PROJECT MANUAL

FOR

2014 WASTEWATER TREATMENT PLANT IMPROVEMENTS

AREA 1 – WET-WEATHER FACILITY IMPROVEMENTS
AREA 2 – PHOSPHORUS REMOVAL – PHASE 1

FOR THE

WASTEWATER TREATMENT UTILITY
CITY OF WEST LAFAYETTE, INDIANA

WESSLER ENGINEERING, INC.
INDIANAPOLIS, INDIANA

JULY 2014

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INDIANAPOLIS, INDIANA

Certified By:

GARY L. RUSTON
REGISTERED
No.
19500302
STATE OF
INDIANA
PROFESSIONAL ENGINEER

Gary L. Ruston
Professional Engineer 19500302

WAYNE C. MOORE
REGISTERED
No.
10707476
STATE OF
INDIANA
PROFESSIONAL ENGINEER

Wayne C. Moore
Professional Engineer 10707476

JULY 2014

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ADVERTISEMENT FOR BIDDERS

Notice is hereby given that the Board of Public Works and Safety of the City of West Lafayette, Indiana, will receive sealed bids at the Office of the Clerk-Treasurer, West Lafayette Police Department, 711 West Navajo St., West Lafayette, IN 47906, until the hour of 8:30 a.m. (local time) on July 29, 2014, for the **2014 Wastewater Treatment Plant Projects.** After said time, all bids will be taken to the Board of Works meeting at Morton Community Center, Multi-Purpose Room, 222 N. Chauncey Avenue, West Lafayette, and all bids will be publicly opened and read aloud. Bids received after said time will be returned unopened. No oral, telegraph, facsimile, or telephone bids or changes to bids will be considered.

The work shall include construction at the West Lafayette Wastewater Treatment Plant of cast-in-place concrete walls; cast-in-place building foundation; new masonry chemical feed building; chemical storage tanks, feed pumps, valves, piping, and appurtenances; miscellaneous metals; coatings; and associated HVAC, electrical & controls, demolition, and restoration.

Bids shall be entered upon a properly and completely executed State Board of Accounts Form 96 (Revised 2013), shall include the contractor's Bid Attachment and financial statement, and shall be submitted in triplicate. Bids shall be in sealed envelope marked “2014 WASTEWATER TREATMENT PLANT PROJECTS.”

The bid must be accompanied by a certified or cashier’s check or a bid bond in an amount of not less than 5% of the total bid price made in favor of the City of West Lafayette, Indiana, which amount shall accrue to and become the property of the City should the Bidder, awarded the contract, fail to enter into the required written agreement and secure same with the required Performance and Payment Bonds each in the amount of 100% of the contract price. Wage rates shall not be less than the common construction wage as determined pursuant to IC 5-16-7-1 et seq. as amended.

The Board reserves the right to reject any or all bids and waive irregularities of bidding.

Copies of the Drawings and Specifications for the work are on file at the Wastewater Treatment Plant, 500 South River Road, West Lafayette, Indiana, and at Wessler Engineering, 6219 South East Street, Indianapolis, Indiana 46227, Telephone (317) 788-4551.

Drawings and Specifications may be obtained from Eastern Engineering (http://distribution.easternengineering.com) for a non-refundable fee. Complete printed sets of bidding documents are available for $150 per set purchased plus actual shipping costs and a complete downloadable set of bidding documents is available for $100.

A Pre-Bid Conference will be held at 10:00 a.m. (local time) on July 17, 2014 at the Wastewater Treatment Plant in West Lafayette, Indiana.

CITY OF WEST LAFAYETTE
BOARD OF PUBLIC WORKS AND SAFETY
Judith C. Rhodes, Clerk-Treasurer

INSTRUCTIONS TO BIDDERS

ARTICLE 1 – DEFINED TERMS

1.01 Terms used in these Instructions to Bidders have the meanings indicated in the General Conditions and Supplementary Conditions.

ARTICLE 2 – COPIES OF BIDDING DOCUMENTS

2.01 Complete sets of the Bidding Documents, in the number and for the deposit sum (if any) stated in the advertisement or invitation to bid, may be obtained from http://distribution.easternengineering.com

2.02 Complete sets of Bidding Documents shall be used in preparing Bids; neither Owner nor Engineer assumes any responsibility for errors or misinterpretations resulting from the use of incomplete sets of Bidding Documents.

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

ARTICLE 3 – QUALIFICATIONS OF BIDDERS

3.01 To demonstrate Bidder's qualifications to perform the Work, within five (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.

3.02 Bidder is advised to carefully review those portions of the Bid Form requiring Bidder's representations and certifications.

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

4.01 Subsurface and Physical Conditions

A. The Supplementary Conditions identify:

1. Those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site that the Engineer has used in preparing the Bidding Documents.
2. Those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at or contiguous to the Site (except Underground Facilities) that the Engineer has used in preparing the Bidding Documents.

B. Copies of reports and drawings referenced in Paragraph 4.01.A, if not included, 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, opinions, or information contained in such reports or shown or indicated in such drawings.

4.02 Underground Facilities

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. No responsibility is assumed by the Owner or Engineer for the accuracy or completeness of the information so presented.

4.03 Hazardous Environmental Condition

A. The Supplementary Conditions identify any reports and drawings known to Owner relating to a Hazardous Environmental Condition identified at the Site.

B. Copies of reports and drawings referenced in Paragraph 4.03.A, if not included, 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.

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

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

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

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

A. Examine and carefully study the Bidding Documents, and the other related data identified in the Bidding Documents;

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

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

D. Obtain and carefully study all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in Paragraph 4.02 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in the Paragraph 4.06 of the Supplementary Conditions as containing reliable "technical data";

E. Consider the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs;

F. Agree at the time of submitting its Bid that no further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of its Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents;

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

H. Correlate the information known to Bidder, information and observation obtained from visits to the Site, reports and drawings identified in the Bidding Documents and all additional examinations, investigations, explorations, tests, studies, and data with the Bidding Documents;

I. Promptly give Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder discovers in the Bidding Documents and confirm that the written resolution thereof by Engineer is acceptable to Bidder; and

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

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

ARTICLE 5 – PRE-BID CONFERENCE

5.01 A Pre-Bid conference will be held at 10:00 a.m. local time on July 17, 2014 at the Wastewater Treatment Plant in West Lafayette, Indiana. Representatives of Owner and Engineer will be present to discuss the Project. Bidders are encouraged to attend and participate in the conference. Engineer will transmit to all prospective Bidders of record such Addenda as Engineer considers necessary in response to questions arising at the conference. Oral statements may not be relied upon and will not be binding or legally effective.

ARTICLE 6 – SITE AND OTHER AREAS

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

ARTICLE 7 – INTERPRETATIONS AND ADDENDA

7.01 All questions about the meaning or intent of the Bidding Documents are to be submitted to Engineer in writing. Interpretations or clarifications considered necessary by Engineer in response to such questions will be issued by Addenda mailed or delivered to all parties recorded by Engineer as having received the Bidding Documents. Questions received less than seven (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.

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

7.03 In general, the Owner will neither approve nor disapprove particular products prior to the opening of the Bids; such products will be considered when offered by the Successful Contractor for incorporation into the work.

ARTICLE 8 – BID SECURITY

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

8.02 The Bid security of the Successful Bidder will be retained until such Bidder has executed the Contract Documents, furnished the required contract security and met the other conditions of the Notice of Award, whereupon the Bid security will be returned. If the Successful Bidder fails to execute and deliver the Contract Documents and furnish the required contract security within 15 days after the Notice of Award, Owner may consider Bidder to be in default, annul the Notice of Award, and the Bid security of that Bidder will be forfeited. Such forfeiture shall be Owner's exclusive remedy if Bidder defaults. The Bid security of other Bidders whom Owner believes to have a reasonable chance of receiving the award may be retained by Owner until seven days after the Effective Date of the Agreement.

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

ARTICLE 9 – CONTRACT TIMES

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

ARTICLE 10 – LIQUIDATED DAMAGES

10.01 Provisions for liquidated damages, if any, are set forth in the Supplementary Conditions and "Sample Form" of the Agreement.

ARTICLE 11 – SUBSTITUTE AND "OR-EQUAL" ITEMS

11.01 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, voluntary alternate, or "or-equal" item of material or equipment may be furnished or used by Contractor if acceptable to Engineer, application for such acceptance will not be considered by Engineer until after the Effective Date of the Agreement.

ARTICLE 12 – SUBCONTRACTORS, CONTRACTOR'S PERSONNEL, SUPPLIERS AND OTHERS

12.01 If the Owner requests the identity of certain Subcontractors, Suppliers, Contractor's personnel, individuals, or entities to be submitted to Owner in advance of a specified date prior to the Effective Date of the Agreement, the apparent Successful Bidder, and any other Bidder so requested, shall within five days after being requested, submit to Owner a list of all such Subcontractors, Suppliers, Contractor's personnel, 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, Contractor's personnel, individual, or entity if requested by Owner. If Owner or Engineer, after due investigation, has reasonable objection to any proposed Subcontractor, Supplier, Contractor's personnel, individual, or entity, Owner may, before the Notice of Award is given, request apparent Successful Bidder to submit a substitute without an increase in the Bid.

12.02 If apparent Successful Bidder declines to make any such substitution, Owner may award the Contract to the next lowest Bidder that proposes to use acceptable Subcontractors, Suppliers, Contractor's personnel, individuals, or entities. Declining to make requested substitutions will not constitute grounds for forfeiture of the Bid security of any Bidder. Any Subcontractor, Supplier, Contractor's personnel, individual, or entity so listed and against which Owner or Engineer makes no written objection prior to the giving of the Notice of Award will be deemed acceptable to Owner and Engineer subject to revocation of such acceptance after the Effective Date of the Agreement as provided in Paragraph 6.06 of the General Conditions.

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

ARTICLE 13 – PREPARATION OF BID

13.01 The Bid Attachment is included with the Bidding Documents. Additional copies may be obtained from Engineer.

13.02 All blanks on the Bid Attachment shall be completed in ink or by typewriter and the Bid Attachment signed in ink. Erasures or alterations shall be initialed in ink by the person signing the Bid Form. A Bid price shall be indicated for each Bid item, listed therein. In the case of optional alternatives the words “No Bid,” “No Change,” or “Not Applicable” may be entered.

13.03 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.

13.04 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.

13.05 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.

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

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

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

13.09 The Bid shall contain an acknowledgment of receipt of all Addenda, the numbers of which shall be filled in on the Bid Attachment.

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

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

ARTICLE 14 – BASIS OF BID; COMPARISON OF BIDS

14.01 Lump Sum

A. Bidders shall submit a Bid on a Lump Sum Base Bid basis as set forth in the Bid Attachment.

14.02 Comparison of Bids

Bids will be compared on the basis of the Lump Sum Base Bid Price.

ARTICLE 15 – SUBMITTAL OF BID

15.01 With each copy of the Bidding Documents, a Bidder is furnished one separate unbound copy of the Bid Attachment, and, if requested by Bidder, the Bid Bond Form. The unbound copy of the Bid Attachment is to be completed and signed and submitted with the following:

A. Signed Bid (Indiana State Board of Accounts Form 96)

B. Signed Bid Attachment

C. Bid Bond, bank money order, or certified check payable to the Owner in the amount of not less than 5% of the Total Bid Price.

D. Financial Statement

15.02 A Bid shall be submitted no later than the date and time prescribed and at the place indicated in the Advertisement for Bidders and shall be enclosed in an opaque plainly marked package with the Project title (and, if applicable, the designated portion of the Project for which the Bid is submitted), the name and address of Bidder, and shall be accompanied by the Bid security and other required documents. If a Bid is sent by mail or other delivery system, the sealed envelope containing the Bid shall be enclosed in a separate package plainly marked on the outside with the notation "BID ENCLOSED." A mailed Bid shall be addressed to the Office of the Clerk-Treasurer, West Lafayette Police Department, 711 West Navajo St., West Lafayette, IN 47906.

ARTICLE 16 – MODIFICATION AND WITHDRAWAL OF BID

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

16.02 If within 24 hours after Bids are opened any Bidder files a duly signed written notice with Owner and promptly thereafter demonstrates to the reasonable satisfaction of Owner that there was a material and substantial mistake in the preparation of its Bid, that Bidder may withdraw its Bid, and the Bid security will be returned. Thereafter, if the Work is rebid, that Bidder will be disqualified from further bidding on the Work.

ARTICLE 17 – OPENING OF BIDS

17.01 Bids will be opened at the time and place indicated in the Advertisement for Bidders and, unless obviously non-responsive, read aloud publicly. An official Tabulation of the Bids and major alternates, if any, will be made available to Bidders after they have been reviewed and certified by the Engineer.

ARTICLE 18 – BIDS TO REMAIN SUBJECT TO ACCEPTANCE

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

ARTICLE 19 – EVALUATION OF BIDS AND AWARD OF CONTRACT

19.01 Owner reserves the right to reject any or all Bids, including without limitation, nonconforming, nonresponsive, unbalanced, or conditional Bids. Owner further reserves the right to reject the Bid of any Bidder whom it finds, after reasonable inquiry and evaluation, to 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 Owner to make an award to that Bidder. Owner also reserves the right to waive all informalities not involving price, time, or changes in the Work and to negotiate contract terms with the Successful Bidder.

19.02 More than one Bid for the same Work from an individual or entity under the same or different names will not be considered. Reasonable grounds for believing that any Bidder has an interest in more than one Bid for the Work may be cause for disqualification of that Bidder and the rejection of all Bids in which that Bidder has an interest.

19.03 In evaluating Bids, Owner will consider whether or not the Bids comply with the prescribed requirements, and such alternates, unit prices and other data, as may be requested in the Bid Form or prior to the Notice of Award.

19.04 In evaluating Bidders, Owner will consider the qualifications of Bidders and may consider the qualifications and experience of Subcontractors, Suppliers, and other individuals or entities proposed for those portions of the Work for which the identity of Subcontractors, Suppliers, and other individuals or entities must be submitted as provided in the Supplementary Conditions.

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

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

ARTICLE 20 - CONTRACT SECURITY AND INSURANCE

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

ARTICLE 21 – SIGNING OF AGREEMENT

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

ARTICLE 22 - SALES AND USE TAXES

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

ARTICLE 23 – RETAINAGE

23.01 Provisions concerning retainage are set forth in the Agreement.

ARTICLE 24 – NOT USED

ARTICLE 25 – SUPPLEMENTAL INSTRUCTIONS

25.01 Domestic Product Requirements

In accordance with Indiana Code 5-16-8-2, all steel and foundry products provided for in this project, including ferrous and non-ferrous metals, piping, fittings, and piping-related products, shall be manufactured in the United States.

25.02 At the Preconstruction Conference, the Contractor will be provided with the Owner's Indiana General Tax Exemption Certificate Account Number for purchase of materials to be installed as a part of this project.

25.03 Wage Rates on this project will be determined in accordance with IC 5-16-7 of the Acts of Indiana. If not included herein at the time of printing these documents, those rates had not been determined, and an Addendum will be issued when those rates are determined.

25.04 Substitutes, Voluntary Alternates, or "Or Equal" Items

A. Where specific manufacturer and/or model numbers for materials and equipment are listed in the detailed Specifications, these items have served as the basis for the design of the new or upgraded facilities in this project. The Bidder shall be aware that materials and equipment submitted as a voluntary alternate or "or equal" item must be certified by the Bidder as (1) meeting or exceeding the requirements of the detailed Specifications; (2) being of equal or better quality; and (3) being of equal function to the specific manufacturer and/or model listed. If the submitted voluntary alternate or "or equal" item requires any modification or deviation from the Drawings, the Bidder shall be responsible for preparing and submitting detailed drawings to the Engineer showing all modifications in structures, piping, electrical, mechanical, or other work required to adapt the plans to the submitted voluntary alternate or "or equal" item. The Engineer will review the submitted detailed drawings of modifications and indicate whether changes are necessary to comply with the project requirements. Detailed drawings which do not comply with the project requirements shall be revised and resubmitted.

B. Voluntary alternate and/or "or equal" equipment that is installed by the Contractor but fails to meet the specified requirements as determined by the Engineer shall be replaced with the specified item at the Contractor's expense. The bidders listed "add" or "deduct" associated with voluntary alternate equipment items shall be based upon an "installed price" and shall take into consideration and include any cost of the design or construction changes that may be required as a result of using an alternate or "or equal" material or equipment.

Part of State Form 52414 (R2 / 2-13) / Form 96 (Revised 2013)

BID OF

_____
(Contractor)

_____
(Address)

_____

FOR

PUBLIC WORKS PROJECTS

OF

_____

_____

_____

_____

Filed _____

_____

Action taken _____

_____

_____

SAMPLE

CONTRACTOR'S BID FOR PUBLIC WORK - FORM 96

State Form 52414 (R2 / 2-13) / Form 96 (Revised 2013)
Prescribed by State Board of Accounts

PART I
(To be completed for all bids. Please type or print)

Date *(month, day, year)*:_____

1. Governmental Unit (Owner):_____
2. County :_____
3. Bidder (Firm):_____

   Address:_____

   City/State/ZIPcode:_____
4. Telephone Number:_____
5. Agent of Bidder *(if applicable)*:_____

Pursuant to notices given, the undersigned offers to furnish labor and/or material necessary to complete the public works project of _____ (Governmental Unit) in accordance with plans and specifications prepared by _____ _____ and dated _____ for the sum of _____ $_____

The undersigned further agrees to furnish a bond or certified check with this bid for an amount specified in the notice of the letting. If alternative bids apply, the undersigned submits a proposal for each in accordance with the notice. Any addendums attached will be specifically referenced at the applicable page.

If additional units of material included in the contract are needed, the cost of units must be the same as that shown in the original contract if accepted by the governmental unit. If the bid is to be awarded on a unit basis, the item number of the units shall be shown on a separate attachment.

The contractor and his subcontractors, if any, shall not discriminate against or intimidate any employee, or applicant for employment to be employed in the performance of this contract, with respect to any matter directly or indirectly related to employment because of race, religion, color, sex, national origin or ancestry. Breach of this covenant may be regarded as a material breach of the contract.

CERTIFICATION OF USE OF UNITED STATES STEEL PRODUCTS
(If applicable)

I, the undersigned bidder or agent as a contractor on a public works project, understand my statutory obligation to use steel products made in the United States (I.C. 5-16-8-2). I hereby certify that I and all subcontractors employed by me for this project will use U.S. steel products on this project if awarded. I understand that violations hereunder may result in forfeiture of contractual payments.

SAMPLE

ACCEPTANCE

The above bid is accepted this _____ day of _____, _____, subject to the following conditions: _____

_____

Contracting Authority Members:

_____ _____

_____ _____

_____ _____

PART II

(For projects of $150,000 or more – IC 36-1-12-4)

Governmental Unit: _____

Bidder (Firm) _____

Date *(month, day, year):* _____

These statements to be submitted under oath by each bidder with and as a part of his bid. Attach additional pages for each section as needed.

SECTION I EXPERIENCE QUESTIONNAIRE

1. What public works projects has your organization completed for the period of one (1) year prior to the date of the current bid?

Contract Amount	Class of Work	Completion Date	Name and Address of Owner

2. What public works projects are now in process of construction by your organization?

Contract Amount	Class of Work	Expected Completion Date	Name and Address of Owner

SAMPLE

3. Have you ever failed to complete any work awarded to you? _____ If so, where and why?

_____

_____

_____

4. List references from private firms for which you have performed work.

_____

_____

_____

_____

_____

SECTION II PLAN AND EQUIPMENT QUESTIONNAIRE

1. Explain your plan or layout for performing proposed work. *(Examples could include a narrative of when you could begin work, complete the project, number of workers, etc. and any other information which you believe would enable the governmental unit to consider your bid.)*

_____

_____

_____

_____

_____

2. Please list the names and addresses of all subcontractors *(i.e. persons or firms outside your own firm who have performed part of the work)* that you have used on public works projects during the past five (5) years along with a brief description of the work done by each subcontractor.

_____

_____

_____

_____

_____

SAMPLE

3. If you intend to sublet any portion of the work, state the name and address of each subcontractor, equipment to be used by the subcontractor, and whether you will require a bond. However, if you are unable to currently provide a listing, please understand a listing must be provided prior to contract approval. Until the completion of the proposed project, you are under a continuing obligation to immediately notify the governmental unit in the event that you subsequently determine that you will use a subcontractor on the proposed project.

_____

_____

_____

_____

_____

4. What equipment do you have available to use for the proposed project? Any equipment to be used by subcontractors may also be required to be listed by the governmental unit.

_____

_____

_____

_____

_____

5. Have you entered into contracts or received offers for all materials which substantiate the prices used in preparing your proposal? If not, please explain the rationale used which would corroborate the prices listed.

_____

_____

_____

_____

_____

SAMPLE

SECTION III CONTRACTOR'S FINANCIAL STATEMENT

Attachment of bidder's financial statement is mandatory. Any bid submitted without said financial statement as required by statute shall thereby be rendered invalid. The financial statement provided hereunder to the governing body awarding the contract must be specific enough in detail so that said governing body can make a proper determination of the bidder's capability for completing the project if awarded.

SECTION IV CONTRACTOR'S NON – COLLUSION AFFIDAVIT

The undersigned bidder or agent, being duly sworn on oath, says that he has not, nor has any other member, representative, or agent of the firm, company, corporation or partnership represented by him, entered into any combination, collusion or agreement with any person relative to the price to be bid by anyone at such letting nor to prevent any person from bidding nor to include anyone to refrain from bidding, and that this bid is made without reference to any other bid and without any agreement, understanding or combination with any other person in reference to such bidding.

He further says that no person or persons, firms, or corporation has, have or will receive directly or indirectly, any rebate, fee, gift, commission or thing of value on account of such sale.

SECTION V OATH AND AFFIRMATION

I HEREBY AFFIRM UNDER THE PENALTIES FOR PERJURY THAT THE FACTS AND INFORMATION CONTAINED IN THE FOREGOING BID FOR PUBLIC WORKS ARE TRUE AND CORRECT.

Dated at _____ this _____ day of _____, _____

_____
(Name of Organization)

By_____

_____
(Title of Person Signing)

ACKNOWLEDGEMENT

STATE OF _____)
) SS
COUNTY OF_____)

Before me, a Notary Public, personally appeared the above-named _____ and swore that the statements contained in the foregoing document are true and correct.

Subscribed and sworn to before me this _____ day of _____, _____.

_____
Notary Public

My Commission Expires:_____

County of Residence:_____

SAMPLE

BID ATTACHMENT

ARTICLE 1 – BID RECIPIENT

1.01 This Bid of _____(Bidder) is submitted to the West Lafayette Wastewater Treatment Utility (Owner) for construction of **2014 Wastewater Treatment Plant Projects, Area 1 – Wet-Weather Facility Improvements and Area 2 – Phosphorus Removal – Phase 1.**

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

ARTICLE 2 – BIDDER'S ACKNOWLEDGEMENTS

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

ARTICLE 3 – BIDDER'S REPRESENTATIONS

3.01 In submitting this Bid, Bidder represents that:

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

Addendum No.	Addendum Date
_____	_____
_____	_____
_____	_____

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

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

D. Bidder has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities) that have been identified in SC-4.02 as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in SC-4.06 as containing reliable "technical data."

E. Bidder has considered the information known to Bidder; information commonly known to contractors doing business in the locality of the Site; information and observations obtained from visits to the Site; the Bidding Documents; and the Site-related reports and drawings identified in the Bidding Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Bidder, including applying the specific means, methods, techniques, sequences, and procedures of construction expressly required by the Bidding Documents; and (3) Bidder's safety precautions and programs.

F. Based on the information and observations referred to in Paragraph 3.01.E above, Bidder does not consider that further examinations, investigations, explorations, tests, studies, or data are necessary for the determination of this Bid for performance of the Work at the price(s) bid and within the times required, and in accordance with the other terms and conditions of the Bidding Documents.

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

H. Bidder has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Bidder has discovered in the Bidding Documents, and the written resolution thereof by Engineer is acceptable to Bidder.

I. The Bidding Documents are generally sufficient to indicate and convey understanding of all terms and conditions for the performance of the Work for which this Bid is submitted.

ARTICLE 4 – BIDDER'S CERTIFICATION

4.01 Bidder certifies that:

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

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

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

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

ARTICLE 5 – BASIS OF BID

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

LUMP SUM BASE BID

The undersigned proposes to furnish all work for the construction of **2014 Wastewater Treatment Plant Projects, Area 1 – Wet-Weather Facility Improvements and Area 2 – Phosphorus Removal – Phase 1,** including the furnishing of all labor, materials, supplies, equipment, and other items of the Drawings and Specifications for the following LUMP SUM BASE BID:

LUMP SUM BASE BID PRICE (in figures) $_____

LUMP SUM BASE BID PRICE (in words) _____

_____Dollars

The above LUMP SUM BASE BID PRICE is based upon using the equipment of the following major equipment manufacturers

Specification Section	Equipment	Manufacturer
11740	Chemical Feed Pumps	Watson-Marlow, Inc.
13700	Chemical Storage Tanks	PolyProcessing Co.

