A. The following is a list of standards which may be referenced in this Section:

1. Institute of Electrical and Electronics Engineers (IEEE):
   a. C62.1, Surge Arresters for Alternating Current Power Circuits.
   b. C62.11, Standards for Metal-Oxide Surge Arrestors for AC Power Circuits.
2. National Electrical Contractor's Association (NECA): 407, Recommended Practice for Installing and Maintaining Panelboards.
3. National Electrical Manufacturers Association (NEMA):
   a. 250, Enclosures for Electrical Equipment (1000 Volts Maximum).
   b. 289, Application Guide for Ground Fault Circuit Interrupters.
   c. AB 1, Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit-Breaker Enclosures.
   d. KS 1, Enclosed Switches
   e. LA 1, Surge Arrestors.
   f. PB 1, Panelboards.
   g. PB 1.1, General Instructions for Proper Installation, Operation and Maintenance of Panelboards Rated 600 Volts or Less.
4. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC).
5. Underwriters Laboratories Inc. (UL):
   a. 67, Standard for Panelboards.
   b. 98, Standard for Enclosed and Dead-Front Switches.
   c. 486E, Standard for Equipment Wiring Terminals for use with Aluminum and/or Copper Conductors.
   d. 489, Standard for Molded-Case Circuit Breakers, Molded-Case Switches, and Circuit Breaker Enclosures.
   e. 508, Standard for Industrial Control Equipment.
   f. 870, Wireways, Auxiliary Gutters and Associated Fittings.
   g. 943, Standard for Ground-Fault Circuit-Interrupters.

1.02 SUBMITTALS

A. Action Submittals:

1. Manufacturer's data sheets for each type of panelboard, protective device, accessory item, and component.
2. Tabulation of features for each panelboard to include the following:
   a. Protective devices with factory settings.
   b. Provisions for future protective devices.
   c. Space for future protective devices.

d. Voltage, frequency, and phase ratings.
e. Enclosure type.
f. Bus and terminal bar configurations and current ratings.
g. Provisions for circuit terminations with wire range.
h. Short circuit current rating of assembled panelboard at system voltage.
i. Features, characteristics, ratings, and factory settings of auxiliary components.

B. Informational Submittals: Manufacturer's recommended installation instructions.

1.03 QUALITY ASSURANCE

A. Listing and Labeling: Provide products specified in this Section that are listed and labeled as defined in NEC Article 100.

PART 2 PRODUCTS

2.01 MANUFACTURERS

A. Materials, equipment, and accessories specified in this section shall be products of:

1. Square D Co.
2. Eaton/Cutler-Hammer.
3. General Electric Co.

2.02 GENERAL

A. Provide equipment in accordance with NEMA PB 1, NFPA 70, and UL 67.

B. Wire Terminations:

1. Panelboard assemblies, including protective devices, shall be suitable for use with 75 degrees C or greater wire insulation systems at NEC 75 degrees C conductor ampacity.
2. In accordance with UL 486E.

C. Load Current Ratings:

1. Unless otherwise indicated, load current ratings for panelboard assemblies, including bus and circuit breakers, are noncontinuous as defined by NEC. Continuous ratings shall be 80 percent of noncontinuous rating.

D. Short Circuit Current Rating (SCCR): Integrated equipment short circuit rating for each panelboard assembly shall be no less than the following:

1. Minimum SCCR at 208Y/120 or 120/240 volts shall be10,000 amperes rms symmetrical.

E. Overcurrent Protective Devices:

1. In accordance with NEMA AB 1, NEMA KS 1, UL 98, and UL 489.
2. Protective devices shall be adapted to panelboard installation.
   a. Capable of device replacement without disturbing adjacent devices and without removing main bus.
   b. Spaces: Cover openings with easily removable cover.

F. Circuit Breakers:

1. General: Thermal-magnetic unless otherwise indicated, quick-make, quick-break, molded case, of indicating type showing ON/OFF and TRIPPED positions of operating handle.
2. Noninterchangeable: In accordance with NEC.
3. Bus Connection: Bolt-on circuit breakers.
4. Trip Mechanism:
   a. Individual permanent thermal and magnetic trip elements in each pole.
   b. Two and three pole, common trip.
   c. Automatically opens all poles when overcurrent occurs on one pole.
   d. Calibrated for 40 degrees C ambient, unless shown otherwise.
5. Unacceptable Substitution:
   a. Do not substitute single-pole circuit breakers with handle ties for multi-pole breakers.
   b. Do not use tandem or dual circuit breakers in normal single-pole spaces.
6. Ground Fault Circuit Interrupter (GFCI): Where indicated, equip breaker as specified above with ground fault sensor and rated to trip on 5-mA ground fault within 0.025 second (UL 943, Class A sensitivity, for protection of personnel).
   a. Ground fault sensor shall be rated same as circuit breaker.
   b. Push-to-test button.
   c. Reset button.