The undersigned desires to offer for consideration, the following voluntary alternate equipment **(circle whether change in Bid Amount is an ADD or DEDUCT)**:

SPEC NO. 11740 – CHEMICAL FEED PUMPS

Alternate Manufacturer and Model:_____

Change in Bid Amount:_____ (ADD) (DEDUCT)

SPEC NO. 13700 – CHEMICAL STORAGE TANKS

Alternate Manufacturer and Model:_____

Change in Bid Amount:_____ (ADD) (DEDUCT)

The undersigned understands that equipment of a proposed voluntary alternate manufacturer must meet or exceed the requirements of the bid documents, be of equal or better quality, and be of equal function to the equipment specified and to any manufacturer's and/or models which are specifically indicated.

The undersigned understands that after a contract is awarded, the Owner may select items of the voluntary alternate manufacturer listed above. If awarded the contract, the Bidder agrees to furnish and install any listed voluntary alternate equipment item for the deduction or addition indicated. The Contract Price will then be adjusted accordingly.

If proposed alternate or "or equal" material or equipment items other than specific manufacturers listed in the Specifications require any modification or deviation from the Plans, the undersigned agrees to prepare and submit detailed drawings to the Engineer showing all modifications in structures, piping, electrical, mechanical, or other work, required to adapt the Plans to the proposed alternate or "or equal" equipment. The Bidder further understands that the Engineer will review said detailed drawings of modifications and either approve them or indicate thereon changes necessary to comply with the project requirements. Detailed drawings which are not approved shall be revised then resubmitted to the Engineer. The submitted Bid is based upon an "installed" price and takes into consideration and includes any and all cost of the design or construction changes that may be required as a result of using voluntary alternate or "or equal" material or equipment.

ARTICLE 6 – TIME OF COMPLETION

6.01 Bidder agrees that Work in Area 1 will be Substantially Complete to allow the Wet-Weather Facility to be fully operational by March 21, 2015, and all other Work will be substantially complete within 240 calendar days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and will be completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within 270 calendar days after the date when the Contract Times commence to run.

6.02 Bidder accepts the provisions of the “Sample Form” of the Agreement as to liquidated damages in the event of failure to complete the Work within the Contract Times stated above.

ARTICLE 7 – DESIGNATION OF INTENDED SUBCONTRACTORS

7.01 The Contractor shall submit in writing for review by the Owner the names of the following subcontractors proposed for the Work. Subcontractors may not be changed, except at the request or with no objection of the Owner. The following schedule shall be completed by the Contractor and will become part of this Bid.

The Bid, as submitted, is based upon the following subcontractors:

Type of Service	Name of Company	Phone Number
Concrete	_____	_____
Coatings	_____	_____
Mechanical/Piping	_____	_____
Electrical	_____	_____
HVAC	_____	_____
Instrumentation & Controls	_____	_____
Roofing	_____	_____

ARTICLE 8 – DEFINED TERMS

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

ARTICLE 9 – BID SUBMITTAL

This Bid submitted by:

_____
Bidder
(Individual) (Partnership) (Corporation)

By:_____

Title:_____

Address:_____

_____

Phone No.:_____Fax:_____

E-mail:_____

Dated:_____

Attest:_____

BID BOND

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

BIDDER *(Name and Address)*:

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

OWNER *(Name and Address)*:

BID
Bid Due Date:
Description *(Project Name and Include Location)*:

BOND
Bond Number:
Date *(Not earlier than Bid due date)*:
Penal sum _____ $ _____
(Words) (Figures)

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

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

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

1. Bidder and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to pay to Owner upon default of Bidder the penal sum set forth on the face of this Bond. Payment of the penal sum is the extent of Bidder's and Surety's liability. Recovery of such penal sum under the terms of this Bond shall be Owner's sole and exclusive remedy upon default of Bidder.

2. Default of Bidder shall occur upon the failure of Bidder to deliver within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents.

3. This obligation shall be null and void if:

3.1 Owner accepts Bidder's Bid and Bidder delivers within the time required by the Bidding Documents (or any extension thereof agreed to in writing by Owner) the executed Agreement required by the Bidding Documents and any performance and payment bonds required by the Bidding Documents, or

3.2 All Bids are rejected by Owner, or

3.3 Owner fails to issue a Notice of Award to Bidder within the time specified in the Bidding Documents (or any extension thereof agreed to in writing by Bidder and, if applicable, consented to by Surety when required by Paragraph 5 hereof).

4. Payment under this Bond will be due and payable upon default of Bidder and within 30 calendar days after receipt by Bidder and Surety of written notice of default from Owner, which notice will be given with reasonable promptness, identifying this Bond and the Project and including a statement of the amount due.

5. Surety waives notice of any and all defenses based on or arising out of any time extension to issue Notice of Award agreed to in writing by Owner and Bidder, provided that the total time for issuing Notice of Award including extensions shall not in the aggregate exceed 120 days from Bid due date without Surety's written consent.

6. No suit or action shall be commenced under this Bond prior to 30 calendar days after the notice of default required in Paragraph 4 above is received by Bidder and Surety and in no case later than one year after Bid due date.

7. Any suit or action under this Bond shall be commenced only in a court of competent jurisdiction located in the state in which the Project is located.

8. Notices required hereunder shall be in writing and sent to Bidder and Surety at their respective addresses shown on the face of this Bond. Such notices may be sent by personal delivery, commercial courier, or by United States Registered or Certified Mail, return receipt requested, postage pre-paid, and shall be deemed to be effective upon receipt by the party concerned.

9. Surety shall cause to be attached to this Bond a current and effective Power of Attorney evidencing the authority of the officer, agent, or representative who executed this Bond on behalf of Surety to execute, seal, and deliver such Bond and bind the Surety thereby.

10. This Bond is intended to conform to all applicable statutory requirements. Any applicable requirement of any applicable statute that has been omitted from this Bond shall be deemed to be included herein as if set forth at length. If any provision of this Bond conflicts with any applicable statute, then the provision of said statute shall govern and the remainder of this Bond that is not in conflict therewith shall continue in full force and effect.

11. The term "Bid" as used herein includes a Bid, offer, or proposal as applicable.

Notice of Award

Date: _____

Project:	
Owner:	Owner's Contract No.:
Contract:	Engineer's Project No.:
Bidder:	
Bidder's Address: *[send Notice of Award Certified Mail, Return Receipt Requested]*	

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

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

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

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

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

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

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

1. Deliver to the Owner [_____] fully executed counterparts of the Contract Documents.
2. Deliver with the executed Contract Documents the Contract security [Bonds] as specified in the Instructions to Bidders (Article 20) and General Conditions (Paragraph 5.01).
3. Other conditions precedent:
   Enroll in and verify the work eligibility status of all its newly hired employees through the E-Verify Program. Submit completed E-Verify Affidavit form to Owner.
   Submit completed Indiana Iran Investment Certification to Owner.
   _____

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

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

_____
Owner

By:_____
Authorized Signature

_____
Title

Copy to Engineer

PERFORMANCE BOND

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

CONTRACTOR (*Name and Address*):

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

OWNER (*Name and Address*):

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

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

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

CONTRACTOR AS PRINCIPAL

_____ (Seal)
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature (Attach Power of Attorney)

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

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

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.

1. If Contractor performs the Contract, Surety and Contractor have no obligation under this Bond, except to participate in conferences as provided in Paragraph 2.1.

2. If there is no Owner Default, Surety's obligation under this Bond shall arise after:
   - 2.1 Owner has notified Contractor and Surety, at the addresses described in Paragraph 9 below, that Owner is considering declaring a Contractor Default and has requested and attempted to arrange a conference with Contractor and Surety to be held not later than 15 days after receipt of such notice to discuss methods of performing the Contract. If Owner, Contractor, and Surety agree, Contractor shall be allowed a reasonable time to perform the Contract, but such an agreement shall not waive Owner's right, if any, subsequently to declare a Contractor Default; and
   - 2.2 Owner has declared a Contractor Default and formally terminated Contractor's right to complete the Contract. Such Contractor Default shall not be declared earlier than 20 days after Contractor and Surety have received notice as provided in Paragraph 2.1; and
   - 2.3 Owner has agreed to pay the Balance of the Contract Price to:
     1. Surety in accordance with the terms of the Contract; or
     2. Another contractor selected pursuant to Paragraph 3.3 to perform the Contract.

3. When Owner has satisfied the conditions of Paragraph 2, Surety shall promptly, and at Surety's expense, take one of the following actions:

   - 3.1 Arrange for Contractor, with consent of Owner, to perform and complete the Contract; or
   - 3.2 Undertake to perform and complete the Contract itself, through its agents or through independent contractors; or
   - 3.3 Obtain bids or negotiated proposals from qualified contractors acceptable to Owner for a contract for performance and completion of the Contract, arrange for a contract to be prepared for execution by Owner and contractor selected with Owner's concurrence, to be secured with performance and payment bonds executed by a qualified surety equivalent to the bonds issued on the Contract, and pay to Owner the amount of damages as described in Paragraph 5 in excess of the Balance of the Contract Price incurred by Owner resulting from Contractor Default; or
   - 3.4 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.

4. If Surety does not proceed as provided in Paragraph 3 with reasonable promptness, Surety shall be deemed to be in default on this Bond 15 days after receipt of an additional written notice from Owner to Surety demanding that Surety perform its obligations under this Bond, and Owner shall be entitled to enforce any remedy available to Owner. If Surety proceeds as provided in Paragraph 3.4, and Owner refuses the payment tendered or Surety has denied liability, in whole or in part, without further notice Owner shall be entitled to enforce any remedy available to Owner.

5. After Owner has terminated Contractor's right to complete the Contract, and if Surety elects to act under Paragraph 3.1, 3.2, or 3.3 above, then the responsibilities of Surety to Owner shall not be greater than those of Contractor under the Contract, and the responsibilities of Owner to Surety shall not be greater than those of Owner under the Contract. To the limit of the amount of this Bond, but subject to commitment by Owner of the Balance of the Contract Price to mitigation of costs and damages on the Contract, Surety is obligated without duplication for:

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

6. 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.

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

8. 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.

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

10. 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.

11. Definitions.

11.1 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.
11.2 Contract: The agreement between Owner and Contractor identified on the signature page, including all Contract Documents and changes thereto.
11.3 Contractor Default: Failure of Contractor, which has neither been remedied nor waived, to perform or otherwise to comply with the terms of the Contract.
11.4 Owner Default: Failure of Owner, which has neither been remedied nor waived, to pay Contractor as required by the Contract or to perform and complete or otherwise comply with the other terms thereof.

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

PAYMENT BOND

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

CONTRACTOR (*Name and Address*):

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

OWNER (*Name and Address*):

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

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

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

CONTRACTOR AS PRINCIPAL

_____ (Seal)
Contractor's Name and Corporate Seal

By: _____
Signature

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

SURETY

_____ (Seal)
Surety's Name and Corporate Seal

By: _____
Signature (Attach Power of Attorney)

_____
Print Name

_____
Title

Attest: _____
Signature

_____
Title

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

1. Contractor and Surety, jointly and severally, bind themselves, their heirs, executors, administrators, successors, and assigns to Owner to pay for labor, materials, and equipment furnished by Claimants for use in the performance of the Contract, which is incorporated herein by reference.

2. With respect to Owner, this obligation shall be null and void if Contractor:

2.1 Promptly makes payment, directly or indirectly, for all sums due Claimants, and

2.2 Defends, indemnifies, and holds harmless Owner from all claims, demands, liens, or suits alleging non-payment by Contractor by any person or entity who furnished labor, materials, or equipment for use in the performance of the Contract, provided Owner has promptly notified Contractor and Surety (at the addresses described in Paragraph 12) of any claims, demands, liens, or suits and tendered defense of such claims, demands, liens, or suits to Contractor and Surety, and provided there is no Owner Default.

3. With respect to Claimants, this obligation shall be null and void if Contractor promptly makes payment, directly or indirectly, for all sums due.

4. Surety shall have no obligation to Claimants under this Bond until:

4.1 Claimants who are employed by or have a direct contract with Contractor have given notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and, with substantial accuracy, the amount of the claim.

4.2 Claimants who do not have a direct contract with Contractor:

1. Have furnished written notice to Contractor and sent a copy, or notice thereof, to Owner, within 90 days after having last performed labor or last furnished materials or equipment included in the claim stating, with substantial accuracy, the amount of the claim and the name of the party to whom the materials or equipment were furnished or supplied, or for whom the labor was done or performed; and
2. Have either received a rejection in whole or in part from Contractor, or not received within 30 days of furnishing the above notice any communication from Contractor by which Contractor had indicated the claim will be paid directly or indirectly; and
3. Not having been paid within the above 30 days, have sent a written notice to Surety (at the address described in Paragraph 12) and sent a copy, or notice thereof, to Owner, stating that a claim is being made under this Bond and enclosing a copy of the previous written notice furnished to Contractor.

5. If a notice by a Claimant required by Paragraph 4 is provided by Owner to Contractor or to Surety, that is sufficient compliance.

6. Reserved.

7. Surety's total obligation shall not exceed the amount of this Bond, and the amount of this Bond shall be credited for any payments made in good faith by Surety.

8. Amounts owed by Owner to Contractor under the Contract shall be used for the performance of the Contract and to satisfy claims, if any, under any performance bond. By Contractor furnishing and Owner accepting this Bond, they agree that all funds earned by Contractor in the performance of the Contract are dedicated to satisfy obligations of Contractor and Surety under this Bond, subject to Owner's priority to use the funds for the completion of the Work.

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

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

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

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

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

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

15. Definitions

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

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

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

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

"SAMPLE FORM"

AGREEMENT

THIS AGREEMENT is dated this _____ day of _____, 2014, by and between the City of West Lafayette, Indiana ("Owner") and _____ _____("Contractor").

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

ARTICLE 1 – WORK

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

2014 Wastewater Treatment Plant Projects
Area 1 – Wet-Weather Facility Improvements
Area 2 – Phosphorus Removal – Phase 1

ARTICLE 2 – ENGINEER

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

ARTICLE 3 – CONTRACT TIMES

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

3.02 Work in Area 1 shall be Substantially Complete to allow the Wet-Weather Facility to be fully operational by March 21, 2015, and all Work will be substantially completed within 240 days after the date when the Contract Times commence to run as provided in Paragraph 2.03 of the General Conditions, and completed and ready for final payment in accordance with Paragraph 14.07 of the General Conditions within 270 days after the date when the Contract Times commence to run.

3.03 Liquidated Damages

A. 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 3.02 above, plus any extensions thereof allowed in accordance with Article 12 of the General Conditions. The parties also recognize the delays, expense, and

difficulties involved in proving in a legal or arbitration proceeding the actual loss suffered by Owner if the Work is not completed on time. Accordingly, instead of requiring any such proof, Owner and Contractor agree that as liquidated damages for delay (but not as a penalty), the Owner, in the form of a Change Order, shall deduct from the monies due the Contractor $1,200.00 for each calendar day that expires after the time specified in Paragraph 3.02 for Substantial Completion until the Work is substantially complete. After Substantial Completion, if Contractor shall neglect, refuse, or fail to complete the remaining Work within the Contract Time or any proper extension thereof granted by Owner, the Owner, in the form of a Change Order, shall deduct from the monies due the Contractor $1,200.00 for each day that expires after the time specified in Paragraph 3.02 for completion and readiness for final payment until the Work is completed and ready for final payment.

ARTICLE 4 – CONTRACT PRICE

4.01 Owner shall pay Contractor for completion of the Work in accordance with the Contract Documents an amount in current funds as follows:

_____	($ _____)
(words)	(figure)

For all Work, at the prices stated in Contractor's Bid.

ARTICLE 5 – PAYMENT PROCEDURES

5.01 Submittal and Processing of Payments

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

5.02 Progress Payments; Retainage

A. Owner shall make progress payments on account of the Contract Price on the basis of Contractor's Applications for Payment on a monthly basis during performance of the Work as provided in Paragraph 5.02.A.1 below. All such payments will be measured by the schedule of values established as provided in Paragraph 2.07.A of the General Conditions (and in the case of Unit Price Work based on the number of units completed) or, in the event there is no schedule of values, as provided in the General Requirements.

1. Prior to Substantial Completion, progress payments will be made in an amount equal to the percentage indicated below but, in each case, less the aggregate of payments previously made and less such amounts as Engineer may determine or Owner may withhold, including but not limited to liquidated damages, in accordance with Paragraph 14.02 of the General Conditions.

2. The Owner shall retain ten percent (10%) of the amount of each payment until final completion and acceptance of all work covered by the Contract Documents. The

Owner at any time, however, after fifty percent (50%) of the Work has been completed, if he finds that satisfactory progress is being made, shall reduce retainage to five percent (5%) on the current and remaining estimates. When the Work is substantially complete (operational or beneficial occupancy), the retained amount may be further reduced below five percent (5%) to only that amount necessary to assure completion. On completion and acceptance on a part of the Work on which the price is stated separately in the Contract Documents, payment may be made in full, including retained percentages, less authorized deductions.

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

5.03 Final Payment

A. Upon final completion and acceptance of the Work in accordance with Paragraph 14.07 of the General Conditions, Owner shall pay the remainder of the Contract Price as recommended by Engineer as provided in Paragraphs 14.07 and 14.08 of the General Conditions, less any applicable liquidated damages.

ARTICLE 6 – CONTRACTOR'S REPRESENTATIONS

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

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

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

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

D. Contractor has carefully studied all: (1) reports of explorations and tests of subsurface conditions at or contiguous to the Site and all drawings of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities), if any, that have been identified in Paragraph SC-4.02 of the Supplementary Conditions as containing reliable "technical data," and (2) reports and drawings of Hazardous Environmental Conditions, if any, at the Site that have been identified in Paragraph SC-4.06 of the Supplementary Conditions as containing reliable "technical data."

E. Contractor has considered the information known to Contractor; information commonly known to contractors doing business in the locality of the Site; information and

observations obtained from visits to the Site; the Contract Documents; and the Site-related reports and drawings identified in the Contract Documents, with respect to the effect of such information, observations, and documents on (1) the cost, progress, and performance of the Work; (2) the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, including any specific means, methods, techniques, sequences, and procedures of construction expressly required by the Contract Documents; and (3) Contractor's safety precautions and programs.

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

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

H. Contractor has given Engineer written notice of all conflicts, errors, ambiguities, or discrepancies that Contractor has discovered in the Contract Documents, and the written resolution thereof by Engineer is acceptable to Contractor.

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

ARTICLE 7 – CONTRACT DOCUMENTS

7.01 Contents

A. The Contract Documents consist of the following:

1. Advertisement for Bidders
2. Instructions to Bidders
3. Contractor's Bid
4. Bid Bond
5. Agreement with E-Verify Affidavit and Indiana Iran Investment Certification
6. Performance Bond
7. Payment Bond
8. General Conditions
9. Supplementary Conditions
10. Specifications as contained in Project Manual dated _____
11. Drawings consisting of _____ sheets dated _____

12. Addenda

    a. No. _____ dated _____

    b. No. _____ dated _____

    c. No. _____ dated _____

    d. No. _____ dated _____

13. The following which may be delivered or issued on or after the Effective Date of the Agreement and are not attached hereto:

    a. Notice to Proceed

    b. Change Order(s).

    c. Certificate of Substantial Completion

B. There are no Contract Documents other than those listed above in this Article 7.

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

ARTICLE 8 – MISCELLANEOUS

8.01 Terms

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

8.02 Assignment of Contract

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

8.03 Successors and Assigns

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

8.04 Severability

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

IN WITNESS WHEREOF, Owner and Contractor have signed this Agreement in triplicate (3 copies). Counterparts have been delivered to Owner and Contractor. All portions of the Contract Documents have been signed or have been identified by Owner and Contractor or on their behalf.

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

OWNER:

_____

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

_____

_____

_____

CONTRACTOR:

_____

By: _____

Title: _____

[CORPORATE SEAL]

Attest: _____

Title: _____

Address for giving notices:

_____

_____

_____

License No.:

_____
(Where applicable)

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

E-Verify Affidavit

Pursuant to Indiana Code 22-5-1.7-11, the Contractor entering into a contract with the Owner is required to enroll in and verify the work eligibility status of all its newly hired employees through the E-Verify program. The Contractor is not required to verify the work eligibility status of all its newly hired employees through the E-Verify program if the E-Verify program no longer exists.

The undersigned, on behalf of the Contractor, being first duly sworn, deposes and states that the Contractor does not knowingly employ an unauthorized alien. The undersigned further affirms that, prior to entering into its contract with the Owner, the undersigned Contractor will enroll in and agrees to verify the work eligibility status of all its new hired employees through the E-Verify program

(Contractor): _____

By (Written Signature): _____

(Printed Name) _____

(Title): _____

Important – Notary Signature and Seal Required in the Space Below

STATE OF _____

SS:

COUNTY OF _____

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

My commission expires:_____(Signed)_____

Residing in _____County, State of _____

INDIANA IRAN INVESTMENT CERTIFICATION

I, _____, the duly authorized representative of
(name of representative)
_____, certify under penalty of perjury that
(name of firm)
_____ does not engage in investment activities in
(name of firm)

Iran as defined by I.C. 5-22-16.5.

NAME OF FIRM

By:_____

Printed Name:_____

Title:_____

SAMPLE

(for use when Owner is municipality in Indiana)

Notice to Proceed

Date: _____

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

You are notified that the Contract Times under the above Contract will commence to run on _____. On that date, you are to start performing your obligations under the Contract Documents. In accordance with Article 3 of the Agreement, the date of Substantial Completion is _____, and the date of readiness for final payment is _____ [(or) the number of days to achieve Substantial Completion is _____, and the number of days to achieve readiness for final payment is _____].

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

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

_____ *[add other requirements]*

Contractor	Owner
Received by	Given by:
Authorized Signature	Authorized Signature
Title	Title
Date	Date

Copy to Wessler Engineering, Inc.

FTM NO. 000

WESSLER ENGINEERING, INC.
2014 WWTP PROJECTS – AREAS 1 & 2

CONTRACTOR

MONTH	DAY	YEAR

SUBJECT:

REFERENCE:

cc: West Lafayette Wastewater Treatment Utility
Wessler RPR
Wessler File
Wessler Project Manager

WESSLER ENGINEERING, INC.

By
Title PROJECT MANAGER

Change Order

No. _____

Date of Issuance: _____ Effective Date: _____

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

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

Description:

Attachments (list documents supporting change):

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

RECOMMENDED:	ACCEPTED:	ACCEPTED:
By: _____	By: _____	By: _____
Engineer (Authorized Signature)	Owner (Authorized Signature)	Contractor (Authorized Signature)
Date: _____	Date: _____	Date: _____

Approved by Funding Agency (if applicable):

_____ Date: _____

A. GENERAL INFORMATION

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

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

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

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

B. COMPLETING THE CHANGE ORDER FORM

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

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

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

Certificate of Substantial Completion

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

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

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

_____

_____

_____

_____

_____
Date of Substantial Completion

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

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

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

☐ Amended Responsibilities ☐ Not Amended

Owner's Amended Responsibilities:

_____

_____

_____

Contractor's Amended Responsibilities:

_____

_____

_____

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

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

Executed by Engineer	Date
Accepted by Contractor	Date
Accepted by Owner	Date

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

STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

Prepared by

ENGINEERS JOINT CONTRACT DOCUMENTS COMMITTEE

and

Issued and Published Jointly by

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ASSOCIATED GENERAL CONTRACTORS OF AMERICA

AMERICAN SOCIETY OF CIVIL ENGINEERS

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A Practice Division of the
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Endorsed by

CONSTRUCTION SPECIFICATIONS INSTITUTE

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

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

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

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

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STANDARD GENERAL CONDITIONS OF THE CONSTRUCTION CONTRACT

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ARTICLE 1 – DEFINITIONS AND TERMINOLOGY

1.01 *Defined Terms*

A. Wherever used in the Bidding Requirements or Contract Documents and printed with initial capital letters, the terms listed below will have the meanings indicated which are applicable to both the singular and plural thereof. In addition to terms specifically defined, terms with initial capital letters in the Contract Documents include references to identified articles and paragraphs, and the titles of other documents or forms.

1. *Addenda*—Written or graphic instruments issued prior to the opening of Bids which clarify, correct, or change the Bidding Requirements or the proposed Contract Documents.

2. *Agreement*—The written instrument which is evidence of the agreement between Owner and Contractor covering the Work.

3. *Application for Payment*—The form acceptable to Engineer which is to be used by Contractor during the course of the Work in requesting progress or final payments and which is to be accompanied by such supporting documentation as is required by the Contract Documents.

4. *Asbestos*—Any material that contains more than one percent asbestos and is friable or is releasing asbestos fibers into the air above current action levels established by the United States Occupational Safety and Health Administration.

5. *Bid*—The offer or proposal of a Bidder submitted on the prescribed form setting forth the prices for the Work to be performed.

6. *Bidder*—The individual or entity who submits a Bid directly to Owner.

7. *Bidding Documents*—The Bidding Requirements and the proposed Contract Documents (including all Addenda).

8. *Bidding Requirements*—The advertisement or invitation to bid, Instructions to Bidders, Bid security of acceptable form, if any, and the Bid Form with any supplements.

9. *Change Order*—A document recommended by Engineer which is signed by Contractor and Owner and authorizes an addition, deletion, or revision in the Work or an adjustment in the Contract Price or the Contract Times, issued on or after the Effective Date of the Agreement.

10. *Claim*—A demand or assertion by Owner or Contractor seeking an adjustment of Contract Price or Contract Times, or both, or other relief with respect to the terms of the Contract. A demand for money or services by a third party is not a Claim.

11. *Contract*—The entire and integrated written agreement between the Owner and Contractor concerning the Work. The Contract supersedes prior negotiations, representations, or agreements, whether written or oral.

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12. *Contract Documents*—Those items so designated in the Agreement. Only printed or hard copies of the items listed in the Agreement are Contract Documents. Approved Shop Drawings, other Contractor submittals, and the reports and drawings of subsurface and physical conditions are not Contract Documents.

13. *Contract Price*—The moneys payable by Owner to Contractor for completion of the Work in accordance with the Contract Documents as stated in the Agreement (subject to the provisions of Paragraph 11.03 in the case of Unit Price Work).

14. *Contract Times*—The number of days or the dates stated in the Agreement to: (i) achieve Milestones, if any; (ii) achieve Substantial Completion; and (iii) complete the Work so that it is ready for final payment as evidenced by Engineer's written recommendation of final payment.

15. *Contractor*—The individual or entity with whom Owner has entered into the Agreement.

16. *Cost of the Work*—See Paragraph 11.01 for definition.

17. *Drawings*—That part of the Contract Documents prepared or approved by Engineer which graphically shows the scope, extent, and character of the Work to be performed by Contractor. Shop Drawings and other Contractor submittals are not Drawings as so defined.

18. *Effective Date of the Agreement*—The date indicated in the Agreement on which it becomes effective, but if no such date is indicated, it means the date on which the Agreement is signed and delivered by the last of the two parties to sign and deliver.

19. *Engineer*—The individual or entity named as such in the Agreement.

20. *Field Order*—A written order issued by Engineer which requires minor changes in the Work but which does not involve a change in the Contract Price or the Contract Times.

21. *General Requirements*—Sections of Division 1 of the Specifications.

22. *Hazardous Environmental Condition*—The presence at the Site of Asbestos, PCBs, Petroleum, Hazardous Waste, or Radioactive Material in such quantities or circumstances that may present a substantial danger to persons or property exposed thereto.

23. *Hazardous Waste*—The term Hazardous Waste shall have the meaning provided in Section 1004 of the Solid Waste Disposal Act (42 USC Section 6903) as amended from time to time.

24. *Laws and Regulations; Laws or Regulations*—Any and all applicable laws, rules, regulations, ordinances, codes, and orders of any and all governmental bodies, agencies, authorities, and courts having jurisdiction.

25. *Liens*—Charges, security interests, or encumbrances upon Project funds, real property, or personal property.

26. *Milestone*—A principal event specified in the Contract Documents relating to an intermediate completion date or time prior to Substantial Completion of all the Work.

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27. *Notice of Award*—The written notice by Owner to the Successful Bidder stating that upon timely compliance by the Successful Bidder with the conditions precedent listed therein, Owner will sign and deliver the Agreement.

28. *Notice to Proceed*—A written notice given by Owner to Contractor fixing the date on which the Contract Times will commence to run and on which Contractor shall start to perform the Work under the Contract Documents.

29. *Owner*—The individual or entity with whom Contractor has entered into the Agreement and for whom the Work is to be performed.

30. *PCBs*—Polychlorinated biphenyls.

31. *Petroleum*—Petroleum, including crude oil or any fraction thereof which is liquid at standard conditions of temperature and pressure (60 degrees Fahrenheit and 14.7 pounds per square inch absolute), such as oil, petroleum, fuel oil, oil sludge, oil refuse, gasoline, kerosene, and oil mixed with other non-Hazardous Waste and crude oils.

32. *Progress Schedule*—A schedule, prepared and maintained by Contractor, describing the sequence and duration of the activities comprising the Contractor's plan to accomplish the Work within the Contract Times.

33. *Project*—The total construction of which the Work to be performed under the Contract Documents may be the whole, or a part.

34. *Project Manual*—The bound documentary information prepared for bidding and constructing the Work. A listing of the contents of the Project Manual, which may be bound in one or more volumes, is contained in the table(s) of contents.

35. *Radioactive Material*—Source, special nuclear, or byproduct material as defined by the Atomic Energy Act of 1954 (42 USC Section 2011 et seq.) as amended from time to time.

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

37. *Samples*—Physical examples of materials, equipment, or workmanship that are representative of some portion of the Work and which establish the standards by which such portion of the Work will be judged.

38. *Schedule of Submittals*—A schedule, prepared and maintained by Contractor, of required submittals and the time requirements to support scheduled performance of related construction activities.

39. *Schedule of Values*—A schedule, prepared and maintained by Contractor, allocating portions of the Contract Price to various portions of the Work and used as the basis for reviewing Contractor's Applications for Payment.

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40. *Shop Drawings*—All drawings, diagrams, illustrations, schedules, and other data or information which are specifically prepared or assembled by or for Contractor and submitted by Contractor to illustrate some portion of the Work.

41. *Site*—Lands or areas indicated in the Contract Documents as being furnished by Owner upon which the Work is to be performed, including rights-of-way and easements for access thereto, and such other lands furnished by Owner which are designated for the use of Contractor.

42. *Specifications*—That part of the Contract Documents consisting of written requirements for materials, equipment, systems, standards and workmanship as applied to the Work, and certain administrative requirements and procedural matters applicable thereto.

43. *Subcontractor*—An individual or entity having a direct contract with Contractor or with any other Subcontractor for the performance of a part of the Work at the Site.

44. *Substantial Completion*—The time at which the Work (or a specified part thereof) has progressed to the point where, in the opinion of Engineer, the Work (or a specified part thereof) is sufficiently complete, in accordance with the Contract Documents, so that the Work (or a specified part thereof) can be utilized for the purposes for which it is intended. The terms "substantially complete" and "substantially completed" as applied to all or part of the Work refer to Substantial Completion thereof.

45. *Successful Bidder*—The Bidder submitting a responsive Bid to whom Owner makes an award.

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

47. *Supplier*—A manufacturer, fabricator, supplier, distributor, materialman, or vendor having a direct contract with Contractor or with any Subcontractor to furnish materials or equipment to be incorporated in the Work by Contractor or Subcontractor.

48. *Underground Facilities*—All underground pipelines, conduits, ducts, cables, wires, manholes, vaults, tanks, tunnels, or other such facilities or attachments, and any encasements containing such facilities, including those that convey electricity, gases, steam, liquid petroleum products, telephone or other communications, cable television, water, wastewater, storm water, other liquids or chemicals, or traffic or other control systems.

49. *Unit Price Work*—Work to be paid for on the basis of unit prices.

50. *Work*—The entire construction or the various separately identifiable parts thereof required to be provided under the Contract Documents. Work includes and is the result of performing or providing all labor, services, and documentation necessary to produce such construction, and furnishing, installing, and incorporating all materials and equipment into such construction, all as required by the Contract Documents.

51. *Work Change Directive*—A written statement to Contractor issued on or after the Effective Date of the Agreement and signed by Owner and recommended by Engineer ordering an

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

1.02 *Terminology*

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

B. *Intent of Certain Terms or Adjectives:*

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

C. *Day:*

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

D. *Defective:*

1. The word "defective," when modifying the word "Work," refers to Work that is unsatisfactory, faulty, or deficient in that it:

a. does not conform to the Contract Documents; or

b. does not meet the requirements of any applicable inspection, reference standard, test, or approval referred to in the Contract Documents; or

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

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

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1. The word "furnish," when used in connection with services, materials, or equipment, shall mean to supply and deliver said services, materials, or equipment to the Site (or some other specified location) ready for use or installation and in usable or operable condition.

2. The word "install," when used in connection with services, materials, or equipment, shall mean to put into use or place in final position said services, materials, or equipment complete and ready for intended use.

3. The words "perform" or "provide," when used in connection with services, materials, or equipment, shall mean to furnish and install said services, materials, or equipment complete and ready for intended use.

4. When "furnish," "install," "perform," or "provide" is not used in connection with services, materials, or equipment in a context clearly requiring an obligation of Contractor, "provide" is implied.

F. Unless stated otherwise in the Contract Documents, words or phrases that have a well-known technical or construction industry or trade meaning are used in the Contract Documents in accordance with such recognized meaning.

ARTICLE 2 – PRELIMINARY MATTERS

2.01 *Delivery of Bonds and Evidence of Insurance*

A. When Contractor delivers the executed counterparts of the Agreement to Owner, Contractor shall also deliver to Owner such bonds as Contractor may be required to furnish.

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

2.02 *Copies of Documents*

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

2.03 *Commencement of Contract Times; Notice to Proceed*

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

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2.04 *Starting the Work*

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

2.05 *Before Starting Construction*

A. *Preliminary Schedules:* Within 10 days after the Effective Date of the Agreement (unless otherwise specified in the General Requirements), Contractor shall submit to Engineer for timely review:

1. a preliminary Progress Schedule indicating the times (numbers of days or dates) for starting and completing the various stages of the Work, including any Milestones specified in the Contract Documents;

2. a preliminary Schedule of Submittals; and

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

2.06 *Preconstruction Conference; Designation of Authorized Representatives*

A. Before any Work at the Site is started, a conference attended by Owner, Contractor, Engineer, and others as appropriate will be held to establish a working understanding among the parties as to the Work and to discuss the schedules referred to in Paragraph 2.05.A, procedures for handling Shop Drawings and other submittals, processing Applications for Payment, and maintaining required records.

B. At this conference Owner and Contractor each shall designate, in writing, a specific individual to act as its authorized representative with respect to the services and responsibilities under the Contract. Such individuals shall have the authority to transmit instructions, receive information, render decisions relative to the Contract, and otherwise act on behalf of each respective party.

2.07 *Initial Acceptance of Schedules*

A. At least 10 days before submission of the first Application for Payment a conference attended by Contractor, Engineer, and others as appropriate will be held to review for acceptability to Engineer as provided below the schedules submitted in accordance with Paragraph 2.05.A. Contractor shall have an additional 10 days to make corrections and adjustments and to complete and resubmit the schedules. No progress payment shall be made to Contractor until acceptable schedules are submitted to Engineer.

1. The Progress Schedule will be acceptable to Engineer if it provides an orderly progression of the Work to completion within the Contract Times. Such acceptance will not impose on Engineer responsibility for the Progress Schedule, for sequencing, scheduling, or progress of

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

2. Contractor's Schedule of Submittals will be acceptable to Engineer if it provides a workable arrangement for reviewing and processing the required submittals.

3. Contractor's Schedule of Values will be acceptable to Engineer as to form and substance if it provides a reasonable allocation of the Contract Price to component parts of the Work.

ARTICLE 3 – CONTRACT DOCUMENTS: INTENT, AMENDING, REUSE

3.01 *Intent*

A. The Contract Documents are complementary; what is required by one is as binding as if required by all.

B. It is the intent of the Contract Documents to describe a functionally complete project (or part thereof) to be constructed in accordance with the Contract Documents. Any labor, documentation, services, materials, or equipment that reasonably may be inferred from the Contract Documents or from prevailing custom or trade usage as being required to produce the indicated result will be provided whether or not specifically called for, at no additional cost to Owner.

C. Clarifications and interpretations of the Contract Documents shall be issued by Engineer as provided in Article 9.

3.02 *Reference Standards*

A. Standards, Specifications, Codes, Laws, and Regulations

1. Reference to standards, specifications, manuals, or codes of any technical society, organization, or association, or to Laws or Regulations, whether such reference be specific or by implication, shall mean the standard, specification, manual, code, or Laws or Regulations in effect at the time of opening of Bids (or on the Effective Date of the Agreement if there were no Bids), except as may be otherwise specifically stated in the Contract Documents.

2. No provision of any such standard, specification, manual, or code, or any instruction of a Supplier, shall be effective to change the duties or responsibilities of Owner, Contractor, or Engineer, or any of their subcontractors, consultants, agents, or employees, from those set forth in the Contract Documents. No such provision or instruction shall be effective to assign to Owner, Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors, any duty or authority to supervise or direct the performance of the Work or any duty or authority to undertake responsibility inconsistent with the provisions of the Contract Documents.

3.03 *Reporting and Resolving Discrepancies*

A. *Reporting Discrepancies:*

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1. *Contractor's Review of Contract Documents Before Starting Work*: Before undertaking each part of the Work, Contractor shall carefully study and compare the Contract Documents and check and verify pertinent figures therein and all applicable field measurements. Contractor shall promptly report in writing to Engineer any conflict, error, ambiguity, or discrepancy which Contractor discovers, or has actual knowledge of, and shall obtain a written interpretation or clarification from Engineer before proceeding with any Work affected thereby.

2. *Contractor's Review of Contract Documents During Performance of Work*: If, during the performance of the Work, Contractor discovers any conflict, error, ambiguity, or discrepancy within the Contract Documents, or between the Contract Documents and (a) any applicable Law or Regulation , (b) any standard, specification, manual, or code, or (c) any instruction of any Supplier, then Contractor shall promptly report it to Engineer in writing. Contractor shall not proceed with the Work affected thereby (except in an emergency as required by Paragraph 6.16.A) until an amendment or supplement to the Contract Documents has been issued by one of the methods indicated in Paragraph 3.04.

3. Contractor shall not be liable to Owner or Engineer for failure to report any conflict, error, ambiguity, or discrepancy in the Contract Documents unless Contractor had actual knowledge thereof.

B. *Resolving Discrepancies:*

1. Except as may be otherwise specifically stated in the Contract Documents, the provisions of the Contract Documents shall take precedence in resolving any conflict, error, ambiguity, or discrepancy between the provisions of the Contract Documents and:

   a. the provisions of any standard, specification, manual, or code, or the instruction of any Supplier (whether or not specifically incorporated by reference in the Contract Documents); or

   b. the provisions of any Laws or Regulations applicable to the performance of the Work (unless such an interpretation of the provisions of the Contract Documents would result in violation of such Law or Regulation).

3.04 *Amending and Supplementing Contract Documents*

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

B. The requirements of the Contract Documents may be supplemented, and minor variations and deviations in the Work may be authorized, by one or more of the following ways:

1. A Field Order;

2. Engineer's approval of a Shop Drawing or Sample (subject to the provisions of Paragraph 6.17.D.3); or

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3. Engineer's written interpretation or clarification.

3.05 *Reuse of Documents*

A. Contractor and any Subcontractor or Supplier shall not:

1. have or acquire any title to or ownership rights in any of the Drawings, Specifications, or other documents (or copies of any thereof) prepared by or bearing the seal of Engineer or its consultants, including electronic media editions; or

2. reuse any such Drawings, Specifications, other documents, or copies thereof on extensions of the Project or any other project without written consent of Owner and Engineer and specific written verification or adaptation by Engineer.

B. The prohibitions of this Paragraph 3.05 will survive final payment, or termination of the Contract. Nothing herein shall preclude Contractor from retaining copies of the Contract Documents for record purposes.

3.06 *Electronic Data*

A. Unless otherwise stated in the Supplementary Conditions, the data furnished by Owner or Engineer to Contractor, or by Contractor to Owner or Engineer, that may be relied upon are limited to the printed copies (also known as hard copies). Files in electronic media format of text, data, graphics, or other types are furnished only for the convenience of the receiving party. Any conclusion or information obtained or derived from such electronic files will be at the user's sole risk. If there is a discrepancy between the electronic files and the hard copies, the hard copies govern.

B. Because data stored in electronic media format can deteriorate or be modified inadvertently or otherwise without authorization of the data's creator, the party receiving electronic files agrees that it will perform acceptance tests or procedures within 60 days, after which the receiving party shall be deemed to have accepted the data thus transferred. Any errors detected within the 60-day acceptance period will be corrected by the transferring party.

C. When transferring documents in electronic media format, the transferring party makes no representations as to long term compatibility, usability, or readability of documents resulting from the use of software application packages, operating systems, or computer hardware differing from those used by the data's creator.

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

4.01 *Availability of Lands*

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

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

B. Upon reasonable written request, Owner shall furnish Contractor with a current statement of record legal title and legal description of the lands upon which the Work is to be performed and Owner's interest therein as necessary for giving notice of or filing a mechanic's or construction lien against such lands in accordance with applicable Laws and Regulations.

C. Contractor shall provide for all additional lands and access thereto that may be required for temporary construction facilities or storage of materials and equipment.

4.02 *Subsurface and Physical Conditions*

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

1. those reports known to Owner of explorations and tests of subsurface conditions at or contiguous to the Site; and

2. those drawings known to Owner of physical conditions relating to existing surface or subsurface structures at the Site (except Underground Facilities).

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

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences, and procedures of construction to be employed by Contractor, and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions, and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions, or information.

4.03 *Differing Subsurface or Physical Conditions*

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

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

2. is of such a nature as to require a change in the Contract Documents; or

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3. differs materially from that shown or indicated in the Contract Documents; or

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

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

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

C. *Possible Price and Times Adjustments:*

1. The Contract Price or the Contract Times, or both, will be equitably adjusted to the extent that the existence of such differing subsurface or physical condition causes an increase or decrease in Contractor's cost of, or time required for, performance of the Work; subject, however, to the following:

   a. such condition must meet any one or more of the categories described in Paragraph 4.03.A; and

   b. with respect to Work that is paid for on a unit price basis, any adjustment in Contract Price will be subject to the provisions of Paragraphs 9.07 and 11.03.

2. Contractor shall not be entitled to any adjustment in the Contract Price or Contract Times if:

   a. Contractor knew of the existence of such conditions at the time Contractor made a final commitment to Owner with respect to Contract Price and Contract Times by the submission of a Bid or becoming bound under a negotiated contract; or

   b. the existence of such condition could reasonably have been discovered or revealed as a result of any examination, investigation, exploration, test, or study of the Site and contiguous areas required by the Bidding Requirements or Contract Documents to be conducted by or for Contractor prior to Contractor's making such final commitment; or

   c. Contractor failed to give the written notice as required by Paragraph 4.03.A.

3. If Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times, or both, a Claim may be made therefor as provided in Paragraph 10.05. However, neither Owner or Engineer, or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other

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

4.04 *Underground Facilities*

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

1. Owner and Engineer shall not be responsible for the accuracy or completeness of any such information or data provided by others; and

2. the cost of all of the following will be included in the Contract Price, and Contractor shall have full responsibility for:

   a. reviewing and checking all such information and data;

   b. locating all Underground Facilities shown or indicated in the Contract Documents;

   c. coordination of the Work with the owners of such Underground Facilities, including Owner, during construction; and

   d. the safety and protection of all such Underground Facilities and repairing any damage thereto resulting from the Work.

B. *Not Shown or Indicated:*

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

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

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

4.05 *Reference Points*

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

4.06 *Hazardous Environmental Condition at Site*

A. *Reports and Drawings:* The Supplementary Conditions identify those reports and drawings known to Owner relating to Hazardous Environmental Conditions that have been identified at the Site.

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

1. the completeness of such reports and drawings for Contractor's purposes, including, but not limited to, any aspects of the means, methods, techniques, sequences and procedures of construction to be employed by Contractor and safety precautions and programs incident thereto; or

2. other data, interpretations, opinions and information contained in such reports or shown or indicated in such drawings; or

3. any Contractor interpretation of or conclusion drawn from any "technical data" or any such other data, interpretations, opinions or information.

C. Contractor shall not be responsible for any Hazardous Environmental Condition uncovered or revealed at the Site which was not shown or indicated in Drawings or Specifications or identified in the Contract Documents to be within the scope of the Work. Contractor shall be responsible for a Hazardous Environmental Condition created with any materials brought to the Site by Contractor, Subcontractors, Suppliers, or anyone else for whom Contractor is responsible.

D. If Contractor encounters a Hazardous Environmental Condition or if Contractor or anyone for whom Contractor is responsible creates a Hazardous Environmental Condition, Contractor shall immediately: (i) secure or otherwise isolate such condition; (ii) stop all Work in connection with such condition and in any area affected thereby (except in an emergency as required by

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Paragraph 6.16.A); and (iii) notify Owner and Engineer (and promptly thereafter confirm such notice in writing). Owner shall promptly consult with Engineer concerning the necessity for Owner to retain a qualified expert to evaluate such condition or take corrective action, if any. Promptly after consulting with Engineer, Owner shall take such actions as are necessary to permit Owner to timely obtain required permits and provide Contractor the written notice required by Paragraph 4.06.E.

E. Contractor shall not be required to resume Work in connection with such condition or in any affected area until after Owner has obtained any required permits related thereto and delivered written notice to Contractor: (i) specifying that such condition and any affected area is or has been rendered safe for the resumption of Work; or (ii) specifying any special conditions under which such Work may be resumed safely. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of any adjustment in Contract Price or Contract Times, or both, as a result of such Work stoppage or such special conditions under which Work is agreed to be resumed by Contractor, either party may make a Claim therefor as provided in Paragraph 10.05.

F. If after receipt of such written notice Contractor does not agree to resume such Work based on a reasonable belief it is unsafe, or does not agree to resume such Work under such special conditions, then Owner may order the portion of the Work that is in the area affected by such condition to be deleted from the Work. If Owner and Contractor cannot agree as to entitlement to or on the amount or extent, if any, of an adjustment in Contract Price or Contract Times as a result of deleting such portion of the Work, then either party may make a Claim therefor as provided in Paragraph 10.05. Owner may have such deleted portion of the Work performed by Owner's own forces or others in accordance with Article 7.

G. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to a Hazardous Environmental Condition, provided that such Hazardous Environmental Condition: (i) was not shown or indicated in the Drawings or Specifications or identified in the Contract Documents to be included within the scope of the Work, and (ii) was not created by Contractor or by anyone for whom Contractor is responsible. Nothing in this Paragraph 4.06.G shall obligate Owner to indemnify any individual or entity from and against the consequences of that individual's or entity's own negligence.

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

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

ARTICLE 5 – BONDS AND INSURANCE

5.01 *Performance, Payment, and Other Bonds*

A. Contractor shall furnish performance and payment bonds, each in an amount at least equal to the Contract Price as security for the faithful performance and payment of all of Contractor's obligations under the Contract Documents. These bonds shall remain in effect until one year after the date when final payment becomes due or until completion of the correction period specified in Paragraph 13.07, whichever is later, except as provided otherwise by Laws or Regulations or by the Contract Documents. Contractor shall also furnish such other bonds as are required by the Contract Documents.

B. All bonds shall be in the form prescribed by the Contract Documents except as provided otherwise by Laws or Regulations, and shall be executed by such sureties as are named in the list of "Companies Holding Certificates of Authority as Acceptable Sureties on Federal Bonds and as Acceptable Reinsuring Companies" as published in Circular 570 (amended) by the Financial Management Service, Surety Bond Branch, U.S. Department of the Treasury. All bonds signed by an agent or attorney-in-fact must be accompanied by a certified copy of that individual's authority to bind the surety. The evidence of authority shall show that it is effective on the date the agent or attorney-in-fact signed each bond.

C. If the surety on any bond furnished by Contractor is declared bankrupt or becomes insolvent or its right to do business is terminated in any state where any part of the Project is located or it ceases to meet the requirements of Paragraph 5.01.B, Contractor shall promptly notify Owner and Engineer and shall, within 20 days after the event giving rise to such notification, provide another bond and surety, both of which shall comply with the requirements of Paragraphs 5.01.B and 5.02.

5.02 *Licensed Sureties and Insurers*

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

5.03 *Certificates of Insurance*

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

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

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

D. Owner does not represent that insurance coverage and limits established in this Contract necessarily will be adequate to protect Contractor.

E. The insurance and insurance limits required herein shall not be deemed as a limitation on Contractor's liability under the indemnities granted to Owner in the Contract Documents.