G. Enclosures:

1. Provide as specified in Section 16050, Basic Electrical Materials and Methods.
2. Material: Type 1, shall be code-gauge, hot-dip galvanized sheet steel with reinforced steel frame.
3. Finish: Rust inhibitor prime followed by manufacturer's standard gray baked enamel or lacquer.

H. Bus:

1. Material: Copper or tin-plated copper full sized throughout length.
2. Provide for mounting of future protective devices along full length of bus regardless of number of units and spaces shown. Machine, drill, and tap as required for current and future positions.

I. Feeder Lugs: Main, feed-through, and neutral shall be replaceable, bolted mechanical or crimp compression type.

J. Equipment Ground Terminal Bus: Copper with suitably sized provisions for termination of ground conductors, and bonded to box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
2. Provide individual termination points for all other grounding conductors such as feeder, grounding electrode, etc.

K. Neutral Terminal Bus: Copper with suitably sized provisions for termination of neutral conductors, and isolated from box.

1. Provide individual mechanical termination points no less than the quantity of breaker pole positions.
2. Provide individual termination points for all other neutral conductors.

L. Provision for Future Devices: Equip with mounting brackets, bus connections, and necessary appurtenances for future protective device ampere ratings indicated.

M. Special Features: Where indicated, provide the following features:

1. Service Equipment Approval: Listed for use as service equipment for panelboards having service disconnecting means.
2. Feed-Through Lugs: At opposite end of phase bus from mains, with additional terminals on neutral and ground buses, sized to accommodate feeders indicated.

2.03 LIGHTING AND APPLIANCE BRANCH CIRCUIT PANELBOARDS

A. Protective Device Locking: Furnish provisions for handle padlocking for main and subfeed devices; also provide for branch devices where indicated.

B. Multi-Section Panelboards: Where more than 42 poles are required or more than one section is otherwise indicated, provide multiple panelboards with separate fronts.

1. Panelboard sections shall be individually installed and field interconnected to form a single electrical unit.

2. Unless otherwise indicated, provide feed-through lugs on each section but last.
3. Surface-mount panels shall be individually mounted and may be different sizes.
4. Surface-mount multi-section panelboards may be comprised of sections of unequal heights.
5. Provide feed-through and main lugs in individual sections as required for field assembly of a complete multi-section panelboard.
6. Provide neutral and ground terminal bars in each section.

PART 3 EXECUTION

3.01 GENERAL

A. Install in accordance with NECA 407, NEMA PB 1.1 and manufacturers' written installation instructions.

B. Install securely, plumb, in-line and square with walls.

C. Install filler plates in unused spaces.

D. Wiring in Panel Gutters: Train conductors neatly in groups; bundle, and wrap with nylon wire ties.

3.02 BRANCH CIRCUIT PANELBOARD

A. Mount flush panels uniformly flush with wall finish.

B. Provide typewritten circuit directory for each panelboard.

END OF SECTION

SECTION 16500
LIGHTING

PART 1 GENERAL

1.01 REFERECES

A. The following is a list of standards which may be referenced in this section:

1. Certified Ballast Manufacturer (CBM).
2. Federal Communications Commission (FCC).
3. Illuminating Engineering Society of North America (IESNA).
4. Institute of Electrical and Electronics Engineers (IEEE): C62.41, Recommended Practice on Surge Voltages in Low-Voltage AC Power Circuits.
5. National Electrical Manufacturers Association (NEMA): 250, Enclosures for Electrical Equipment (1,000 Volts Maximum).
6. National Fire Protection Association (NFPA): 70, National Electrical Code (NEC) – Softbound Version.
7. Underwriters Laboratories, Inc. (UL): 595, Marine-Type Electric Lighting Fixtures.