5.04 *Contractor's Insurance*

A. Contractor shall purchase and maintain such insurance as is appropriate for the Work being performed and as will provide protection from claims set forth below which may arise out of or result from Contractor's performance of the Work and Contractor's other obligations under the Contract Documents, whether it is to be performed by Contractor, any Subcontractor or Supplier, or by anyone directly or indirectly employed by any of them to perform any of the Work, or by anyone for whose acts any of them may be liable:

1. claims under workers' compensation, disability benefits, and other similar employee benefit acts;

2. claims for damages because of bodily injury, occupational sickness or disease, or death of Contractor's employees;

3. claims for damages because of bodily injury, sickness or disease, or death of any person other than Contractor's employees;

4. claims for damages insured by reasonably available personal injury liability coverage which are sustained:

   a. by any person as a result of an offense directly or indirectly related to the employment of such person by Contractor, or

   b. by any other person for any other reason;

5. claims for damages, other than to the Work itself, because of injury to or destruction of tangible property wherever located, including loss of use resulting therefrom; and

6. claims for damages because of bodily injury or death of any person or property damage arising out of the ownership, maintenance or use of any motor vehicle.

B. The policies of insurance required by this Paragraph 5.04 shall:

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1. with respect to insurance required by Paragraphs 5.04.A.3 through 5.04.A.6 inclusive, be written on an occurrence basis, include as additional insureds (subject to any customary exclusion regarding professional liability) Owner and Engineer, and any other individuals or entities identified in the Supplementary Conditions, all of whom shall be listed as additional insureds, and include coverage for the respective officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of all such additional insureds, and the insurance afforded to these additional insureds shall provide primary coverage for all claims covered thereby;

2. include at least the specific coverages and be written for not less than the limits of liability provided in the Supplementary Conditions or required by Laws or Regulations, whichever is greater;

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

4. contain a provision or endorsement that the coverage afforded will not be canceled, materially changed or renewal refused until at least 30 days prior written notice has been given to Owner and Contractor and to each other additional insured identified in the Supplementary Conditions to whom a certificate of insurance has been issued (and the certificates of insurance furnished by the Contractor pursuant to Paragraph 5.03 will so provide);

5. remain in effect at least until final payment and at all times thereafter when Contractor may be correcting, removing, or replacing defective Work in accordance with Paragraph 13.07; and

6. include completed operations coverage:

    a. Such insurance shall remain in effect for two years after final payment.

    b. Contractor shall furnish Owner and each other additional insured identified in the Supplementary Conditions, to whom a certificate of insurance has been issued, evidence satisfactory to Owner and any such additional insured of continuation of such insurance at final payment and one year thereafter.

5.05 *Owner's Liability Insurance*

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

5.06 *Property Insurance*

A. Unless otherwise provided in the Supplementary Conditions, Owner shall purchase and maintain property insurance upon the Work at the Site in the amount of the full replacement cost thereof (subject to such deductible amounts as may be provided in the Supplementary Conditions or required by Laws and Regulations). This insurance shall:

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1. include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee;

2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss or damage to the Work, temporary buildings, falsework, and materials and equipment in transit, and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by the Supplementary Conditions.

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

4. cover materials and equipment stored at the Site or at another location that was agreed to in writing by Owner prior to being incorporated in the Work, provided that such materials and equipment have been included in an Application for Payment recommended by Engineer;

5. allow for partial utilization of the Work by Owner;

6. include testing and startup; and

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

B. Owner shall purchase and maintain such equipment breakdown insurance or additional property insurance as may be required by the Supplementary Conditions or Laws and Regulations which will include the interests of Owner, Contractor, Subcontractors, and Engineer, and any other individuals or entities identified in the Supplementary Conditions, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them, each of whom is deemed to have an insurable interest and shall be listed as a loss payee.

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

D. Owner shall not be responsible for purchasing and maintaining any property insurance specified in this Paragraph 5.06 to protect the interests of Contractor, Subcontractors, or others in the Work to the extent of any deductible amounts that are identified in the Supplementary Conditions. The risk of loss within such identified deductible amount will be borne by Contractor, Subcontractors, or others suffering any such loss, and if any of them wishes property

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

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

5.07 *Waiver of Rights*

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

B. Owner waives all rights against Contractor, Subcontractors, and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them for:

1. loss due to business interruption, loss of use, or other consequential loss extending beyond direct physical loss or damage to Owner's property or the Work caused by, arising out of, or resulting from fire or other perils whether or not insured by Owner; and

2. loss or damage to the completed Project or part thereof caused by, arising out of, or resulting from fire or other insured peril or cause of loss covered by any property insurance maintained on the completed Project or part thereof by Owner during partial utilization pursuant to Paragraph 14.05, after Substantial Completion pursuant to Paragraph 14.04, or after final payment pursuant to Paragraph 14.07.

C. Any insurance policy maintained by Owner covering any loss, damage or consequential loss referred to in Paragraph 5.07.B shall contain provisions to the effect that in the event of payment of any such loss, damage, or consequential loss, the insurers will have no rights of recovery

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

5.08 *Receipt and Application of Insurance Proceeds*

A. Any insured loss under the policies of insurance required by Paragraph 5.06 will be adjusted with Owner and made payable to Owner as fiduciary for the loss payees, as their interests may appear, subject to the requirements of any applicable mortgage clause and of Paragraph 5.08.B. Owner shall deposit in a separate account any money so received and shall distribute it in accordance with such agreement as the parties in interest may reach. If no other special agreement is reached, the damaged Work shall be repaired or replaced, the moneys so received applied on account thereof, and the Work and the cost thereof covered by an appropriate Change Order.

B. Owner as fiduciary shall have power to adjust and settle any loss with the insurers unless one of the parties in interest shall object in writing within 15 days after the occurrence of loss to Owner's exercise of this power. If such objection be made, Owner as fiduciary shall make settlement with the insurers in accordance with such agreement as the parties in interest may reach. If no such agreement among the parties in interest is reached, Owner as fiduciary shall adjust and settle the loss with the insurers and, if required in writing by any party in interest, Owner as fiduciary shall give bond for the proper performance of such duties.

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

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

5.10 *Partial Utilization, Acknowledgment of Property Insurer*

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

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ARTICLE 6 – CONTRACTOR'S RESPONSIBILITIES

6.01 *Supervision and Superintendence*

A. Contractor shall supervise, inspect, and direct the Work competently and efficiently, devoting such attention thereto and applying such skills and expertise as may be necessary to perform the Work in accordance with the Contract Documents. Contractor shall be solely responsible for the means, methods, techniques, sequences, and procedures of construction. Contractor shall not be responsible for the negligence of Owner or Engineer in the design or specification of a specific means, method, technique, sequence, or procedure of construction which is shown or indicated in and expressly required by the Contract Documents.

B. At all times during the progress of the Work, Contractor shall assign a competent resident superintendent who shall not be replaced without written notice to Owner and Engineer except under extraordinary circumstances.

6.02 *Labor; Working Hours*

A. Contractor shall provide competent, suitably qualified personnel to survey and lay out the Work and perform construction as required by the Contract Documents. Contractor shall at all times maintain good discipline and order at the Site.

B. Except as otherwise required for the safety or protection of persons or the Work or property at the Site or adjacent thereto, and except as otherwise stated in the Contract Documents, all Work at the Site shall be performed during regular working hours. Contractor will not permit the performance of Work on a Saturday, Sunday, or any legal holiday without Owner's written consent (which will not be unreasonably withheld) given after prior written notice to Engineer.

6.03 *Services, Materials, and Equipment*

A. Unless otherwise specified in the Contract Documents, Contractor shall provide and assume full responsibility for all services, materials, equipment, labor, transportation, construction equipment and machinery, tools, appliances, fuel, power, light, heat, telephone, water, sanitary facilities, temporary facilities, and all other facilities and incidentals necessary for the performance, testing, start-up, and completion of the Work.

B. All materials and equipment incorporated into the Work shall be as specified or, if not specified, shall be of good quality and new, except as otherwise provided in the Contract Documents. All special warranties and guarantees required by the Specifications shall expressly run to the benefit of Owner. If required by Engineer, Contractor shall furnish satisfactory evidence (including reports of required tests) as to the source, kind, and quality of materials and equipment.

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

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6.04 *Progress Schedule*

A. Contractor shall adhere to the Progress Schedule established in accordance with Paragraph 2.07 as it may be adjusted from time to time as provided below.

1. Contractor shall submit to Engineer for acceptance (to the extent indicated in Paragraph 2.07) proposed adjustments in the Progress Schedule that will not result in changing the Contract Times. Such adjustments will comply with any provisions of the General Requirements applicable thereto.

2. Proposed adjustments in the Progress Schedule that will change the Contract Times shall be submitted in accordance with the requirements of Article 12. Adjustments in Contract Times may only be made by a Change Order.

6.05 *Substitutes and "Or-Equals"*

A. Whenever an item of material or equipment is specified or described in the Contract Documents by using the name of a proprietary item or the name of a particular Supplier, the specification or description is intended to establish the type, function, appearance, and quality required. Unless the specification or description contains or is followed by words reading that no like, equivalent, or "or-equal" item or no substitution is permitted, other items of material or equipment or material or equipment of other Suppliers may be submitted to Engineer for review under the circumstances described below.

1. *"Or-Equal" Items:* If in Engineer's sole discretion an item of material or equipment proposed by Contractor is functionally equal to that named and sufficiently similar so that no change in related Work will be required, it may be considered by Engineer as an "or-equal" item, in which case review and approval of the proposed item may, in Engineer's sole discretion, be accomplished without compliance with some or all of the requirements for approval of proposed substitute items. For the purposes of this Paragraph 6.05.A.1, a proposed item of material or equipment will be considered functionally equal to an item so named if:

a. in the exercise of reasonable judgment Engineer determines that:

1) it is at least equal in materials of construction, quality, durability, appearance, strength, and design characteristics;

2) it will reliably perform at least equally well the function and achieve the results imposed by the design concept of the completed Project as a functioning whole; and

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

b. Contractor certifies that, if approved and incorporated into the Work:

1) there will be no increase in cost to the Owner or increase in Contract Times; and

2) it will conform substantially to the detailed requirements of the item named in the Contract Documents.

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2. *Substitute Items:*

   a. If in Engineer's sole discretion an item of material or equipment proposed by Contractor does not qualify as an "or-equal" item under Paragraph 6.05.A.1, it will be considered a proposed substitute item.

   b. Contractor shall submit sufficient information as provided below to allow Engineer to determine if the item of material or equipment proposed is essentially equivalent to that named and an acceptable substitute therefor. Requests for review of proposed substitute items of material or equipment will not be accepted by Engineer from anyone other than Contractor.

   c. The requirements for review by Engineer will be as set forth in Paragraph 6.05.A.2.d, as supplemented by the General Requirements, and as Engineer may decide is appropriate under the circumstances.

   d. Contractor shall make written application to Engineer for review of a proposed substitute item of material or equipment that Contractor seeks to furnish or use. The application:

      1) shall certify that the proposed substitute item will:

         a) perform adequately the functions and achieve the results called for by the general design,

         b) be similar in substance to that specified, and

         c) be suited to the same use as that specified;

      2) will state:

         a) the extent, if any, to which the use of the proposed substitute item will prejudice Contractor's achievement of Substantial Completion on time,

         b) whether use of the proposed substitute item in the Work will require a change in any of the Contract Documents (or in the provisions of any other direct contract with Owner for other work on the Project) to adapt the design to the proposed substitute item, and

         c) whether incorporation or use of the proposed substitute item in connection with the Work is subject to payment of any license fee or royalty;

      3) will identify:

         a) all variations of the proposed substitute item from that specified, and

         b) available engineering, sales, maintenance, repair, and replacement services; and

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4) shall contain an itemized estimate of all costs or credits that will result directly or indirectly from use of such substitute item, including costs of redesign and claims of other contractors affected by any resulting change.

B. *Substitute Construction Methods or Procedures:* If a specific means, method, technique, sequence, or procedure of construction is expressly required by the Contract Documents, Contractor may furnish or utilize a substitute means, method, technique, sequence, or procedure of construction approved by Engineer. Contractor shall submit sufficient information to allow Engineer, in Engineer's sole discretion, to determine that the substitute proposed is equivalent to that expressly called for by the Contract Documents. The requirements for review by Engineer will be similar to those provided in Paragraph 6.05.A.2.

C. *Engineer's Evaluation:* Engineer will be allowed a reasonable time within which to evaluate each proposal or submittal made pursuant to Paragraphs 6.05.A and 6.05.B. Engineer may require Contractor to furnish additional data about the proposed substitute item. Engineer will be the sole judge of acceptability. No "or equal" or substitute will be ordered, installed or utilized until Engineer's review is complete, which will be evidenced by a Change Order in the case of a substitute and an approved Shop Drawing for an "or equal." Engineer will advise Contractor in writing of any negative determination.

D. *Special Guarantee:* Owner may require Contractor to furnish at Contractor's expense a special performance guarantee or other surety with respect to any substitute.

E. *Engineer's Cost Reimbursement*: Engineer will record Engineer's costs in evaluating a substitute proposed or submitted by Contractor pursuant to Paragraphs 6.05.A.2 and 6.05.B. Whether or not Engineer approves a substitute so proposed or submitted by Contractor, Contractor shall reimburse Owner for the reasonable charges of Engineer for evaluating each such proposed substitute. Contractor shall also reimburse Owner for the reasonable charges of Engineer for making changes in the Contract Documents (or in the provisions of any other direct contract with Owner) resulting from the acceptance of each proposed substitute.

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

6.06 *Concerning Subcontractors, Suppliers, and Others*

A. Contractor shall not employ any Subcontractor, Supplier, or other individual or entity (including those acceptable to Owner as indicated in Paragraph 6.06.B), whether initially or as a replacement, against whom Owner may have reasonable objection. Contractor shall not be required to employ any Subcontractor, Supplier, or other individual or entity to furnish or perform any of the Work against whom Contractor has reasonable objection.

B. If the Supplementary Conditions require the identity of certain Subcontractors, Suppliers, or other individuals or entities to be submitted to Owner in advance for acceptance by Owner by a specified date prior to the Effective Date of the Agreement, and if Contractor has submitted a list thereof in accordance with the Supplementary Conditions, Owner's acceptance (either in writing or by failing to make written objection thereto by the date indicated for acceptance or objection in the Bidding Documents or the Contract Documents) of any such Subcontractor, Supplier, or

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

C. Contractor shall be fully responsible to Owner and Engineer for all acts and omissions of the Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work just as Contractor is responsible for Contractor's own acts and omissions. Nothing in the Contract Documents:

1. shall create for the benefit of any such Subcontractor, Supplier, or other individual or entity any contractual relationship between Owner or Engineer and any such Subcontractor, Supplier or other individual or entity; nor

2. shall create any obligation on the part of Owner or Engineer to pay or to see to the payment of any moneys due any such Subcontractor, Supplier, or other individual or entity except as may otherwise be required by Laws and Regulations.

D. Contractor shall be solely responsible for scheduling and coordinating the Work of Subcontractors, Suppliers, and other individuals or entities performing or furnishing any of the Work under a direct or indirect contract with Contractor.

E. Contractor shall require all Subcontractors, Suppliers, and such other individuals or entities performing or furnishing any of the Work to communicate with Engineer through Contractor.

F. The divisions and sections of the Specifications and the identifications of any Drawings shall not control Contractor in dividing the Work among Subcontractors or Suppliers or delineating the Work to be performed by any specific trade.

G. All Work performed for Contractor by a Subcontractor or Supplier will be pursuant to an appropriate agreement between Contractor and the Subcontractor or Supplier which specifically binds the Subcontractor or Supplier to the applicable terms and conditions of the Contract Documents for the benefit of Owner and Engineer. Whenever any such agreement is with a Subcontractor or Supplier who is listed as a loss payee on the property insurance provided in Paragraph 5.06, the agreement between the Contractor and the Subcontractor or Supplier will contain provisions whereby the Subcontractor or Supplier waives all rights against Owner, Contractor, Engineer, and all other individuals or entities identified in the Supplementary Conditions to be listed as insureds or loss payees (and the officers, directors, members, partners, employees, agents, consultants, and subcontractors of each and any of them) for all losses and damages caused by, arising out of, relating to, or resulting from any of the perils or causes of loss covered by such policies and any other property insurance applicable to the Work. If the insurers on any such policies require separate waiver forms to be signed by any Subcontractor or Supplier, Contractor will obtain the same.

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6.07 *Patent Fees and Royalties*

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

B. To the fullest extent permitted by Laws and Regulations, Owner shall indemnify and hold harmless Contractor, and its officers, directors, members, partners, employees, agents, consultants, and subcontractors from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals, and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device specified in the Contract Documents, but not identified as being subject to payment of any license fee or royalty to others required by patent rights or copyrights.

C. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any infringement of patent rights or copyrights incident to the use in the performance of the Work or resulting from the incorporation in the Work of any invention, design, process, product, or device not specified in the Contract Documents.

6.08 *Permits*

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

6.09 *Laws and Regulations*

A. Contractor shall give all notices required by and shall comply with all Laws and Regulations applicable to the performance of the Work. Except where otherwise expressly required by applicable Laws and Regulations, neither Owner nor Engineer shall be responsible for monitoring Contractor's compliance with any Laws or Regulations.

B. If Contractor performs any Work knowing or having reason to know that it is contrary to Laws or Regulations, Contractor shall bear all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all

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

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

6.10 *Taxes*

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

6.11 *Use of Site and Other Areas*

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

1. Contractor shall confine construction equipment, the storage of materials and equipment, and the operations of workers to the Site and other areas permitted by Laws and Regulations, and shall not unreasonably encumber the Site and other areas with construction equipment or other materials or equipment. Contractor shall assume full responsibility for any damage to any such land or area, or to the owner or occupant thereof, or of any adjacent land or areas resulting from the performance of the Work.

2. Should any claim be made by any such owner or occupant because of the performance of the Work, Contractor shall promptly settle with such other party by negotiation or otherwise resolve the claim by arbitration or other dispute resolution proceeding or at law.

3. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to any claim or action, legal or equitable, brought by any such owner or occupant against Owner, Engineer, or any other party indemnified hereunder to the extent caused by or based upon Contractor's performance of the Work.

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

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

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

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

6.12 *Record Documents*

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

6.13 *Safety and Protection*

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

1. all persons on the Site or who may be affected by the Work;

2. all the Work and materials and equipment to be incorporated therein, whether in storage on or off the Site; and

3. other property at the Site or adjacent thereto, including trees, shrubs, lawns, walks, pavements, roadways, structures, utilities, and Underground Facilities not designated for removal, relocation, or replacement in the course of construction.

B. Contractor shall comply with all applicable Laws and Regulations relating to the safety of persons or property, or to the protection of persons or property from damage, injury, or loss; and shall erect and maintain all necessary safeguards for such safety and protection. Contractor shall notify owners of adjacent property and of Underground Facilities and other utility owners when prosecution of the Work may affect them, and shall cooperate with them in the protection, removal, relocation, and replacement of their property.

C. Contractor shall comply with the applicable requirements of Owner's safety programs, if any. The Supplementary Conditions identify any Owner's safety programs that are applicable to the Work.

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D. Contractor shall inform Owner and Engineer of the specific requirements of Contractor's safety program with which Owner's and Engineer's employees and representatives must comply while at the Site.

E. All damage, injury, or loss to any property referred to in Paragraph 6.13.A.2 or 6.13.A.3 caused, directly or indirectly, in whole or in part, by Contractor, any Subcontractor, Supplier, or any other individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, shall be remedied by Contractor (except damage or loss attributable to the fault of Drawings or Specifications or to the acts or omissions of Owner or Engineer or anyone employed by any of them, or anyone for whose acts any of them may be liable, and not attributable, directly or indirectly, in whole or in part, to the fault or negligence of Contractor or any Subcontractor, Supplier, or other individual or entity directly or indirectly employed by any of them).

F. Contractor's duties and responsibilities for safety and for protection of the Work shall continue until such time as all the Work is completed and Engineer has issued a notice to Owner and Contractor in accordance with Paragraph 14.07.B that the Work is acceptable (except as otherwise expressly provided in connection with Substantial Completion).

6.14 *Safety Representative*

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

6.15 *Hazard Communication Programs*

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

6.16 *Emergencies*

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

6.17 *Shop Drawings and Samples*

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

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1. *Shop Drawings:*

    a. Submit number of copies specified in the General Requirements.

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

2. *Samples:*

    a. Submit number of Samples specified in the Specifications.

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

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

C. *Submittal Procedures:*

1. Before submitting each Shop Drawing or Sample, Contractor shall have:

    a. reviewed and coordinated each Shop Drawing or Sample with other Shop Drawings and Samples and with the requirements of the Work and the Contract Documents;

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

    c. determined and verified the suitability of all materials offered with respect to the indicated application, fabrication, shipping, handling, storage, assembly, and installation pertaining to the performance of the Work; and

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

2. Each submittal shall bear a stamp or specific written certification that Contractor has satisfied Contractor's obligations under the Contract Documents with respect to Contractor's review and approval of that submittal.

3. With each submittal, Contractor shall give Engineer specific written notice of any variations that the Shop Drawing or Sample may have from the requirements of the Contract Documents. This notice shall be both a written communication separate from the Shop

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

D. *Engineer's Review:*

1. Engineer will provide timely review of Shop Drawings and Samples in accordance with the Schedule of Submittals acceptable to Engineer. Engineer's review and approval will be only to determine if the items covered by the submittals will, after installation or incorporation in the Work, conform to the information given in the Contract Documents and be compatible with the design concept of the completed Project as a functioning whole as indicated by the Contract Documents.

2. Engineer's review and approval will not extend to means, methods, techniques, sequences, or procedures of construction (except where a particular means, method, technique, sequence, or procedure of construction is specifically and expressly called for by the Contract Documents) or to safety precautions or programs incident thereto. The review and approval of a separate item as such will not indicate approval of the assembly in which the item functions.

3. Engineer's review and approval shall not relieve Contractor from responsibility for any variation from the requirements of the Contract Documents unless Contractor has complied with the requirements of Paragraph 6.17.C.3 and Engineer has given written approval of each such variation by specific written notation thereof incorporated in or accompanying the Shop Drawing or Sample. Engineer's review and approval shall not relieve Contractor from responsibility for complying with the requirements of Paragraph 6.17.C.1.

E. *Resubmittal Procedures:*

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

6.18 *Continuing the Work*

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

6.19 *Contractor's General Warranty and Guarantee*

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

B. Contractor's warranty and guarantee hereunder excludes defects or damage caused by:

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1. abuse, modification, or improper maintenance or operation by persons other than Contractor, Subcontractors, Suppliers, or any other individual or entity for whom Contractor is responsible; or

2. normal wear and tear under normal usage.

C. Contractor's obligation to perform and complete the Work in accordance with the Contract Documents shall be absolute. None of the following will constitute an acceptance of Work that is not in accordance with the Contract Documents or a release of Contractor's obligation to perform the Work in accordance with the Contract Documents:

1. observations by Engineer;

2. recommendation by Engineer or payment by Owner of any progress or final payment;

3. the issuance of a certificate of Substantial Completion by Engineer or any payment related thereto by Owner;

4. use or occupancy of the Work or any part thereof by Owner;

5. any review and approval of a Shop Drawing or Sample submittal or the issuance of a notice of acceptability by Engineer;

6. any inspection, test, or approval by others; or

7. any correction of defective Work by Owner.

6.20 *Indemnification*

A. To the fullest extent permitted by Laws and Regulations, Contractor shall indemnify and hold harmless Owner and Engineer, and the officers, directors, members, partners, employees, agents, consultants and subcontractors of each and any of them from and against all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to the performance of the Work, provided that any such claim, cost, loss, or damage is attributable to bodily injury, sickness, disease, or death, or to injury to or destruction of tangible property (other than the Work itself), including the loss of use resulting therefrom but only to the extent caused by any negligent act or omission of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work or anyone for whose acts any of them may be liable .

B. In any and all claims against Owner or Engineer or any of their officers, directors, members, partners, employees, agents, consultants, or subcontractors by any employee (or the survivor or personal representative of such employee) of Contractor, any Subcontractor, any Supplier, or any individual or entity directly or indirectly employed by any of them to perform any of the Work, or anyone for whose acts any of them may be liable, the indemnification obligation under Paragraph 6.20.A shall not be limited in any way by any limitation on the amount or type of damages, compensation, or benefits payable by or for Contractor or any such Subcontractor,

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

C. The indemnification obligations of Contractor under Paragraph 6.20.A shall not extend to the liability of Engineer and Engineer's officers, directors, members, partners, employees, agents, consultants and subcontractors arising out of:

1. the preparation or approval of, or the failure to prepare or approve maps, Drawings, opinions, reports, surveys, Change Orders, designs, or Specifications; or

2. giving directions or instructions, or failing to give them, if that is the primary cause of the injury or damage.

6.21 *Delegation of Professional Design Services*

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

B. If professional design services or certifications by a design professional related to systems, materials or equipment are specifically required of Contractor by the Contract Documents, Owner and Engineer will specify all performance and design criteria that such services must satisfy. Contractor shall cause such services or certifications to be provided by a properly licensed professional, whose signature and seal shall appear on all drawings, calculations, specifications, certifications, Shop Drawings and other submittals prepared by such professional. Shop Drawings and other submittals related to the Work designed or certified by such professional, if prepared by others, shall bear such professional's written approval when submitted to Engineer.

C. Owner and Engineer shall be entitled to rely upon the adequacy, accuracy and completeness of the services, certifications or approvals performed by such design professionals, provided Owner and Engineer have specified to Contractor all performance and design criteria that such services must satisfy.

D. Pursuant to this Paragraph 6.21, Engineer's review and approval of design calculations and design drawings will be only for the limited purpose of checking for conformance with performance and design criteria given and the design concept expressed in the Contract Documents. Engineer's review and approval of Shop Drawings and other submittals (except design calculations and design drawings) will be only for the purpose stated in Paragraph 6.17.D.1.

E. Contractor shall not be responsible for the adequacy of the performance or design criteria required by the Contract Documents.

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ARTICLE 7 – OTHER WORK AT THE SITE

7.01 *Related Work at Site*

A. Owner may perform other work related to the Project at the Site with Owner's employees, or through other direct contracts therefor, or have other work performed by utility owners. If such other work is not noted in the Contract Documents, then:

1. written notice thereof will be given to Contractor prior to starting any such other work; and

2. if Owner and Contractor are unable to agree on entitlement to or on the amount or extent, if any, of any adjustment in the Contract Price or Contract Times that should be allowed as a result of such other work, a Claim may be made therefor as provided in Paragraph 10.05.

B. Contractor shall afford each other contractor who is a party to such a direct contract, each utility owner, and Owner, if Owner is performing other work with Owner's employees, proper and safe access to the Site, provide a reasonable opportunity for the introduction and storage of materials and equipment and the execution of such other work, and properly coordinate the Work with theirs. Contractor shall do all cutting, fitting, and patching of the Work that may be required to properly connect or otherwise make its several parts come together and properly integrate with such other work. Contractor shall not endanger any work of others by cutting, excavating, or otherwise altering such work; provided, however, that Contractor may cut or alter others' work with the written consent of Engineer and the others whose work will be affected. The duties and responsibilities of Contractor under this Paragraph are for the benefit of such utility owners and other contractors to the extent that there are comparable provisions for the benefit of Contractor in said direct contracts between Owner and such utility owners and other contractors.

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

7.02 *Coordination*

A. If Owner intends to contract with others for the performance of other work on the Project at the Site, the following will be set forth in Supplementary Conditions:

1. the individual or entity who will have authority and responsibility for coordination of the activities among the various contractors will be identified;

2. the specific matters to be covered by such authority and responsibility will be itemized; and

3. the extent of such authority and responsibilities will be provided.

B. Unless otherwise provided in the Supplementary Conditions, Owner shall have sole authority and responsibility for such coordination.

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7.03 *Legal Relationships*

A. Paragraphs 7.01.A and 7.02 are not applicable for utilities not under the control of Owner.

B. Each other direct contract of Owner under Paragraph 7.01.A shall provide that the other contractor is liable to Owner and Contractor for the reasonable direct delay and disruption costs incurred by Contractor as a result of the other contractor's wrongful actions or inactions.

C. Contractor shall be liable to Owner and any other contractor under direct contract to Owner for the reasonable direct delay and disruption costs incurred by such other contractor as a result of Contractor's wrongful action or inactions.

ARTICLE 8 – OWNER'S RESPONSIBILITIES

8.01 *Communications to Contractor*

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

8.02 *Replacement of Engineer*

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

8.03 *Furnish Data*

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

8.04 *Pay When Due*

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

8.05 *Lands and Easements; Reports and Tests*

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

8.06 *Insurance*

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

8.07 *Change Orders*

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

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8.08 *Inspections, Tests, and Approvals*

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

8.09 *Limitations on Owner's Responsibilities*

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

8.10 *Undisclosed Hazardous Environmental Condition*

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

8.11 *Evidence of Financial Arrangements*

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

8.12 *Compliance with Safety Program*

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

ARTICLE 9 – ENGINEER'S STATUS DURING CONSTRUCTION

9.01 *Owner's Representative*

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

9.02 *Visits to Site*

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

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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.

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B. In connection with Engineer's authority, and limitations thereof, as to design calculations and design drawings submitted in response to a delegation of professional design services, if any, see Paragraph 6.21.

C. In connection with Engineer's authority as to Change Orders, see Articles 10, 11, and 12.

D. In connection with Engineer's authority as to Applications for Payment, see Article 14.

9.07 *Determinations for Unit Price Work*

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

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

A. Engineer will be the initial interpreter of the requirements of the Contract Documents and judge of the acceptability of the Work thereunder. All matters in question and other matters between Owner and Contractor arising prior to the date final payment is due relating to the acceptability of the Work, and the interpretation of the requirements of the Contract Documents pertaining to the performance of the Work, will be referred initially to Engineer in writing within 30 days of the event giving rise to the question.

B. Engineer will, with reasonable promptness, render a written decision on the issue referred. If Owner or Contractor believes that any such decision entitles them to an adjustment in the Contract Price or Contract Times or both, a Claim may be made under Paragraph 10.05. The date of Engineer's decision shall be the date of the event giving rise to the issues referenced for the purposes of Paragraph 10.05.B.

C. Engineer's written decision on the issue referred will be final and binding on Owner and Contractor, subject to the provisions of Paragraph 10.05.

D. When functioning as interpreter and judge under this Paragraph 9.08, Engineer will not show partiality to Owner or Contractor and will not be liable in connection with any interpretation or decision rendered in good faith in such capacity.

9.09 *Limitations on Engineer's Authority and Responsibilities*

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

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B. Engineer will not supervise, direct, control, or have authority over or be responsible for Contractor's means, methods, techniques, sequences, or procedures of construction, or the safety precautions and programs incident thereto, or for any failure of Contractor to comply with Laws and Regulations applicable to the performance of the Work. Engineer will not be responsible for Contractor's failure to perform the Work in accordance with the Contract Documents.

C. Engineer will not be responsible for the acts or omissions of Contractor or of any Subcontractor, any Supplier, or of any other individual or entity performing any of the Work.

D. Engineer's review of the final Application for Payment and accompanying documentation and all maintenance and operating instructions, schedules, guarantees, bonds, certificates of inspection, tests and approvals, and other documentation required to be delivered by Paragraph 14.07.A will only be to determine generally that their content complies with the requirements of, and in the case of certificates of inspections, tests, and approvals that the results certified indicate compliance with, the Contract Documents.

E. The limitations upon authority and responsibility set forth in this Paragraph 9.09 shall also apply to the Resident Project Representative, if any, and assistants, if any.

9.10 *Compliance with Safety Program*

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

ARTICLE 10 – CHANGES IN THE WORK; CLAIMS

10.01 *Authorized Changes in the Work*

A. Without invalidating the Contract and without notice to any surety, Owner may, at any time or from time to time, order additions, deletions, or revisions in the Work by a Change Order, or a Work Change Directive. Upon receipt of any such document, Contractor shall promptly proceed with the Work involved which will be performed under the applicable conditions of the Contract Documents (except as otherwise specifically provided).

B. If Owner and Contractor are unable to agree on entitlement to, or on the amount or extent, if any, of an adjustment in the Contract Price or Contract Times, or both, that should be allowed as a result of a Work Change Directive, a Claim may be made therefor as provided in Paragraph 10.05.

10.02 *Unauthorized Changes in the Work*

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

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10.03 *Execution of Change Orders*

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

1. changes in the Work which are: (i) ordered by Owner pursuant to Paragraph 10.01.A, (ii) required because of acceptance of defective Work under Paragraph 13.08.A or Owner's correction of defective Work under Paragraph 13.09, or (iii) agreed to by the parties;

2. changes in the Contract Price or Contract Times which are agreed to by the parties, including any undisputed sum or amount of time for Work actually performed in accordance with a Work Change Directive; and

3. changes in the Contract Price or Contract Times which embody the substance of any written decision rendered by Engineer pursuant to Paragraph 10.05; provided that, in lieu of executing any such Change Order, an appeal may be taken from any such decision in accordance with the provisions of the Contract Documents and applicable Laws and Regulations, but during any such appeal, Contractor shall carry on the Work and adhere to the Progress Schedule as provided in Paragraph 6.18.A.

10.04 *Notification to Surety*

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

10.05 *Claims*

A. *Engineer's Decision Required*: All Claims, except those waived pursuant to Paragraph 14.09, shall be referred to the Engineer for decision. A decision by Engineer shall be required as a condition precedent to any exercise by Owner or Contractor of any rights or remedies either may otherwise have under the Contract Documents or by Laws and Regulations in respect of such Claims.

B. *Notice:* Written notice stating the general nature of each Claim shall be delivered by the claimant to Engineer and the other party to the Contract promptly (but in no event later than 30 days) after the start of the event giving rise thereto. The responsibility to substantiate a Claim shall rest with the party making the Claim. Notice of the amount or extent of the Claim, with supporting data shall be delivered to the Engineer and the other party to the Contract within 60 days after the start of such event (unless Engineer allows additional time for claimant to submit additional or more accurate data in support of such Claim). A Claim for an adjustment in Contract Price shall be prepared in accordance with the provisions of Paragraph 12.01.B. A Claim for an adjustment in Contract Times shall be prepared in accordance with the provisions of Paragraph 12.02.B. Each Claim shall be accompanied by claimant's written statement that the adjustment claimed is the entire adjustment to which the claimant believes it is entitled as a result of said event. The

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

C. *Engineer's Action*: Engineer will review each Claim and, within 30 days after receipt of the last submittal of the claimant or the last submittal of the opposing party, if any, take one of the following actions in writing:

1. deny the Claim in whole or in part;

2. approve the Claim; or

3. notify the parties that the Engineer is unable to resolve the Claim if, in the Engineer's sole discretion, it would be inappropriate for the Engineer to do so. For purposes of further resolution of the Claim, such notice shall be deemed a denial.

D. In the event that Engineer does not take action on a Claim within said 30 days, the Claim shall be deemed denied.

E. Engineer's written action under Paragraph 10.05.C or denial pursuant to Paragraphs 10.05.C.3 or 10.05.D will be final and binding upon Owner and Contractor, unless Owner or Contractor invoke the dispute resolution procedure set forth in Article 16 within 30 days of such action or denial.

F. No Claim for an adjustment in Contract Price or Contract Times will be valid if not submitted in accordance with this Paragraph 10.05.

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

11.01 *Cost of the Work*

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

1. Payroll costs for employees in the direct employ of Contractor in the performance of the Work under schedules of job classifications agreed upon by Owner and Contractor. Such employees shall include, without limitation, superintendents, foremen, and other personnel employed full time on the Work. Payroll costs for employees not employed full time on the Work shall be apportioned on the basis of their time spent on the Work. Payroll costs shall include, but not be limited to, salaries and wages plus the cost of fringe benefits, which shall include social security contributions, unemployment, excise, and payroll taxes, workers' compensation, health and retirement benefits, bonuses, sick leave, vacation and holiday pay applicable thereto. The expenses of performing Work outside of regular working hours, on

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

2. Cost of all materials and equipment furnished and incorporated in the Work, including costs of transportation and storage thereof, and Suppliers' field services required in connection therewith. All cash discounts shall accrue to Contractor unless Owner deposits funds with Contractor with which to make payments, in which case the cash discounts shall accrue to Owner. All trade discounts, rebates and refunds and returns from sale of surplus materials and equipment shall accrue to Owner, and Contractor shall make provisions so that they may be obtained.

3. Payments made by Contractor to Subcontractors for Work performed by Subcontractors. If required by Owner, Contractor shall obtain competitive bids from subcontractors acceptable to Owner and Contractor and shall deliver such bids to Owner, who will then determine, with the advice of Engineer, which bids, if any, will be acceptable. If any subcontract provides that the Subcontractor is to be paid on the basis of Cost of the Work plus a fee, the Subcontractor's Cost of the Work and fee shall be determined in the same manner as Contractor's Cost of the Work and fee as provided in this Paragraph 11.01.

4. Costs of special consultants (including but not limited to engineers, architects, testing laboratories, surveyors, attorneys, and accountants) employed for services specifically related to the Work.

5. Supplemental costs including the following:

   a. The proportion of necessary transportation, travel, and subsistence expenses of Contractor's employees incurred in discharge of duties connected with the Work.

   b. Cost, including transportation and maintenance, of all materials, supplies, equipment, machinery, appliances, office, and temporary facilities at the Site, and hand tools not owned by the workers, which are consumed in the performance of the Work, and cost, less market value, of such items used but not consumed which remain the property of Contractor.

   c. Rentals of all construction equipment and machinery, and the parts thereof whether rented from Contractor or others in accordance with rental agreements approved by Owner with the advice of Engineer, and the costs of transportation, loading, unloading, assembly, dismantling, and removal thereof. All such costs shall be in accordance with the terms of said rental agreements. The rental of any such equipment, machinery, or parts shall cease when the use thereof is no longer necessary for the Work.

   d. Sales, consumer, use, and other similar taxes related to the Work, and for which Contractor is liable, as imposed by Laws and Regulations.

   e. Deposits lost for causes other than negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable, and royalty payments and fees for permits and licenses.

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f. Losses and damages (and related expenses) caused by damage to the Work, not compensated by insurance or otherwise, sustained by Contractor in connection with the performance of the Work (except losses and damages within the deductible amounts of property insurance established in accordance with Paragraph 5.06.D), provided such losses and damages have resulted from causes other than the negligence of Contractor, any Subcontractor, or anyone directly or indirectly employed by any of them or for whose acts any of them may be liable. Such losses shall include settlements made with the written consent and approval of Owner. No such losses, damages, and expenses shall be included in the Cost of the Work for the purpose of determining Contractor's fee.

g. The cost of utilities, fuel, and sanitary facilities at the Site.

h. Minor expenses such as telegrams, long distance telephone calls, telephone service at the Site, express and courier services, and similar petty cash items in connection with the Work.

i. The costs of premiums for all bonds and insurance Contractor is required by the Contract Documents to purchase and maintain.

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

1. Payroll costs and other compensation of Contractor's officers, executives, principals (of partnerships and sole proprietorships), general managers, safety managers, engineers, architects, estimators, attorneys, auditors, accountants, purchasing and contracting agents, 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.

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.

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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.

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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;

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c. where one or more tiers of subcontracts are on the basis of Cost of the Work plus a fee and no fixed fee is agreed upon, the intent of Paragraphs 12.01.C.2.a and 12.01.C.2.b is that the Subcontractor who actually performs the Work, at whatever tier, will be paid a fee of 15 percent of the costs incurred by such Subcontractor under Paragraphs 11.01.A.1 and 11.01.A.2 and that any higher tier Subcontractor and Contractor will each be paid a fee of five percent of the amount paid to the next lower tier Subcontractor;

d. no fee shall be payable on the basis of costs itemized under Paragraphs 11.01.A.4, 11.01.A.5, and 11.01.B;

e. the amount of credit to be allowed by Contractor to Owner for any change which results in a net decrease in cost will be the amount of the actual net decrease in cost plus a deduction in Contractor's fee by an amount equal to five percent of such net decrease; and

f. when both additions and credits are involved in any one change, the adjustment in Contractor's fee shall be computed on the basis of the net change in accordance with Paragraphs 12.01.C.2.a through 12.01.C.2.e, inclusive.

12.02 *Change of Contract Times*

A. The Contract Times may only be changed by a Change Order. Any Claim for an adjustment in the Contract Times shall be based on written notice submitted by the party making the Claim to the Engineer and the other party to the Contract in accordance with the provisions of Paragraph 10.05.

B. Any adjustment of the Contract Times covered by a Change Order or any Claim for an adjustment in the Contract Times will be determined in accordance with the provisions of this Article 12.

12.03 *Delays*

A. Where Contractor is prevented from completing any part of the Work within the Contract Times due to delay beyond the control of Contractor, the Contract Times will be extended in an amount equal to the time lost due to such delay if a Claim is made therefor as provided in Paragraph 12.02.A. Delays beyond the control of Contractor shall include, but not be limited to, acts or neglect by Owner, acts or neglect of utility owners or other contractors performing other work as contemplated by Article 7, fires, floods, epidemics, abnormal weather conditions, or acts of God.

B. If Owner, Engineer, or other contractors or utility owners performing other work for Owner as contemplated by Article 7, or anyone for whom Owner is responsible, delays, disrupts, or interferes with the performance or progress of the Work, then Contractor shall be entitled to an equitable adjustment in the Contract Price or the Contract Times, or both. Contractor's entitlement to an adjustment of the Contract Times is conditioned on such adjustment being essential to Contractor's ability to complete the Work within the Contract Times.

C. If Contractor is delayed in the performance or progress of the Work by fire, flood, epidemic, abnormal weather conditions, acts of God, acts or failures to act of utility owners not under the

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

D. Owner, Engineer, and their officers, directors, members, partners, employees, agents, consultants, or subcontractors shall not be liable to Contractor for any claims, costs, losses, or damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Contractor on or in connection with any other project or anticipated project.

E. Contractor shall not be entitled to an adjustment in Contract Price or Contract Times for delays within the control of Contractor. Delays attributable to and within the control of a Subcontractor or Supplier shall be deemed to be delays within the control of Contractor.

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

13.01 *Notice of Defects*

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

13.02 *Access to Work*

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

13.03 *Tests and Inspections*

A. Contractor shall give Engineer timely notice of readiness of the Work for all required inspections, tests, or approvals and shall cooperate with inspection and testing personnel to facilitate required inspections or tests.

B. Owner shall employ and pay for the services of an independent testing laboratory to perform all inspections, tests, or approvals required by the Contract Documents except:

1. for inspections, tests, or approvals covered by Paragraphs 13.03.C and 13.03.D below;

2. that costs incurred in connection with tests or inspections conducted pursuant to Paragraph 13.04.B shall be paid as provided in Paragraph 13.04.C; and

3. as otherwise specifically provided in the Contract Documents.

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C. If Laws or Regulations of any public body having jurisdiction require any Work (or part thereof) specifically to be inspected, tested, or approved by an employee or other representative of such public body, Contractor shall assume full responsibility for arranging and obtaining such inspections, tests, or approvals, pay all costs in connection therewith, and furnish Engineer the required certificates of inspection or approval.

D. Contractor shall be responsible for arranging and obtaining and shall pay all costs in connection with any inspections, tests, or approvals required for Owner's and Engineer's acceptance of materials or equipment to be incorporated in the Work; or acceptance of materials, mix designs, or equipment submitted for approval prior to Contractor's purchase thereof for incorporation in the Work. Such inspections, tests, or approvals shall be performed by organizations acceptable to Owner and Engineer.

E. If any Work (or the work of others) that is to be inspected, tested, or approved is covered by Contractor without written concurrence of Engineer, Contractor shall, if requested by Engineer, uncover such Work for observation.

F. Uncovering Work as provided in Paragraph 13.03.E shall be at Contractor's expense unless Contractor has given Engineer timely notice of Contractor's intention to cover the same and Engineer has not acted with reasonable promptness in response to such notice.

13.04 *Uncovering Work*

A. If any Work is covered contrary to the written request of Engineer, it must, if requested by Engineer, be uncovered for Engineer's observation and replaced at Contractor's expense.

B. If Engineer considers it necessary or advisable that covered Work be observed by Engineer or inspected or tested by others, Contractor, at Engineer's request, shall uncover, expose, or otherwise make available for observation, inspection, or testing as Engineer may require, that portion of the Work in question, furnishing all necessary labor, material, and equipment.

C. If it is found that the uncovered Work is defective, Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such uncovering, exposure, observation, inspection, and testing, and of satisfactory replacement or reconstruction (including but not limited to all costs of repair or replacement of work of others); and Owner shall be entitled to an appropriate decrease in the Contract Price. If the parties are unable to agree as to the amount thereof, Owner may make a Claim therefor as provided in Paragraph 10.05.

D. If the uncovered Work is not found to be defective, Contractor shall be allowed an increase in the Contract Price or an extension of the Contract Times, or both, directly attributable to such uncovering, exposure, observation, inspection, testing, replacement, and reconstruction. If the parties are unable to agree as to the amount or extent thereof, Contractor may make a Claim therefor as provided in Paragraph 10.05.

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13.05 *Owner May Stop the Work*

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

13.06 *Correction or Removal of Defective Work*

A. Promptly after receipt of written notice, Contractor shall correct all defective Work, whether or not fabricated, installed, or completed, or, if the Work has been rejected by Engineer, remove it from the Project and replace it with Work that is not defective. Contractor shall pay all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) arising out of or relating to such correction or removal (including but not limited to all costs of repair or replacement of work of others).

B. When correcting defective Work under the terms of this Paragraph 13.06 or Paragraph 13.07, Contractor shall take no action that would void or otherwise impair Owner's special warranty and guarantee, if any, on said Work.

13.07 *Correction Period*

A. If within one year after the date of Substantial Completion (or such longer period of time as may be prescribed by the terms of any applicable special guarantee required by the Contract Documents) or by any specific provision of the Contract Documents, any Work is found to be defective, or if the repair of any damages to the land or areas made available for Contractor's use by Owner or permitted by Laws and Regulations as contemplated in Paragraph 6.11.A is found to be defective, Contractor shall promptly, without cost to Owner and in accordance with Owner's written instructions:

1. repair such defective land or areas; or

2. correct such defective Work; or

3. if the defective Work has been rejected by Owner, remove it from the Project and replace it with Work that is not defective, and

4. satisfactorily correct or repair or remove and replace any damage to other Work, to the work of others or other land or areas resulting therefrom.

B. If Contractor does not promptly comply with the terms of Owner's written instructions, or in an emergency where delay would cause serious risk of loss or damage, Owner may have the defective Work corrected or repaired or may have the rejected Work removed and replaced. All claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute

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

C. In special circumstances where a particular item of equipment is placed in continuous service before Substantial Completion of all the Work, the correction period for that item may start to run from an earlier date if so provided in the Specifications.

D. Where defective Work (and damage to other Work resulting therefrom) has been corrected or removed and replaced under this Paragraph 13.07, the correction period hereunder with respect to such Work will be extended for an additional period of one year after such correction or removal and replacement has been satisfactorily completed.

E. Contractor's obligations under this Paragraph 13.07 are in addition to any other obligation or warranty. The provisions of this Paragraph 13.07 shall not be construed as a substitute for, or a waiver of, the provisions of any applicable statute of limitation or repose.

13.08 *Acceptance of Defective Work*

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

13.09 *Owner May Correct Defective Work*

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

B. In exercising the rights and remedies under this Paragraph 13.09, Owner shall proceed expeditiously. In connection with such corrective or remedial action, Owner may exclude Contractor from all or part of the Site, take possession of all or part of the Work and suspend Contractor's services related thereto, take possession of Contractor's tools, appliances, construction equipment and machinery at the Site, and incorporate in the Work all materials and

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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

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

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

B. *Review of Applications:*

1. Engineer will, within 10 days after receipt of each Application for Payment, either indicate in writing a recommendation of payment and present the Application to Owner or return the Application to Contractor indicating in writing Engineer's reasons for refusing to recommend payment. In the latter case, Contractor may make the necessary corrections and resubmit the Application.

2. Engineer's recommendation of any payment requested in an Application for Payment will constitute a representation by Engineer to Owner, based on Engineer's observations of the executed Work as an experienced and qualified design professional, and on Engineer's review of the Application for Payment and the accompanying data and schedules, that to the best of Engineer's knowledge, information and belief:

   a. the Work has progressed to the point indicated;

   b. the quality of the Work is generally in accordance with the Contract Documents (subject to an evaluation of the Work as a functioning whole prior to or upon Substantial Completion, the results of any subsequent tests called for in the Contract Documents, a final determination of quantities and classifications for Unit Price Work under Paragraph 9.07, and any other qualifications stated in the recommendation); and

   c. the conditions precedent to Contractor's being entitled to such payment appear to have been fulfilled in so far as it is Engineer's responsibility to observe the Work.