1.02 SUBMITTALS

A. Action Submittals:

1. Shop Drawings:
   a. Interior Luminaires:
      1) Catalog data sheets and pictures.
      2) Luminaire finish and metal gauge.
      3) Lens material, pattern, and thickness.
      4) Candle power distribution curves in two or more planes.
      5) Candle power chart 0 to 90 degrees.
      6) Lumen output chart.
      7) Average maximum brightness data in foot lamberts.
      8) Coefficients of utilization for zonal cavity calculations.
      9) Mounting or suspension details.
   b. Exterior Luminaires:
      1) Catalog data sheets and pictures.
      2) Luminaire finish and metal gauge.
      3) Lens material, pattern, and thickness.
      4) IESNA lighting classification and isolux diagram.
      5) Fastening details to wall or pole.
      6) Ballast type, location, and method of fastening.
   c. Lamps:
      1) Voltages.
      2) Colors.

3) Approximate life (in hours).
4) Approximate initial lumens.
5) Lumen maintenance curve.
6) Lamp type and base.

d. Ballasts:
1) Type.
2) Wiring diagram.
3) Nominal watts and input watts.
4) Input voltage and power factor.
5) Starting current, line current, and restrike current values.
6) Sound rating.
7) Temperature rating.
8) Efficiency ratings.
9) Low temperature characteristics.
10) Emergency ballasts rating and capacity data.

e. Photocells:
1) Voltage, and power consumption.
2) Capacity.
3) Contacts and time delay.
4) Operating levels.
5) Enclosure type and dimensions.
6) Temperature range.

1.03 QUALITY ASSURANCE

A. Authority Having Jurisdiction (AHJ):

1. Provide the Work in accordance with NFPA 70, National Electrical Code (NEC). Where required by the AHJ, material and equipment shall be labeled or listed by a nationally recognized testing laboratory or other organization acceptable to the AHJ in order to provide a basis for approval under NEC.
2. Materials and equipment manufactured within the scope of standards published by Underwriters Laboratories, Inc. shall conform to those standards and shall have an applied UL listing mark.

1.04 EXTRA MATERIALS

A. Furnish, tag, and box for shipment and storage the following spare parts:

Item	Quantity
Spare ballast of each type	One complete set
Spare lamps of each type	8 (T8 Fluorescent)
	1 (150W M.H.)

PART 2 PRODUCTS

2.01 LUMINAIRES

A. Specific requirements relative to execution of the Work of this section are located on the Drawings.

B. Feed-through type, or separate junction box.

C. Ballasts: Two-lamp when possible.

D. Wire Leads: Minimum 18 AWG.

E. Component Access: Accessible and replaceable without removing luminaire from ceiling.

F. Soffit Installations:

1. UL Labeled: SUITABLE FOR DAMP LOCATIONS.
2. Ballast: Removable, prewired.

G. Exterior Installations:

1. UL Labeled: SUITABLE FOR WET LOCATIONS.
2. Ballast: Removable, prewired.
3. When factory-installed photocells are provided, entire assembly shall have UL label.

H. Emergency Lighting:

1. Power Pack: Self-contained, 120/277-volt transformer, inverter/charger, sealed nickel cadmium battery, and indicator switch in accordance with UL 924.
2. Lighted, push-to-test indicator.
3. Capable of providing full illumination for 1-1/2 hours in emergency mode.
4. Capable of full recharge in 24 hours, automatically upon resumption of normal line voltage.
5. Capable of protecting against excess charging and discharging.

2.02 LAMPS

A. Fluorescent:

1. Type Efficiency: Energy. "T8"
2. Color: Cool white.

B. High Intensity Discharge:

1. Type: Metal halide.
2. Color: Clear.

C. Manufacturers:

1. General Electric Co.
2. Osram Sylvania.
3. Phillips Lighting Company.

2.03 BALLASTS

A. General:

1. Meet requirements for fixture light output, reliable starting, radio interference, total harmonic distortion, electromagnetic interference, and dielectric rating.
2. Certified by electrical testing laboratory to conform to CBM specifications.

B. Fluorescent (Electronic):

1. Provide in 1 lamp, 2 lamp, or 3 lamp models.
2. High frequency ballast of 20k Hz or greater.
3. Meets FCC Part 18.
4. UL listed, Class P, sound rating A.
5. Power factor of 90 percent or greater.
6. Total harmonic distortion THD shall be less than 20 percent.
7. Shall withstand line transients per IEEE C62.41, Cat A.
8. Shall not contain PCB's and shall carry a minimum 3-year manufacturer's warranty.
9. Ballast shall start lamp at a minimum temperature of 0 degree F.