3. By recommending any such payment Engineer will not thereby be deemed to have represented that:

   a. inspections made to check the quality or the quantity of the Work as it has been performed have been exhaustive, extended to every aspect of the Work in progress, or involved detailed inspections of the Work beyond the responsibilities specifically assigned to Engineer in the Contract Documents; or

   b. there may not be other matters or issues between the parties that might entitle Contractor to be paid additionally by Owner or entitle Owner to withhold payment to Contractor.

4. Neither Engineer's review of Contractor's Work for the purposes of recommending payments nor Engineer's recommendation of any payment, including final payment, will impose responsibility on Engineer:

   a. to supervise, direct, or control the Work, or

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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

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d. Owner has actual knowledge of the occurrence of any of the events enumerated in Paragraphs 14.02.B.5.a through 14.02.B.5.c or Paragraph 15.02.A.

2. If Owner refuses to make payment of the full amount recommended by Engineer, Owner will give Contractor immediate written notice (with a copy to Engineer) stating the reasons for such action and promptly pay Contractor any amount remaining after deduction of the amount so withheld. Owner shall promptly pay Contractor the amount so withheld, or any adjustment thereto agreed to by Owner and Contractor, when Contractor remedies the reasons for such action.

3. Upon a subsequent determination that Owner's refusal of payment was not justified, the amount wrongfully withheld shall be treated as an amount due as determined by Paragraph 14.02.C.1 and subject to interest as provided in the Agreement.

14.03 *Contractor's Warranty of Title*

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

14.04 *Substantial Completion*

A. When Contractor considers the entire Work ready for its intended use Contractor shall notify Owner and Engineer in writing that the entire Work is substantially complete (except for items specifically listed by Contractor as incomplete) and request that Engineer issue a certificate of Substantial Completion.

B. Promptly after Contractor's notification, Owner, Contractor, and Engineer shall make an inspection of the Work to determine the status of completion. If Engineer does not consider the Work substantially complete, Engineer will notify Contractor in writing giving the reasons therefor.

C. If Engineer considers the Work substantially complete, Engineer will deliver to Owner a tentative certificate of Substantial Completion which shall fix the date of Substantial Completion. There shall be attached to the certificate a tentative list of items to be completed or corrected before final payment. Owner shall have seven days after receipt of the tentative certificate during which to make written objection to Engineer as to any provisions of the certificate or attached list. If, after considering such objections, Engineer concludes that the Work is not substantially complete, Engineer will, within 14 days after submission of the tentative certificate to Owner, notify Contractor in writing, stating the reasons therefor. If, after consideration of Owner's objections, Engineer considers the Work substantially complete, Engineer will, within said 14 days, execute and deliver to Owner and Contractor a definitive certificate of Substantial Completion (with a revised tentative list of items to be completed or corrected) reflecting such changes from the tentative certificate as Engineer believes justified after consideration of any objections from Owner.

D. At the time of delivery of the tentative certificate of Substantial Completion, Engineer will deliver to Owner and Contractor a written recommendation as to division of responsibilities

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

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

14.05 *Partial Utilization*

A. Prior to Substantial Completion of all the Work, Owner may use or occupy any substantially completed part of the Work which has specifically been identified in the Contract Documents, or which Owner, Engineer, and Contractor agree constitutes a separately functioning and usable part of the Work that can be used by Owner for its intended purpose without significant interference with Contractor's performance of the remainder of the Work, subject to the following conditions:

1. Owner at any time may request Contractor in writing to permit Owner to use or occupy any such part of the Work which Owner believes to be ready for its intended use and substantially complete. If and when Contractor agrees that such part of the Work is substantially complete, Contractor, Owner, and Engineer will follow the procedures of Paragraph 14.04.A through D for that part of the Work.

2. Contractor at any time may notify Owner and Engineer in writing that Contractor considers any such part of the Work ready for its intended use and substantially complete and request Engineer to issue a certificate of Substantial Completion for that part of the Work.

3. Within a reasonable time after either such request, Owner, Contractor, and Engineer shall make an inspection of that part of the Work to determine its status of completion. If Engineer does not consider that part of the Work to be substantially complete, Engineer will notify Owner and Contractor in writing giving the reasons therefor. If Engineer considers that part of the Work to be substantially complete, the provisions of Paragraph 14.04 will apply with respect to certification of Substantial Completion of that part of the Work and the division of responsibility in respect thereof and access thereto.

4. No use or occupancy or separate operation of part of the Work may occur prior to compliance with the requirements of Paragraph 5.10 regarding property insurance.

14.06 *Final Inspection*

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

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14.07 *Final Payment*

A. *Application for Payment:*

1. After Contractor has, in the opinion of Engineer, satisfactorily completed all corrections identified during the final inspection and has delivered, in accordance with the Contract Documents, all maintenance and operating instructions, schedules, guarantees, bonds, certificates or other evidence of insurance, certificates of inspection, marked-up record documents (as provided in Paragraph 6.12), and other documents, Contractor may make application for final payment following the procedure for progress payments.

2. The final Application for Payment shall be accompanied (except as previously delivered) by:

   a. all documentation called for in the Contract Documents, including but not limited to the evidence of insurance required by Paragraph 5.04.B.6;

   b. consent of the surety, if any, to final payment;

   c. a list of all Claims against Owner that Contractor believes are unsettled; and

   d. complete and legally effective releases or waivers (satisfactory to Owner) of all Lien rights arising out of or Liens filed in connection with the Work.

3. In lieu of the releases or waivers of Liens specified in Paragraph 14.07.A.2 and as approved by Owner, Contractor may furnish receipts or releases in full and an affidavit of Contractor that: (i) the releases and receipts include all labor, services, material, and equipment for which a Lien could be filed; and (ii) all payrolls, material and equipment bills, and other indebtedness connected with the Work for which Owner might in any way be responsible, or which might in any way result in liens or other burdens on Owner's property, have been paid or otherwise satisfied. If any Subcontractor or Supplier fails to furnish such a release or receipt in full, Contractor may furnish a bond or other collateral satisfactory to Owner to indemnify Owner against any Lien.

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

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

C. *Payment Becomes Due:*

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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:

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1. Contractor's persistent failure to perform the Work in accordance with the Contract Documents (including, but not limited to, failure to supply sufficient skilled workers or suitable materials or equipment or failure to adhere to the Progress Schedule established under Paragraph 2.07 as adjusted from time to time pursuant to Paragraph 6.04);

2. Contractor's disregard of Laws or Regulations of any public body having jurisdiction;

3. Contractor's repeated disregard of the authority of Engineer; or

4. Contractor's violation in any substantial way of any provisions of the Contract Documents.

B. If one or more of the events identified in Paragraph 15.02.A occur, Owner may, after giving Contractor (and surety) seven days written notice of its intent to terminate the services of Contractor:

1. exclude Contractor from the Site, and take possession of the Work and of all Contractor's tools, appliances, construction equipment, and machinery at the Site, and use the same to the full extent they could be used by Contractor (without liability to Contractor for trespass or conversion);

2. incorporate in the Work all materials and equipment stored at the Site or for which Owner has paid Contractor but which are stored elsewhere; and

3. complete the Work as Owner may deem expedient.

C. If Owner proceeds as provided in Paragraph 15.02.B, Contractor shall not be entitled to receive any further payment until the Work is completed. If the unpaid balance of the Contract Price exceeds all claims, costs, losses, and damages (including but not limited to all fees and charges of engineers, architects, attorneys, and other professionals and all court or arbitration or other dispute resolution costs) sustained by Owner arising out of or relating to completing the Work, such excess will be paid to Contractor. If such claims, costs, losses, and damages exceed such unpaid balance, Contractor shall pay the difference to Owner. Such claims, costs, losses, and damages incurred by Owner will be reviewed by Engineer as to their reasonableness and, when so approved by Engineer, incorporated in a Change Order. When exercising any rights or remedies under this Paragraph, Owner shall not be required to obtain the lowest price for the Work performed.

D. Notwithstanding Paragraphs 15.02.B and 15.02.C, Contractor's services will not be terminated if Contractor begins within seven days of receipt of notice of intent to terminate to correct its failure to perform and proceeds diligently to cure such failure within no more than 30 days of receipt of said notice.

E. Where Contractor's services have been so terminated by Owner, the termination will not affect any rights or remedies of Owner against Contractor then existing or which may thereafter accrue. Any retention or payment of moneys due Contractor by Owner will not release Contractor from liability.

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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.

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ARTICLE 16 – DISPUTE RESOLUTION

16.01 *Methods and Procedures*

A. Either Owner or Contractor may request mediation of any Claim submitted to Engineer for a decision under Paragraph 10.05 before such decision becomes final and binding. The mediation will be governed by the Construction Industry Mediation Rules of the American Arbitration Association in effect as of the Effective Date of the Agreement. The request for mediation shall be submitted in writing to the American Arbitration Association and the other party to the Contract. Timely submission of the request shall stay the effect of Paragraph 10.05.E.

B. Owner and Contractor shall participate in the mediation process in good faith. The process shall be concluded within 60 days of filing of the request. The date of termination of the mediation shall be determined by application of the mediation rules referenced above.

C. If the Claim is not resolved by mediation, Engineer's action under Paragraph 10.05.C or a denial pursuant to Paragraphs 10.05.C.3 or 10.05.D shall become final and binding 30 days after termination of the mediation unless, within that time period, Owner or Contractor:

1. elects in writing to invoke any dispute resolution process provided for in the Supplementary Conditions; or

2. agrees with the other party to submit the Claim to another dispute resolution process; or

3. gives written notice to the other party of the intent to submit the Claim to a court of competent jurisdiction.

ARTICLE 17 – MISCELLANEOUS

17.01 *Giving Notice*

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

1. delivered in person to the individual or to a member of the firm or to an officer of the corporation for whom it is intended; or

2. delivered at or sent by registered or certified mail, postage prepaid, to the last business address known to the giver of the notice.

17.02 *Computation of Times*

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

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17.03 *Cumulative Remedies*

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

17.04 *Survival of Obligations*

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

17.05 *Controlling Law*

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

17.06 *Headings*

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

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SUPPLEMENTARY CONDITIONS

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

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

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

SC-2.02 ***Copies of Documents***

DELETE Paragraph 2.02.A in its entirety and INSERT the following in its place:

A. Owner shall furnish to Contractor up to three (3) printed or hard copies of the Drawings and Project Manual and one set in electronic format. Additional copies will be furnished upon request at the cost of reproduction.

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

DELETE Paragraph GC-2.03 in its entirety and INSERT the following:

The Contract Times will commence 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.

SC-3.04 ***Amending and Supplementing Contract documents***

A. DELETE Work Change Directive.

B.1 DELETE Field Order and INSERT Field Transmittal Memorandum.

SC-4.02 ***Subsurface and Physical Conditions***

DELETE Paragraphs 4.02.A and 4.02.B in their entirety and INSERT the following:

A. No reports of explorations or tests of subsurface conditions at or contiguous to the Site, or drawings of physical conditions relating to existing surface or subsurface structures at the Site, were conducted specifically for this Project.

SC-4.04 ***Underground Facilities***

B.2 DELETE Work Change Directive.

SC-4.06 ***Hazardous Environmental Conditions***

DELETE Paragraph 4.06A and 4.06B in their entirety and INSERT the following:

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

B. Not Used.

SC-5.03 ***Certificates of Insurance***

DELETE Paragraph 5.03B in its entirety and INSERT the following:

B. The Contractor's Certificate of Insurance shall name the Owner and the Engineer as additionally insured. The Certificate of Insurance shall clearly state the insurance coverage required is in effect and has not been decreased by claims, if any, paid by the Insurance Company. The Contractor's insurance shall not be canceled or expire without the written consent of the Owner.

SC-5.04 ***Contractor's Liability Insurance***

ADD the following to the last portion of Paragraph 5.04.B.1:

"…and the insurance afforded to these additional insured shall provide primary <u>and non-contributory</u> coverage for all claims covered thereby."

ADD the following new paragraph immediately after Paragraph 5.04.B:

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

1. Workers' Compensation, and related coverages under Paragraphs 5.04.A.1 and A.2 of the General Conditions:
   a. State: Statutory
   b. Applicable Federal (e.g., Longshoreman's): Statutory
   c. Employer's Liability: Statutory
2. Contractor's General Liability under Paragraphs 5.04.A.3 through A.6 of the General Conditions which shall include completed operations and product liability coverages:

a.	General Aggregate	$2,000,000.00
b.	Products-Completed Operations Aggregate	$2,000,000.00
c.	Each Occurrence (BI-PD)	$1,000,000.00
d.	Property Damage liability insurance will provide explosion, collapse, and underground coverages where applicable	
e.	Excess or Umbrella Liability	
	1. General Aggregate	$5,000,000.00
	2. Each Occurrence	$5,000,000.00

f. Fire Damage (each occurrence) $ 50,000.00
g. Medical Expenses (per person) $ 5,000.00

3. Automobile Liability under Paragraph 5.04.A.6 of the General Conditions:
   a. Bodily Injury:
      Each Person $1,000,000.00
      Each Accident $1,000.000.00
   b. Property Damage:
      Each Accident $1,000,000.00
      Combined Single Limit of $1,000,000.00
   c. Excess or Umbrella Liability
      1. General Aggregate $5,000,000.00
      2. Each Occurrence $5,000,000.00

4. The Contractual Liability coverage required by Paragraph 5.04.B.3 of the General Conditions shall provide coverage for not less than the following amounts:
   a. Bodily Injury
      Each Accident $1,000,000.00
      Annual Aggregate $2,000,000.00
   b. Property Damage
      Each Accident $1,000,000.00
      Annual Aggregate $2,000,000.00
   c. Excess and Umbrella Liability
      1. General Aggregate $5,000,000.00
      2. Each Occurrence $5,000,000.00

SC-5.06 ***Property Insurance***

DELETE Paragraph 5.06.A in its entirety and INSERT the following in its place:

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. This insurance shall:

   1. 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 loss payee;
   2. be written on a Builder's Risk "all-risk" policy form that shall at least include insurance for physical loss and damage to the Work, temporary buildings, falsework, and materials and equipment in transit and shall insure against at least the following perils or causes of loss: fire, lightning, extended coverage, theft, vandalism and malicious mischief, earthquake, collapse, debris removal, demolition occasioned by enforcement of Laws and Regulations, water damage (other than that caused by flood), and such other perils or causes of loss as may be specifically required by these 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;
7. be maintained in effect until final payment is made unless otherwise agreed to in writing by Owner, Contractor, and Engineer with 30 days written notice to each other loss payee to whom a certificate of insurance has been issued; and
8. comply with the requirements of Paragraph 5.06.C of the General Conditions.

DELETE Paragraph 5.06.B and REPLACE with the following:

B. Contractor shall purchase and maintain equipment breakdown insurance, and any other additional property insurance required by Laws and Regulations, which insurance will include the interest of Owner, Contractor, Subcontractors, Engineer, and Engineer's Consultants 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 a loss payee.

DELETE paragraph 5.06E in its entirety.

SC-6.01 ***Concerning Supervision and Superintendence***

ADD the following to Paragraph 6.01.B:

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.

ADD the following Paragraph 6.01.C:

C. Prior to the Acceptance of Contractor’s Bid, the Owner may require the Contractor to submit the identity and related experience of the Contractor's proposed Superintendent and Project Management Personnel in order to better evaluate the Bid and Contractor’s past performance. Submitted information shall be accompanied by an experience statement with pertinent information regarding similar projects and other evidence of qualification for each such individual. If Owner or Engineer, after due investigation, has objection to any proposed Personnel, Owner may, before the Notice of Award is given, request Contractor to submit a substitute, without an increase in the Bid Price. If the Contractor declines to make any such substitution, Owner may award the Contract to the next most responsive Bidder that proposes to use acceptable Personnel. Any Personnel 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. The Contractor’s proposed replacement of the Superintendent or Project Management Personnel shall also be subject to these requirements.

SC-6.02 ***Concerning Contractor's Labor***

ADD the following to Paragraph 6.02.A:

Owner and Engineer reserve the right to require the Contractor to remove from the Project labor personnel (including subcontractors) who the Owner or Engineer determine to not be competent, suitably qualified, or reasonably disciplined in the performance of the Work.

Concerning Work Hours

ADD the following to Paragraph 6.02.B:

Work shall not be permitted at night, on Sundays, or on legal holidays without prior written approval of the Engineer. Contractor shall request permission to work at night, on Sundays, or on legal holidays a minimum of 48 hours in advance, except in the case of emergency and then only to such extent as it is absolutely necessary and with written approval of the Engineer (Owner).

If the Contractor works on Saturdays, Sundays, or legal holidays, the Contractor agrees to reimburse the Owner for the Engineer's Resident Project Representative costs in the amount of One Hundred Dollars ($100.00) per hour. Said reimbursement shall be in the form of a Change Order reducing the Contract Amount due the Contractor.

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

DELETE paragraph 6.06B in its entirety and INSERT the following:

B. As part of the Bid Attachment, the Owner may require the identity of the Contractor's proposed Subcontractors and Suppliers of Equipment and Materials in order to better evaluate the Bid. Where the identification of Suppliers is required, supply only one name per equipment or material items. Owner's acceptance (either in writing or by failing to make written objection thereto) 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 at no additional cost. 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.

ADD a new paragraph immediately after Paragraph 6.06.G:

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-6.08 ***Permits***

Contractor shall obtain and pay for all construction permits and licenses except those listed in Section 01010 – Summary of Work

SC-6.10 ***Taxes***

ADD a new paragraph immediately after Paragraph 6.10.A:

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

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

SC-6.12 ***Record Documents***

A. DELETE Work Change Directive and Field Orders and INSERT Field Transmittal Memorandum.

SC-6.16 ***Emergencies***

A. DELETE Work Change Directive and INSERT Field Transmittal Memorandum.

SC-6.17 ***Shop Drawings and Samples***

ADD the following new paragraphs immediately after Paragraph 6.17.E:

F. Contractor shall furnish required submittals with sufficient information and accuracy in order to obtain required approval of an item with no more than two submittals. Engineer will record Engineer's 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.

G. In the event Contractor requests a change of a previously approved item, Contractor shall reimburse Owner for Engineer's charges for its review time unless the need for such change is beyond the control of Contractor.

SC-9.03 ***Project Representative***

ADD a new paragraph immediately following Paragraph 9.03A:

B. The duties, responsibilities and limitations of the authority of the Resident Project Representative shall be as shown on the attached Exhibit "A".

SC-9.04 ***Authorized Variations in Work***

A. DELETE Field Order and INSERT Field Transmittal Memorandum.

SC-10.01 ***Authorized Changes in the Work***

A. DELETE Work Change Directive and INSERT Field Transmittal Memorandum.

SC-10.03 ***Execution of Change Orders***

A.2. DELETE Work Change Directive and INSERT Field Transmittal Memorandum.

SC-12.01 ***Change of Contract Price***

DELETE the semicolon at the end of GC 12.01.C.2.c, and ADD the following language:

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

SC-14.01 ***Schedule of Values***

INSERT the following Paragraph 14.01.B:

B. Detail Breakdown of Contract Amount. Except in cases where unit prices form the basis for payment under the contact, the Contractor shall, within ten days of receipt of Notice to Proceed, submit a complete and detailed Schedule of Values, which is an itemization of the Contract Amount showing the value assigned to each item of the Work. The Schedule of Values shall be approved by the Owner and Engineer. In the event the Schedule of Values appears to be front-loaded or unbalanced, in the opinion of the Owner or the Engineer, Contractor shall provide detailed documentation to support the values in question, or revise the Schedule of Values to address Owner and Engineer's concerns.

Upon approval of the itemization of the Contract Amount by the Engineer, it shall be used as the basis for all Requests for Payment. The value assigned to each item of the Work may be considered in evaluating additions and deletions in the scope of Work. The Contractor will prepare all requests for payment with input from the Engineer and Resident Project Representative.

SC-14.02 ***Progress Payments***

DELETE Paragraph 14.02.A.1 in its entirety and INSERT the following:

1. At the date established for each progress payment (but not more often than once a month), Contractor shall submit to the Engineer a Request for Payment for work done and materials delivered and stored on the site. Each Request for Payment shall be computed on the basis of work completed on all items listed

in the detailed Itemization of Contract (or on unit prices), less retainage. The Contractor shall furnish the Engineer and Owner all reasonable information required for obtaining the necessary data relative to the progress and execution of the work. 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 another location agreed to in writing, the Request for Payment shall be accompanied by evidence that the materials and equipment are covered by appropriate property insurance, all of which must be satisfactory to the Owner. The Request for Payment must be submitted on the Payment Application Form provided by the Engineer.

DELETE Paragraph 14.02.C.1 in its entirety and INSERT the following:

1. Thirty (30) 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, unless payment is provided through a governmental funding agency. The time limit for payment from a funding agency to become due shall be in accordance with the respective funding agency's timeline for approval and disbursement of funds. If payment from the funding agency is disbursed through the Owner, payment to the Contractor shall become due ten (10) days after Owner's receipt of funds from the funding agency.

INSERT the following Article 14.02.E:

E. Other Payment to Contractor Provisions

1. Uncorrected Work. Should the Owner direct the Contractor not to correct work that has been damaged or that was not performed in accordance with the Contract Documents, an equitable deduction from the Contract Amount shall be made to compensate the Owner for the Uncorrected work.
2. Payment for Removal of Rejected Work and Materials. The removal of work and materials rejected in accordance with paragraph 13.06.A of the General Conditions and the re-execution of acceptable work by the Contractor shall be at the expense of the Contractor, and he shall pay the cost of replacing the work of other contractors destroyed or damaged by the removal of the rejected work or materials and the subsequent replacement of acceptable work.
   a. Removal by Owner: Removal of rejected work or materials and storage of materials by the Owner, in accordance with paragraph 13.09.A of the General Conditions, shall be paid by the Contractor within 30 days after written notice to pay is given by the Owner. If the Contractor does not pay the expenses of such removal and after ten (10) days written notice being given by the Owner of his intent to sell the materials, the Owner may sell the materials at auction or at private sale and will pay the Contractor the net proceeds therefrom after deducting all the costs and expenses that should have been borne by the Contractor.
3. Procedure for payment associated with approved Extra Work shall be the same as that for original Contract Work.

SC-14.04 ***Substantial Completion***

INSERT Paragraph 14.04.C.1 as follows:

1. Upon Substantial Completion, Owner shall pay an amount sufficient to increase total payments to Contractor to 100 percent of the Work completed, less such amounts as Engineer shall determine in accordance with Paragraph 14.02.B.5 of the General Conditions, less 200 percent of Engineer's estimate of the value of Work to be completed or corrected as shown on the tentative list of items to be completed or corrected attached to the certificate of Substantial Completion, and less any applicable liquidated damages. This amount will constitute final payment for the project as described in paragraphs GC-14.07 through GC-14.08 of the General Conditions..

Miscellaneous

Insert Paragraphs as follows:

SC-17.07 ***Operations within Right-of-Way***

In public thoroughfares, all operations of the Contractor, including those of a temporary nature, must be confined within the applicable right-of-way limits. The Contractor shall be solely responsible for any encroachment on private property beyond the right-of-way limits described in the General Conditions.

SC-17.08 ***Operations within Private Easement***

On private property in a private easement, all operations of the Contractor, including those of a temporary nature, must be confined within the applicable easement limits. The Contractor shall be solely responsible for any encroachment on private property beyond the easement limits, he shall be responsible for any damage to private property and shall indemnify and hold the Owner and the Engineer harmless against all claims for damages that may be brought against the Owner or the Engineer by a third party. Contractor shall notify the property owner(s) at least two (2) working days prior to the start of construction on any portion of work on private property.

SC-17.09 ***Liquidated Damages***

In the event the Contractor fails to complete satisfactorily the entire work contemplated and provided for under this contract on or before the dates of completion determined as described elsewhere herein, the Owner shall, in the form of a Change Order, deduct from the monies due the Contractor the sums as outlined in Article 3 of the "Sample Form" of the Agreement. If the monies due the Contractor are less than the amount of such liquidated damages, then the Contractor or his surety shall pay the balance to the Owner.

SC-17.10 ***Failure to Perform***

In the event of failure of the Contractor to perform in accordance with the Contract Documents, or there is a breach of the Agreement by the Contractor, Contractor shall

be liable for payment to the Owner for the legal, engineering, and other related expenses incurred by the Owner in conjunction with the Contractor's failure to perform or Contractor's breach of the Agreement.

SC-17.11 ***Occupational Safety and Health Act of 1970***

These construction documents and the joint and several phases of construction hereby contemplated are to be governed, at all times, by applicable provisions of the federal laws, including but not limited to, the latest amendments of the following:

Williams - Steiger Occupational Safety and Health Act of 1980, Public Law 91-596.

Part 1910 - Occupational Safety and Health Standards, Chapter XVII of Title 29, code of Federal Regulations.

Indiana Occupational Safety and Health Administration (IOSHA) OSHA Safety and Health Standards for the Construction Industry (29 CFR Part 1926) with Amendments as of August 1, 1991 Including 29 CFR Part 1910 General Industry Safety and health Standards Applicable to Construction.

SC-17.12 ***Maintenance Bond***

A Maintenance Bond is not required.

-END-

EXHIBIT "A"

DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF RESIDENT PROJECT REPRESENTATIVE

Prepared by

ENGINEERS' JOINT CONTRACT DOCUMENTS COMMITTEE

and

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PROFESSIONAL ENGINEERS IN PRIVATE PRACTICE
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AMERICAN SOCIETY OF CIVIL ENGINEERS

A LISTING OF THE DUTIES, RESPONSIBILITIES AND LIMITATIONS OF AUTHORITY OF THE RESIDENT PROJECT REPRESENTATIVE**

**unless otherwise noted

ENGINEER shall furnish a Resident Project Representative (RPR), assistants and other field staff to assist ENGINEER in observing performance of the Work of the CONTRACTOR.

Through more extensive on-site observations of the Work in progress and field checks of materials and equipment by the RPR and assistants, ENGINEER shall endeavor to provide further protection for OWNER against defects and deficiencies in the Work; but, the furnishing of such services will not make ENGINEER responsible for or give ENGINEER control over construction means, methods, techniques, sequences or procedures or for safety precautions or programs, or responsibility for CONTRACTOR's failure to perform the Work in accordance with the Contract Documents.

The duties and responsibilities of the RPR are limited to those of ENGINEER in ENGINEER's agreement with the OWNER and in the construction Contract Documents, and are further limited and described as follows:

A. General

RPR will be ENGINEER's employee or agent at the Site, will act as directed by and under the supervision of ENGINEER, and will confer with ENGINEER regarding RPR's actions. RPR's dealings in matters pertaining to the Work in general shall be with ENGINEER and CONTRACTOR. RPR's dealings with Subcontractors shall be through or with the full knowledge and approval of CONTRACTOR.

B. Duties and Responsibilities of RPR

1. *Schedules* – Review the Progress Schedule, Schedule of Shop Drawing and Sample submittals, and Schedule of Values prepared by CONTRACTOR and consult with ENGINEER concerning acceptability.

2. *Conferences and Meetings* – Attend meetings with CONTRACTOR, such as preconstruction conferences, progress meetings, job conferences and other project related meetings and prepare and circulate copies of minutes thereof.

3. *Liaison* –
   a. Serve as ENGINEER's liaison with CONTRACTOR; working principally through CONTRACTOR's authorized representative and assist in providing information regarding the intent of the Contract Documents.
   b. Assist ENGINEER in serving as OWNER's liaison with CONTRACTOR when CONTRACTOR's operations affect OWNER's on-Site operations.
   c. Assist in obtaining from OWNER additional details or information, when required for proper execution of the Work.

4. *Interpretation of Contract Documents* –
   Report to ENGINEER when clarifications and interpretations of the Contract Documents are needed and transmit to CONTRACTOR clarifications and interpretations as issued by ENGINEER.

5. *Shop Drawings and Samples* –
   a. Record date of receipt of Samples and approved Shop Drawings.
   b. Receive samples, which are furnished at the Site by CONTRACTOR, and notify ENGINEER of availability of Samples for examination.

6. *Modifications* –
   Consider and evaluate CONTRACTOR'S suggestions for modifications in Drawings or Specifications and report such suggestions, together with RPR's recommendations, to ENGINEER. Transmit to CONTRACTOR in writing decisions as issued by ENGINEER.

7. *Review of Work, Rejection of Defective Work* –
   a. Conduct on-site observations of CONTRACTOR's Work in progress to assist ENGINEER in determining if the Work is in general proceeding in accordance with the Contract Documents.
   b. Report to ENGINEER whenever RPR believes that any part of CONRACTOR's work in progress will not produce a completed Project that conforms generally to the Contract Documents or will imperil the integrity of the design concept of the completed Project as a functioning whole as indicated in the Contract Documents, or has been damaged, or does not meet the requirements of any inspection, test or approval required to be made; and advise ENGINEER of that part of work in progress that RPR believes should be corrected or rejected or should be uncovered for observation, or requires special testing, inspection or approval.

8. *Inspections, Tests, and System Startups*-
   a. Verify that tests, equipment and systems startups and operating and maintenance training are conducted in the presence of appropriate OWNER's personnel, and that CONTRACTOR maintains adequate records thereof.

b. Observe, record and report to ENGINEER appropriate details relative to the test procedures and systems startups.

9. *Records* –
   a. Record names, addresses, fax numbers, e-mail addresses, web site locations, and telephone numbers of all CONTRACTORS, Subcontractors and major Suppliers of materials and equipment.
   b. Maintain records for use in preparing Project documentation.

10. *Reports* -
    a. Furnish to ENGINEER periodic reports as required of progress of the Work and of CONTRACTOR's compliance with the progress schedule and schedule of Shop Drawings and Sample submittals.
    b. Draft and recommend to ENGINEER proposed Change Orders, Work Change Directives, and Field Orders. Obtain backup material from CONTRACTOR.
    c. Immediately notify ENGINEER of the occurrence of any Site accidents, emergencies, acts of God endangering the Work, damage to property by fire or other causes, or the discovery of any Hazardous Environmental Condition.

11. *Payment Requests* –
    Review Applications for Payment with CONTRACTOR for compliance with the established procedure for their submission and forward with recommendations to ENGINEER, noting particularly the relationship of the payment requested to the Schedule of Values, Work completed, and materials and equipment delivered at the Site but not incorporated in the Work.

12. *Certificates, Maintenance and Operation Manuals* –
    During the course of the Work, verify that certificates, maintenance and operation manuals and other data required by the Specifications to be assembled and furnished by CONTRACTOR are applicable to the items actually installed and in accordance with Contract Documents, and have these documents delivered to ENGINEER for review and forwarding to OWNER prior to payment for that part of the Work.

13. *Completion* –
    a. Participate in a Substantial Completion inspection, assist in the determination of Substantial Completion and the preparation of lists of items to be completed or corrected.
    b. Participate in a final inspection in the company of ENGINEER, OWNER, and CONTRACTOR and prepare a final list of items to be completed and deficiencies to be remedied.

c. Observe whether all items on final list have been completed or corrected and make recommendations to ENGINEER concerning acceptance and issuance of the Notice of Acceptability of the Work.

C. Limitations of Authority

Resident Project Representative shall not:

1. Authorize any deviation from the Contract Documents or substitution of materials or equipment (including "or-equal" items).
2. Exceed limitations of ENGINEER's authority as set forth in the Contract Documents.
3. Undertake any of the responsibilities of CONTRACTOR, Subcontractors, Suppliers, or CONTRACTOR's superintendent.
4. Advise on, issue directions relative to, or assume control over any aspect of the means, methods, techniques, sequences or procedures of CONTRACTOR's work unless such advice or directions are specifically required by the Contract Documents.
5. Advise on, issue directions regarding, or assume control over safety practices, precautions, and programs in connection with the activites or operations of OWNER or CONTRACTOR.
6. Participate in specialized field or laboratory tests or inspections conducted off-site by others except as specifically authorized by ENGINEER.
7. Accept Shop Drawing or Sample submittals from anyone other than CONTRACTOR.
8. Authorize OWNER to occupy the Project in whole or in part.

DIVISION 1 - GENERAL REQUIREMENTS

SECTION 01010 - SUMMARY OF WORK

PART 1 - GENERAL

1.01 Description

The work shall include the construction of a new chemical feed building including cast-in-place concrete; masonry; installation of chemical piping, connections, and appurtenances; chemical feed pumps; chemical storage tanks; electrical and controls; HVAC; and all associated work, demolition, and restoration for the Project.

The work shall also include the construction at the Wet Weather Facility (WWF) including improvements to the existing Control Chamber, WWF Basin, and WWF Building, which includes cast-in-place concrete; installation of chemical piping, connections, and appurtenances; miscellaneous metals: and all associated work, demolition, and restoration for the project.

1.02 Contract

A. Work shall be constructed under a Lump Sum Contract.

B. Extra compensation will not be allowed for any matter or thing the Contractor might have fully informed himself prior to the bidding. No verbal agreement, understandings, or conversations with an agent or employee of the Owner and/or Engineer either before or after the execution of this Contract shall affect or modify the terms of obligations herein contained.

1.03 Completion

A. Work required by the Contract Documents will commence within 10 days after the date of the Notice to Proceed. The Work shall be substantially complete 240 calendar days thereafter. All Work at the WWF shall be Substantially Complete to allow the facility to be fully operational by March 21, 2015. The Work shall be fully complete within 270 calendar days thereafter unless the period for completion is extended otherwise by the Contract Documents.

B. The Project will be ready for substantial completion review when test and performance evaluations are completed, all work is complete and ready for service and occupancy, proper coatings and stains are dry, interior of all rooms requiring work have been broom cleaned and mopped and the site is clear of construction rubbish and debris.

1.04 Work by Others

A. The Owner reserves the right to let other Contracts in connection with other portions of the project.

1.05 Items to be Provided by Owner

A. None, except those items shown on the Drawings and/or specified herein.

1.06 Coordination

A. Establish order of work, schedule, and working hours for construction, subject to approval of Owner and Engineer, which will assure orderly and expeditious progress of work.

B. Coordinate with plant personnel for work affecting existing plant operations. Schedule construction to minimize interruptions to existing services and inconveniences to others.

1.07 Local Labor and Materials

A. Whenever possible, the Contractor, his subcontractors, material men, or others who employ labor, shall employ labor locally.

B. Purchase materials such as sand, cement, gravel, pipe, steel, lumber, etc., from local dealers wherever such local dealers' prices meet competition's and where such materials meet the Specifications.

1.08 Rights of Access

Provide Engineer, Owner, Environmental Protection Agency, and the State of Indiana will have access to the work wherever it is in preparation or progress. Provide facilities for such access and inspection.

1.09 Safety and Health Regulations for Construction

Follow all employer obligations under Chapter XVII of Title 29, Code of Federal Regulations, Part 1926, otherwise known as "Safety and Health Regulations for Construction and CFR Part 1910.46 Permit Required for Confined Space". Provide the Owner and Engineer the name of the Contractor's Safety Officer, plus the on-site Safety Representative, if other than the Superintendent, as indicated under Article 6.21 of the General Conditions of the Construction Contract.

1.10 Discovery of Hazardous Material

If, during the course of this work, the existence of hazardous material, including asbestos containing material, is observed in the work area, immediately notify the Owner in writing. Do not perform any work pertinent to the hazardous material prior to receipt of special instructions from the Owner.

1.11 Easements

A. All work will be performed on the Owner's property; therefore, no easements are necessary.

1.12 Operations Within Right-of-Way

In public thoroughfares, all operations of the Contractor, including those of temporary nature, must be confined within the applicable right-of-way limits. If the methods of the construction are such as to require the use of land beyond the public thoroughfares, make arrangements with the property owners affected for the use of such additional land. Such additional agreements will not include any liability for the Owner or Engineer and shall have no direct effect on the completion of the project, project cost, or the time of completion.

1.13 Permits

A. The Owner will obtain permits which are related to the design and construction of the completed facilities. Permits obtained by the Owner include, but are not limited to, permits from the following:

1. Indiana Department of Environmental Management

B. Secure all necessary permits or licenses from the city, state or county in connection with construction procedures. Perform construction in full accordance with any and all requirements of the State of Indiana as well as local, county and city or town requirements. Obtain copies of the design permits listed under 1.13 from the Owner and abide by all terms and conditions of the permits.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

-END-

SECTION 01050 - CONSTRUCTION ENGINEERING

PART 1 - GENERAL

1.01 Description

A. Provide Construction Engineering, including layout and verification of existing elevations shown on the Drawings, to complete the Work as described on the Drawings and in these Specifications.

1.02 Survey Data

A. Make all measurements and check all dimensions and elevations necessary for coordination and the proper construction of the Work shown in the Drawings and Specifications, and during the Work make all necessary measurements to prevent misfitting in said Work, and be responsible for the accurate construction of the Work.

PART 2 - MATERIALS

Not Used.

PART 3 - EXECUTION

3.01 Perform all necessary Construction Engineering, including layout and staking, to insure that the Work conforms to the lines, grades, and elevations shown on the Drawings or otherwise specified or required. This includes establishing all necessary lines, points, corners with references for recovery of said items during construction; a level circuit to establish additional benchmarks for use during construction, setting stakes for structures, any other reference points as required for control lines and grades.

3.02 Check and verify all existing elevations shown on the Drawings for existing structures and piping that are affected by the Work. Perform this as soon as possible to allow adequate time for modifications to be made to the Work to account for existing elevations which differ from those shown on the Drawings or in Record Documents. Obtain and verify the elevations of exposed, accessible, or above ground structures and piping before any Work associated with shop drawing submittal preparation associated with those structures or piping begins. Obtain and verify elevations of inaccessible or buried structures, structural components, and piping immediately after excavation has exposed those components. No additional compensation will be made to the Contractor for failure to obtain this information in a timely manner which would have permitted modifications to the Work that would have avoided additional work and cost.

3.03 Furnish all equipment, personnel and materials necessary for performing the Construction Engineering.

3.04 When staking utilities, culverts or inlets, perform the necessary checking to establish location and grade to best fit the conditions.

3.05 Be responsible for the accuracy of the layout and staking and the final result of the construction accuracy.

-END-

SECTION 01090 - REFERENCE STANDARDS

PART 1 - GENERAL

1.01 Summary

A. Section Includes: Construction work, alterations, repairs, mechanical installations and appliances connected therewith shall comply with the State Building rules and regulations of the Indiana Department of Homeland Security Fire and Building Safety Division, Indiana Department of Environmental Management, National Electric Code, Uniform Building Code, local municipal ordinances and other statutory provisions pertaining to this class of work; such rules, regulations and ordinances are to be considered part of these Specifications.

B. The work performed under this contract shall also conform to the following requirements:

1. Indiana State Construction Industry Safety Code
2. Indiana Department of Homeland Security Fire and Building Safety Division

C. Fees for licenses shall be paid by the Contractor.

1.02 Reference Abbreviations

Reference to a technical society, trade association or standards setting organization may be made in the Specifications by abbreviations in accordance with the following list:

AABC	Associated Air Balance Council
AAR	Association of American Railroads
AAMA	American Architectural Manufacturers Association
AASHTO	American Association of State Highway and Transportation Officials
AATCC	American Association of Textile Chemists and Colorists
ACI	American Concrete Institute
ADC	Air Diffusion Council
AFBMA	Anti-Friction Bearing Manufacturers Association
A-E	Architect/Engineer
AGA	American Gas Association
AHAM	Association of Home Appliance Manufacturers
AIA	American Institute of Architects
AISC	American Institute of Steel Construction
AISI	American Iron and Steel Institute
AMCA	Air Movement and Control Association International, Inc.
ANSI	American National Standards Institute
APA	The Engineered Wood Association
ARI	American Refrigeration Institute
AREMA	The American Railway Engineering and Maintenance-of-Way Association
ASCE	American Society of Civil Engineers
ASHRAE	American Society of Heating, Refrigerating and Air Conditioning Engineers
ASLA	American Society of Landscape Architects
ASME	American Society of Mechanical Engineers

ASSE	American Society of Safety Engineers
ASTM	American Society for Testing and Materials
AWI	Architectural Woodwork Institute
AWPA	American Wood Protection Association
AWS	American Welding Society
AWWA	American Water Works Association
BHMA	Builders Hardware Manufacturers Association
BIA	Brick Industry Association
CABO	Council of American Building Officials
CAGI	Compressed Air and Gas Institute
CISPI	Cast Iron Soil Pipe Institute
CTI	Cooling Tower Institute
DHI	Door and Hardware Institute
DOH	Department of Health
DOT	Department of Transportation
FS	Federal Specifications
FHWA	Federal Highway Administration, Department of Transportation
FM	Associated Factory Mutual Laboratories
FSS	Federal Specifications and Standards, General Services Administration
GANA	Glass Association of North America
HI	Hydraulic Institute
HPVA	Hardwood Plywood and Veneer Association
ICEA	Insulated Cable Engineers Association
IDEM	Indiana Department of Environmental Management
IEEE	Institute of Electrical and Electronics Engineers
IFI	Industrial Fasteners Institute
IGCC	Insulating Glass Certification Council
INDOT	Indiana Department of Transportation
IPCEA	Insulated Power Cable Engineers Association
ISPC	Indiana State Plumbing Code
MIL	Military Specifications
MSHA	Mine Safety and Health Administration
MSS	Manufacturer's Standardization Society
NAAMM	National Association of Architectural Metal Manufacturers
NACM	National Association of Chain Manufacturers
NAIMA	North American Insulation Manufacturers Association
NAVFAC	U.S. Naval Facilities Engineering Command
NEBB	National Environmental Balancing Bureau
NEC	National Electrical Code
NEMA	National Electrical Manufacturers Association
NETA	International Electrical Testing Association
NFPA	National Fire Protection Association
NFPA	National Forest Products Association
NIST	National Institute of Standards and Technology
NSF	National Sanitation Foundation
OSHA	Occupational Safety and Health Administration
PCI	Precast Prestressed Concrete Institute
PDI	Plumbing and Drainage Institute
PFI	Pipe Fabricators Institute
SAE	Society of Automotive Engineers
SPECS	Specifications

SMACNA	Sheet Metal and Air Conditioning Contractors' National Association
SPI	Society of the Plastics Industry
SSPC	The Society for Protective Coatings
STI	Steel Tank Institute
TCNA	Tile Council of North America
UL	Underwriter's Laboratories, Inc.
USBR	US Bureau of Reclamation
WWPA	Western Wood Products Association

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

-END-

SECTION 01200 - PROJECT MEETINGS

PART 1 - GENERAL

1.01 Project Meetings

A. A Preconstruction Conference will be held within 30 days after delivery of the executed Agreement by Owner to Contractor, but before starting the Work, at the site, or other location designated by the Owner. The Engineer shall make arrangements for the Preconstruction Conference and notify participants in advance of the conference date. The Contractor shall submit a list of Subcontractors and suppliers as required by the General Conditions at the Preconstruction Conference, if this list was not already submitted with the Contractor's bid. In the event the listed subcontractor(s) or major material suppliers have changed from those identified in the Contractor's bid, Contractor shall be responsible for submitting the revised list of subcontractor(s) and/or major material suppliers at the Preconstruction Conference. Attendance required includes the Engineer, Contractor, Subcontractor(s), and the Owner, or his representative. Significant proceedings of this meeting will be recorded by the Engineer and copies distributed to the participants.

   Within ten days after delivery of the executed Agreement by Owner to Contractor, Contractor shall submit to Engineer for approval, an estimated progress schedule indicating the starting and completion dates of the various stages of the Work, including any Milestones specified in the Contract Documents, preliminary Schedule of Values, and a preliminary schedule of Shop Drawing submittals listing the submittal name, type, and corresponding specification section.

B. Progress Meetings will be held on a monthly basis during the period of construction at a time and place mutually agreed upon between the Contractor and Engineer and Owner. Meeting notes will be prepared by the Engineer and copies distributed to the participants.

C. Special Meetings may be called by the Engineer or Contractor or Owner as progress of the work dictates.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

-END-

SECTION 01300 - SUBMITTALS

PART 1 - GENERAL

1.01 Construction Schedules

A. Progress schedules (CPM/PERT Charts) shall be submitted by the Contractor at the monthly progress meetings or as otherwise requested by the Engineer during the contract period. Provide complete sequence of construction by activity showing dates for beginning and completion of each element of construction. Identify work in separate phases, or other logically grouped activity. Identify first work day of each week on a horizontal time scale. Sheet size shall be 24" x 36" max., 8-1/2" x 11" min. but of sufficient size to allow space for updating.

B. Submit construction schedules to the Engineer for review. If required, resubmit within 7 days after return of reviewed copy addressing Engineer's review comments.

C. Show all changes occurring since previous submission of updated schedule. Indicate progress of each activity and show completion dates. Include major changes in scope, activities modified since previous updating, revised projections due to changes and other identifiable changes.

D. Distribute copies of monthly progress schedule to:

1. Engineer
2. Owner's Representative(s)
3. Job site file
4. Subcontractors
5. Other concerned parties

E. Instruct recipients to report any inability to comply, and provide detailed explanation, with suggested remedies.

1.02 Products and Materials Approvals

A. General

1. Submit a minimum of six (6) copies of all items, equipment, and materials to be incorporated into the Work and as required by the Engineer unless specified otherwise. Three (3) copies will be retained by the Engineer. Additional copies submitted by the Contractor will be returned after review by the Engineer.
2. A Specification followed by one or more manufacturers and "or approved equal" is open to equal products or materials as determined to be "equal" solely by the Engineer. The Engineer's decision shall be final in this regard. The Contractor shall supply a product of one of the listed manufacturers at no additional cost or time if Engineer finds substituted product unsatisfactory.
3. Where specific manufacturers and/or model numbers for materials or equipment are listed in the detailed Specifications, these items have served as the basis for the design of the new facilities in this project. The Contractor shall

be aware that materials and equipment submitted as an alternate or "or equal" item must be certified by the Contractor as (1) meeting or exceeding the requirements of the detailed Specifications; (2) being of equal or better quality; and (3) being of equal function to the specific manufacturer and/or model listed. If the submitted alternate or "or equal" item requires any modification or deviation from the Drawings, the Contractor shall be responsible for preparing and submitting detailed drawings to the Engineer showing all modifications in structures, piping, electrical, mechanical, or other work required to adapt the work to the submitted alternate or "or equal" item. The Engineer will review the submitted detailed drawings of the modifications and indicate whether changes are necessary to comply with the project requirements. Detailed drawings which do not comply with the project requirements shall be revised and resubmitted. The Contractor's listed "add" or "deduct" associated with alternate equipment items shall be based upon an "installed price" and shall take into consideration and include any cost of the design or construction changes that may be required as a result of an alternate or "or equal" material or equipment.

Voluntary alternate and/or "or equal" equipment that is installed by Contractor but fails to meet the specified requirements as determined solely by the Engineer shall be replaced with the specified item at the Contractor's expense.

B. Shop Drawings

Shop Drawings shall be submitted to the Engineer within 30 days after Notice-to-Proceed.

1. Submit to the Engineer Shop Drawings and complete catalog data for every manufactured item of equipment and all components to be used in the work in accordance with the General Conditions. The Shop Drawings shall be of sufficient detail to assure that the item complies with the Specifications and shall provide the necessary data for installation, operation, and maintenance.
2. Completion of the project within the contracted time is critical, and Shop Drawing and catalog data quality can affect the construction time. Shop Drawings shall be legible. Faxed copies of the Shop Drawings are unacceptable and will be returned without review.
3. Submit drawings to the Engineer for review before equipment is fabricated or sent to the project. Also submit wiring diagrams pertinent to equipment. Same shall be applicable to this project and not a "cover-all" type drawings.
4. "Typical" drawings or general catalog cut-sheets are not acceptable unless they meet the specified product without modification. Manufacturer's standard drawings and cut-sheets may be submitted provided they are made to indicate the items or equipment being provided specifically for this project by the following methods:
   a. Project name, equipment name, tag numbers, location, and/or other identifying description are included on the drawings and cut sheets.
   b. All sizes, special features, options, modifications, etc., that are provided specific to this project are noted in some fashion.
   c. All options or features not provided specific to this project are deleted, crossed out, or otherwise removed from consideration.