C. Metal Halide:

1. High power factor, normal ambient, 180 degrees C insulation class.
2. Types:
   a. Autotransformer with capacitor and ignitor for lamps 150 watts and less.
   b. Constant wattage autotransformer with capacitor for lamps above 150 watts.

D. Manufacturers:

1. Cooper Lighting.
2. MagneTek Lighting Products.
3. Advance Transformer Co.

4. Motorola Lighting Inc.
5. SLI Inc.
6. General Electric.

2.04 LIGHTING CONTROL

A. Photocell:

1. Automatic ON/OFF switching photo control.
2. Housing: Self-contained, die-cast aluminum, unaffected by moisture, vibration, or temperature changes.
3. Setting: ON at dusk and OFF at dawn.
4. Time delay feature to prevent false switching.
5. Field adjustable to control operating levels.
6. Manufacturers:
   a. Tork.
   b. Paragon Electric Company.

2.05 EMERGENCY BALLAST

A. In accordance with UL 924.

B. Nickel cadmium battery, charger, and electronic circuitry in metal case plus ac ballast.

C. Solid state charging indicator monitoring light and double-pole test switch.

D. Capable of operating two fluorescent lamps for a period of 90 minutes with output of 1,100 to 1,200 lumens.

E. Manufacturers:

1. MagneTek Lighting Products.
2. The Bodine Co., Inc.
3. Lithonia.

2.06 IN-LINE FUSE HOLDER AND FUSE

A. Fuse Holder:

1. General: Waterproof, of corrosion-resistant material.
2. Rating: 600 volts.

B. Fuse:

1. General: Midget, dual element.
2. Rating: 5-amp, voltage as required by application.

C. Manufacturer: Methods Electronics Inc. Network, Buss Div.

PART 3 EXECUTION

3.01 LUMINAIRES

A. General:

1. Install in accordance with manufacturer's recommendations.
2. Provide proper hangers, pendants, and canopies as necessary for complete installation.
3. Provide additional ceiling bracing, hanger supports, and other structural reinforcements to building required to safely mount.
4. Install plumb and level.
5. Mounting heights shown for pendant mounted luminaires are measured from bottom of luminaire to finished floor or finished grade, whichever is applicable.
6. Mounting heights shown for wall-mounted luminaires are measured from center of mounting plate to finished floor or finished grade, whichever is applicable.
7. Install each luminaire outlet box with galvanized stud.

B. Pendant Mounted:

1. Provide swivel type hangers and canopies to match luminaires, unless otherwise noted.
2. Space single-stem hangers on continuous-row fluorescent luminaires nominally 48 inches apart.
3. Provide twin-stem hangers on single luminaires.

C. *Unfinished Areas: Locate luminaires to avoid conflict with other building* systems or blockage of luminaire light output.

1. Fixture Suspension: Provide 1/4-inch threaded steel hanger rods. Scissor type hangers not permitted.
2. Attachment to Steel Beams: Provide flanged beam clips and straight or angled hangers.

D. Building Exterior: Flush-mounted back box and concealed conduit, unless otherwise indicated.

3.02 LAMPS

A. Provide in each fixture, number and type for which fixture is designed, unless otherwise noted.

3.03 BALLASTS

A. Install in accordance with manufacturer's recommendations.

B. Utilize all ballast mounting holes to fasten securely within luminaire.

C. Replace noisy or defective ballasts.

3.04 LIGHTING CONTROL

A. Outdoor Luminaires: Photocells switch lights ON at dusk and OFF at dawn.

3.05 EMERGENCY BALLAST

A. Install battery, charger, and electronic circuitry metal case inside fluorescent fixture housing.

B. Wire in accordance with manufacturer's wiring diagrams.

3.06 CLEANING

A. Remove labels and markings, except UL listing mark.

B. Wipe luminaires inside and out to remove construction dust.

C. Clean luminaire plastic lenses with antistatic cleaners only.

D. Touch up painted surfaces of luminaires and poles with matching paint ordered from manufacturer.

E. Replace defective lamps at time of Substantial Completion.

END OF SECTION

PART 5

DRAWINGS
(BOUND SEPARATELY)