5. Contractor agrees that Shop Drawing Submittals processed by the Engineer are not Change Orders; that the purpose of Shop Drawing Submittals by the Contractor is to demonstrate to the Engineer that the Contractor understands the design concept, that he demonstrates his understanding by indicating which equipment and materials he intends to furnish and install and by detailing the fabrication and installation methods he intends to use.
6. Engineer cannot review incomplete Shop Drawings and will not accept responsibility for any delays caused by incomplete Shop Drawing Submittals. The Engineer agrees to expedite his shop drawing review but it is imperative that all shop drawing submittals be complete and properly marked as indicated in this Section. Complete submittals must include a response to each requirement listed in the Specifications. Submittals which do not comply with these requirements will be returned as an incomplete submittal.
7. Contractor further agrees that if deviations, discrepancies or conflicts between Shop Drawings and Specifications are discovered either prior to or after Shop Drawing Submittals are processed by the Engineer, the design Drawings and Specifications shall control and shall be followed.
8. If any part of a shop drawing lists data or information which is in conflict or differs from the Specification or Drawings, the Contractor shall clearly indicate the difference or conflict on the submittal and include in a cover letter a description of the differences listed under "Exceptions to the Specifications and/or Drawings". Submittals which contain differences or discrepancies which are not noted may be rejected.
9. If the first Shop Drawing Submittal from the Contractor is rejected by the Engineer, and the second Shop Drawing Submittal by the Contractor for the same item is also rejected by the Engineer, then the review time and expenses that the Engineer incurs in conjunction with the review of the third Shop Drawing Submittal, and also subsequent Shop Drawing Submittals, shall be charged to the Contractor, and the Contractor shall reimburse the Owner for the Engineer's time and expenses at the then current "Hourly Rate Schedule" of the Engineer and this compensation shall be paid to the Owner within 30 days after the date of resubmittal of the appropriate Shop Drawing. As an option, Owner may withhold Engineer’s review fees from payment to Contractor.
10. Review of Shop Drawings does not relieve Contractor of responsibility for correct ordering of material and equipment. Contractor review should insure that equipment will fit in available space.
11. Include all significant data on Shop Drawing Submittals shown in Specifications and on Equipment Schedule.
12. Submit Shop Drawings in brochure form and include all related equipment in one brochure.
13. Contractor is to affix his company name and date in form of stamp, to all Shop Drawings and Submittals before submitting. Signature of Contractor's Representative is required.
14. Contractor's Certification: Equipment data and Shop Drawings shall be submitted by the Contractor with a cover letter, or the Contractor's stamp of approval, indicating that he has reviewed, checked, and approved the data submitted; that they are in compliance with the requirements of the project and with the provisions of the Contract Documents; that any exceptions to the Specifications or Drawings are specifically noted or pointed out as such; and

that he has verified all field measurements and construction criteria, materials, catalog numbers, and similar data.

15. In general, the Engineer shall have 15 calendar days to review and return submittals. Extremely large submittals may take longer.

C. Information to be Included in Submittals:

1. Manufacturer's model number or catalog number, size and performance curves and data. Indicate operating point on curves and tabular data, for each piece of equipment that curves or data represent.
2. Indication of all performance data, construction materials, finishes and modifications to manufacturer's standard design called for in the Specifications.
3. Location of connections for all piping required.
4. Rough-in foundation and support point dimensions.
5. Wiring diagrams or connection diagrams pertaining to this project only.
6. Data shall be coordinated and included in single submittal.
7. For submissions such as catalogs, delete or strike out information not pertinent to work so that there is no confusion.
8. Submittals not conforming to the above will be returned without review.
9. The procedure in seeking approval of the Shop Drawings shall be as follows:
   a. Submit the required number of complete sets of drawings, miscellaneous metals and major equipment Shop Drawings and other descriptive data together with the same required number of copies of a letter of transmittal to the Engineer for approval. The letter of transmittal shall contain the name of the project, workmanship and materials section number, the name of the Contractor, the list of drawings submitted including numbers and titles, requests for any approval of departures from the contract requirements, and any other pertinent information as required for the items being submittled. If electronic submittals are allowed, Contractor shall provide submittals in a format and quantity as required by the Engineer.
   b. If a drawing or descriptive data is stamped "No Exceptions Taken" or "Make Corrections Noted", three copies with a letter of transmittal will be returned to the Contractor.
   c. If a drawing or descriptive data is stamped "Make Corrections Noted", make the corrections indicated and proceed as noted.
   d. If a drawing or descriptive data is stamped "Rejected-Resubmit" or "Revise and Resubmit", the Contractor will receive two (2) marked copies with a letter of transmittal. Make the necessary corrections and resubmit the documents, as required. The letter transmitting corrected documents shall indicate that the documents comprise a re-submittal.
   e. If any corrections, other than those noted by the Engineer, are made on a Shop Drawing prior to re-submittal, such changes should be pointed out by the Contractor upon re-submittal.
   f. Revise and resubmit the Shop Drawings as required, until reviewed and marked as ”No Exceptions Taken”.
10. Failure to provide this information and certification with or on the submittals shall be cause for the return of Shop Drawings or equipment data without review or other action.

1.03 Equipment Manuals

A. Manufacturer Operation and Maintenance (O&M) Manuals shall be submitted to the Engineer for review a minimum of four (4) weeks prior to system start up for each respective system or equipment. System or equipment start up and substantial completion may be delayed at the discretion of the Engineer if Operation and Maintenance Manuals are not received by the Engineer in the time frame specified herein.

B. Furnish four (4) printed sets and two (2) CD's or DVD's with electronic copies in pdf/bookmarked format of the equipment manufacturer's operation and maintenance (O&M) materials and manuals to the Engineer. The O&M Manual shall include local sources of service and parts for the equipment.

C. All O&M Manuals submitted shall be specific for the items and models furnished under this contract and reflect as-approved and as-installed information. Standard manuals from equipment suppliers which reflect all sizes and options of equipment available from the supplier shall be clearly marked to indicate the applicable sizes and options specific to this project.

D. Manual Organization

1. Organize operation and maintenance manuals into suitable sets of manageable size.
2. Bind data into individual binders for each manual, properly identified on front and spine. For large manuals, provide an index sheet and thumb tabs for separate information categories.
3. Provide heavy-duty, three-ring, vinyl-covered binders, 1/2 to 3 inch thick as required to contain information, sized for 8-1/2x11 or 11x17 paper with inside pockets or pocket folders for folded sheets.

E. Information to be Included

1. Each O&M manual shall include information specified in individual Specification Sections and the following:
   a. Project title, equipment manufacturer, local equipment supplier, subcontractor, and prime contractor, including contact information (address, phone number, and e-mail) for each.
   b. Copy of manufacturer warranties specific to this project.
   c. Copies of factory tests or certified tests and reports, if required by the Specification Section or by referenced standards.
   d. Equipment installation instructions.
   e. Troubleshooting guide and emergency instructions.
   f. List of spare parts provided or recommended.
   g. Recommended maintenance materials, instructions, and procedures, including schedules, drawings, and diagrams.
   h. Precautions against improper maintenance and exposure.
   i. Inspection and system test procedures.
   j. Copies of revised Shop Drawings and Product Data showing as-installed information, including:

1) Detailed drawings and descriptions of equipment showing all dimensions, elevations, parts, constructed details, materials of construction, performance data, descriptive literature, weights, and other physical characteristics, including performance curves, motor starting and full-load amps, motor horsepower, and motor data.
2) Project name, equipment name, tag numbers, location, and/or other identifying description included on the drawings and cut sheets.
3) All sizes, special features, options, modifications, etc., that are provided specific to this project.
4) All options or features not provided specific to this project are deleted, crossed out, or otherwise removed.

k. Electrical & Controls Information:
1) Detailed drawings and descriptions of electrical and controls equipment, including main and auxiliary control panels, showing all dimensions, parts, constructed details, and materials of construction.
2) Complete electrical system drawings and description including, but not limited to, the following:
a) Complete system interconnection diagrams between power supply, control panels, drive motors, secondary drive motors, and all ancillary equipment connected to control system, including terminal number connection points.
b) Control panel overall dimensions and layout of external and internal mounted components.
c) Complete electrical schematics with power wiring and control wiring in accordance with current standards. Schematics shall include all component ratings.
3) Complete motor rating including all nameplate data, guaranteed minimum rated efficiency, and speed torque curves
4) Description of control system in written form including functions monitored, controlled, and alarmed. Include sequence of operation and interface requirements.

F. Each prime contractor is responsible for maintenance manuals for its own Work. Where a manual includes information on installations by more than one contract, the Contractor who is the principal source of information, as designated by the Engineer, shall receive information from other contractors, coordinate and collate information for a unified manual, and provide binders and submittal as specified.

1.04 Partial Payment Claims

A. These claims are described in the General Conditions. Three (3) sets of these fully executed claims shall be submitted to the Engineer on a monthly basis as determined at the Preconstruction Conference.

B. Submit to the Engineer one copy of invoices and delivery tickets for materials and equipment claimed as stored materials on partial payment claims. Prices must be shown on the invoices or delivery tickets if the Contractor is claiming reimbursement for materials and equipment stored onsite, in the possession of the Owner. Amounts claimed for stored materials cannot exceed the amounts indicated in the invoice for the applicable items. Amounts claimed for a stored

material shall not exceed the value of that work item listed on the approved Schedule of Values.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

-END-

SECTION 01400 – QUALITY CONTROL

PART 1 - GENERAL

1.01 Description

A. This Section includes administrative and procedural requirements for quality assurance and quality control.

B. Testing and inspection services are required to verify compliance with requirements specified or indicated. These services do not relieve Contractor of responsibility for compliance with the Contract Documents requirements.

1. Specific quality-control requirements for individual construction activities are specified in the Sections that specify those activities. Requirements in those Sections may also cover production of standard products.
2. Specified tests, inspections, and related actions do not limit Contractor's quality-control procedures that facilitate compliance with the Contract Document requirements.
3. Requirements for Contractor to provide quality-control services required by Engineer, Owner, or authorities having jurisdiction are not limited by provisions of this Section.

1.02 Related Documents

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

A. Related Sections include the following:

1. Divisions 2 through 16 Sections for specific test and inspection requirements.

1.03 Definitions

A. Quality-Assurance Services: Activities, actions, and procedures performed before and during execution of the Work to guard against defects and deficiencies and ensure that proposed construction complies with requirements.

B. Quality-Control Services: Tests, inspections, procedures, and related actions during and after execution of the Work to evaluate that completed construction complies with requirements. Services do not include contract enforcement activities performed by Engineer.

C. Mockups: Full-size, physical example assemblies to illustrate finishes and materials. Mockups are used to verify selection made under Sample submittals, to demonstrate aesthetic effects and, where indicated, qualities of materials and execution, and to review construction, coordination, testing, or operation; they are not Samples. Mockup shall establish the standard by which the Work will be judged.

D. Testing Agency: An entity engaged to perform specific tests, inspections, or both. Testing laboratories shall mean the same as testing agency.

1.04 Delegated Design

A. Performance and Design Criteria: Where professional design services or certifications by a design professional are specifically required of the Contractor by the Contract Documents, provide products and systems complying with specific performance and design criteria indicated.

1. If criteria indicated are not sufficient to perform services or certification required, submit a written request for additional information to Engineer.

1.05 Inspection Services

A. All materials and each part or detail of the work shall be subject to inspection by the Engineer at all times. The Engineer shall be allowed access to all parts of the work and shall be furnished with such information and assistance by the Contractor as is required to make a complete and detailed inspection. Such inspection may include preparation and manufacture of the materials at the plant.

B. The inspection of the work shall not relieve the Contractor of any obligation to fulfill his contract as prescribed, and defective work shall be made good and unsuitable materials shall be rejected, not withstanding that such defective work and materials have been previously overlooked and accepted on estimates for payments.

C. All work shall be tested to the satisfaction of the Engineer before acceptance. The cost of all tests is to be borne by the Contractor.

D. No work shall be done at night, holidays, Saturdays or Sundays without the prior approval of the Engineer.

1.06 Submittals

A. Qualification Data: For testing agencies specified in "Quality Assurance" Article to demonstrate their capabilities and experience. Include proof of qualifications in the form of a recent report on the inspection of the testing agency by a recognized authority.

B. Delegated-Design Submittal: In addition to Shop Drawings, Product Data, and other required submittals, submit a statement, signed and sealed by the responsible design professional, for each product and system specifically assigned to Contractor to be designed or certified by a design professional, indicating that the products and systems are in compliance with performance and design criteria indicated. Include list of codes, loads, and other factors used in performing these services.

C. Schedule of Tests and Inspections: Prepare in tabular form and include the following:

1. Specification Section number and title.

2. Description of test and inspection.
3. Identification of applicable standards.
4. Identification of test and inspection methods.
5. Number of tests and inspections required.
6. Time schedule or time span for tests and inspections.
7. Entity responsible for performing tests and inspections.
8. Requirements for obtaining samples.
9. Unique characteristics of each quality-control service.

D. Reports: Prepare and submit certified written reports that include the following:

1. Date of issue.
2. Project title and number.
3. Name, address, and telephone number of testing agency.
4. Dates and locations of samples and tests or inspections.
5. Names of individuals making tests and inspections.
6. Description of the Work and test and inspection method.
7. Identification of product and Specification Section.
8. Complete test or inspection data.
9. Test and inspection results and an interpretation of test results.
10. Ambient conditions at time of sample taking and testing and inspection.
11. Comments or professional opinion on whether tested or inspected Work complies with the Contract Documents requirements.
12. Name and signature of laboratory inspector.
13. Recommendations on retesting and reinspection.

E. Permits, Licenses, and Certificates: For Owner's records, submit copies of permits, licenses, certifications, inspection reports, releases, jurisdictional settlements, notices, receipts for fee payments, judgments, correspondence, records, and similar documents, established for compliance with standards and regulations bearing on performance of the Work.

1.07 Quality Assurance

A. Fabricator Qualifications: A firm experienced in producing products similar to those indicated for this Project and with a record of successful in-service performance, as well as sufficient production capacity to produce required units.

B. Factory-Authorized Service Representative Qualifications: An authorized representative of manufacturer who is trained and approved by manufacturer to inspect installation of manufacturer's products that are similar in material, design, and extent to those indicated for this Project.

C. Installer Qualifications: A firm or individual experienced in installing, erecting, or assembling work similar in material, design, and extent to that indicated for this Project, whose work has resulted in construction with a record of successful in-service performance.

D. Manufacturer Qualifications: A firm experienced in manufacturing products or systems similar to those indicated for this Project and with a record of successful in-service performance.

E. Professional Engineer Qualifications: A professional engineer who is legally qualified to practice in jurisdiction where Project is located and who is experienced in providing engineering services of the kind indicated. Engineering services are defined as those performed for installations of the system, assembly, or product that are similar to those indicated for this Project in material, design, and extent.

F. Specialists: Certain sections of the Specification may require that specific construction activities shall be performed by entities who are recognized experts in those operations. Specialists shall satisfy qualification requirements indicated and shall be engaged for the activities indicated.

1. Requirement for specialist shall not supersede building codes and similar regulations governing the Work, not interfere with local trade-union jurisdictional settlements and similar conventions.

G. Testing Agency Qualifications: An agency with the experience and capability to conduct testing and inspection indicated, and that specializes in types of tests and inspections to be performed.

H. Mockups: Before installing portions of the Work requiring mockups, build mockups for each form of construction and finish required to comply with the following requirements, using materials indicated for the completed Work:

1. Build mockups in location and size indicated or, if not indicated, as directed by Engineer.
2. Notify Engineer seven days in advance of dates and times when mockups will be constructed.
3. Demonstrate the proposed range of aesthetic effects and workmanship.
4. Obtain Engineer's approval of mockups before starting work, fabrication, or construction.
5. Maintain mockups during construction in an undisturbed condition as a standard for judging the completed Work.
6. Demolish and remove mockups when directed, unless otherwise indicated.

1.08 Quality Control

A. Contractor Responsibilities: Unless otherwise indicated, provide quality-control services specified and required by authorities having jurisdiction.

1. Where services are indicated as Contractor's responsibility, engage a qualified testing agency to perform these quality-control services.
2. Contractor shall not employ the same entity engaged by Owner, unless agreed to in writing by Owner.
3. Notify testing agencies at least 24 hours in advance of time when Work that requires testing or inspection will be performed.
4. Where quality-control services are indicated as Contractor's responsibility, submit a certified written report, in duplicate, of each quality-control service.
5. Testing and inspection requested by Contractor and not required by the Contract Documents are Contractor's responsibility.
6. Submit additional copies of each written report directly to authorities having jurisdiction, when they so direct.

B. Manufacturer's Field Services: Where indicated, engage a factory-authorized service representative to inspect field-assembled components and equipment installation, including service connections. Report results in writing.

C. Retesting/Reinspection: Regardless of whether original tests or inspections were Contractor's responsibility, provide quality-control services, including retesting and reinspection, for construction that revised or replaced Work that failed to comply with requirements established by the Contract Documents.

D. Testing Agency Responsibilities: Cooperate with Engineer and Contractor in performance of duties. Provide qualified personnel to perform required tests and inspections.

1. Notify Engineer and Contractor promptly of irregularities or deficiencies observed in the Work during performance of its services.
2. Interpret tests and inspections and state in each report whether tested and inspected work complies with or deviates from requirements.
3. Submit a certified written report, in duplicate, of each test, inspection, and similar quality-control service through Contractor.
4. Do not release, revoke, alter, or increase requirements of the Contract Documents or approve or accept any portion of the Work.
5. Do not perform any duties of Contractor.

E. Associated Services: Cooperate with agencies performing required tests, inspections, and similar quality-control services, and provide reasonable auxiliary services as requested. Notify agency sufficiently in advance of operations to permit assignment of personnel. Provide the following:

1. Access to the Work.
2. Incidental labor and facilities necessary to facilitate tests and inspections.
3. Adequate quantities of representative samples of materials that require testing and inspection. Assist agency in obtaining samples.
4. Facilities for storage and field-curing of test samples.
5. Delivery of samples to testing agencies.
6. Preliminary design mix proposed for use for material mixes that require control by testing agency.
7. Security and protection for samples and for testing and inspection equipment at Project site.

F. Coordination: Coordinate sequence of activities to accommodate required quality-assurance and quality-control services with a minimum of delay and to avoid necessity of removing and replacing construction to accommodate testing and inspection.

1. Schedule time for tests, inspections, obtaining samples, and similar activities.

G. Schedule of Tests and Inspections: Prepare a schedule of tests, inspections, and similar quality-control services required by the Contract Documents. Submit schedule within 15 days of date established for the Notice to Proceed.

1. Distribution: Distribute schedule to Owner, Engineer, testing agencies, and each party involved in performance of portions of the Work where tests and inspections are required.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 Repair and Protection

A. General: On completion of testing, inspection, sample taking, and similar services, repair damaged construction and restore substrates and finishes.

1. Comply with the Contract Document requirements for Division 1 Section "Cutting and Patching".

B. Protect construction exposed by or for quality-control service activities.

C. Repair and protection are Contractor's responsibility, regardless of the assignment of responsibility for quality-control services.

-END-

SECTION 01500 - CONSTRUCTION FACILITIES AND TEMPORARY CONTROLS

PART 1 - GENERAL

1.01 Description

A. Provide the following temporary facilities:

1. Engineer's Field office.
2. Telephone service/Internet access.
3. Electric service.
4. Water service.
5. Sanitary facilities.
6. Heat, A/C, and ventilation.
7. Utility connections, maintenance and removal.
8. Barricades and enclosures.
9. Bulletin Board (for required notices)

B. Temporary structures required by the Contractor and his Subcontractors for storage or other purposes in the performance of their contracts shall be located and erected only with the approval of Engineer and shall be removed and premises cleaned of all debris when directed.

C. Arrange for all temporary utilities.

1.02 Requirements of Regulatory Agencies

A. Obtain permits as specified in Section 01010 - Summary of Work.

B. Comply with the latest applicable Federal, State, and local codes, including but not limited to the following:

1. Occupational Safety and Health Act.
2. National Electric Code.
3. National Electric Safety Code.
4. Uniform Building Code.
5. Life Safety Code.

C. Comply with utility regulations.

1.03 Temporary Structures

A. Field Office – Resident Project Representative

1. Provide a fully equipped field office for the exclusive use of the Engineer and/or his representatives. Field office shall be on-site and functional prior to the beginning of construction and not removed until Final Completion of the project is established. The Contractor's first pay request will not be processed by the Engineer until the field office is on-site, fully equipped and functional.

2. Field office shall be a trailer office, a minimum of 320 square feet, be well ventilated, lighted, heated, and air conditioned.
   a. Equip field office with two desks, two rolling desk chairs, two tables, and four drawer file cabinet. Provide an ABC rated fire extinguisher.
   b. Provide a dedicated water cooler and porta-john for the exclusive use of the RPR.
   c. Provide adequate all-weather parking for a minimum of two cars in close proximity to the office.
   d. Provide a wireless multi-function printer/copier/scanner for the exclusive use of the Engineer. Multi-function printer/copier/scanner shall be color ink-jet (or color laser) capable of printing and scanning 11x17 sheets, Brother MFC-6490-CW or equal. Provide a stocked inventory of 8.5x11 and 11x17 paper, as well as spare ink-jet (or toner) cartridges.
   e. Provide high-speed wireless Internet access with a minimum download speed of 6.0 Mbps and upload speed of 768K. Dial-up service is not acceptable. If cell service is used, a minimum data transfer capacity of 3 Gb/mo. shall be required.

B. Storage Sheds

Storage sheds or trailers shall be provided by each Subcontractor as required. Coordinate location and removal with General Contractor.

C. Enclosures

Provide temporary weathertight enclosures for all exterior openings. Equip exterior doors with locks and closers. Provide lights, signs and barricades as required to protect construction personnel, and the general public.

D. Sanitary Facilities

Provide sanitary facilities for use of all construction personnel including those of other contractors for the duration of the project as follows:

1. Chemical units complete with weathertight enclosure adequately ventilated and equipped with latching door.
2. Maintain chemical units weekly or at lesser periods if determined necessary. Chemical units shall be in accordance with the rules and regulations of the locality of the project (State, county or city).
3. Furnish toilet paper and hand sanitizer for the chemical units and replenish supply whenever required.

E. Water and Electric Service

Install and maintain all extensions from the service sources to work areas as required to provide adequate water supply and electric power for all aspects of the work and in accordance with all relevant codes and regulations.

F. Heat and Ventilation

1. Provide heat and air conditioning as required to maintain specified conditions for construction operations, provide for a safe working environment in accordance with health regulations, and to protect materials and finishes from damage due to temperature or humidity. Follow requirements set forth elsewhere in these Specifications.
   a. Whenever fixtures, water services or items subject to damage from cold have been installed, maintain the temperature above 50°F.
2. Prior to operation of permanent facilities for temporary purposes, verify that installation is approved for operation, and that filters are in place. Provide and pay for operation, maintenance, and utilities and fully service all equipment, including cleaning filters, until the time the Work is turned over to the Owner.
3. Provide ventilation of enclosed areas to cure materials, to disperse humidity, and to prevent accumulations of dust, fumes, vapors, or gases.
4. No open fires will be permitted.

G. Trash Containers

Provide a trash container for the disposal of packaging materials, pieces of broken pipe, rubbish, trash and other debris. Empty trash containers weekly.

1.04 Installation

A. Temporary Structures

Locate temporary structures to avoid interference with work. Relocate as required and/or directed by Engineer. Construct temporary structures on stable foundation with code approved service connections.

B. Temporary Electrical Service

Install service and distribution overhead. Do not run branch circuits on floor.

1.05 Protection

A. Safety

Maintain lights and barricades on all obstructions and hazards during contract period in conformance with Federal, State, and local laws and codes.

B. Fire Protection

Provide multipurpose dry chemical fire extinguishers as required. Mount units in protective red enclosures plainly marked and readily accessible.

C. Protection of Piping Rough-in's

Keep materials out of piping by capping or other protection. Trades responsible for stoppage will be charged for cleaning.

1.06 Removal and Clean-Up

Remove all temporary facilities and materials completely upon completion of construction. Remove debris and clean area. Repair all damage and restore area to finish condition.

1.07 Access Roads and Parking Areas

A. Provide and maintain vehicular access to the site and within the site for use by persons and equipment involved in the construction of the project. Maintain access roads and driveways with sufficient rock, stone, or gravel to provide a suitable support for vehicular traffic and anticipated loads.

B. Provide and maintain temporary parking facilities for use by construction personnel and the Engineer. Maintain parking facilities free of construction materials, mud, snow, ice and debris.

C. Restore areas to original or to specified conditions shown on the Drawings at completion of the work.

1.08 Barricades

A. Provide, erect and maintain all necessary barricades, suitable and sufficient danger signals and signs. Take all necessary precautions for the protection and safety of the public, workmen, structures and equipment. Roads closed to traffic shall be protected by effective barricades. Obstructions shall be illuminated during hours of darkness.

B. Erect warning signs in advance of any location on the project where operations may interfere with the use of the road by traffic and at all intermediate points where the new work crosses or coincides with the existing road. Construct and erect warning signs in accordance with the Federal Highway Administration's Manual on Uniform Traffic Control Devices (MUTCD) and the Indiana Supplement, latest editions.

1.09 Maintenance of Traffic

A. Maintain the road surfaces during the construction, take precautions to prevent unnecessary damage to partially completed surfaces, and repair any portions which do become damaged. Bear all costs involved in such maintenance, precautions, and repairs, including the cost of all necessary materials.

B. Before closing any thoroughfare, notify and, if necessary, obtain a permit or permits from the duly constituted public authority having jurisdiction, state, county, or city.

C. During construction, maintain and protect the pedestrian and vehicular traffic at all times on all streets involved and provide access to all residential and commercial establishments adjacent to the construction area. Furnish and maintain signage, barricades, flares, etc. The signage, barricades, etc., must be in good condition and the cost shall be included in the total lump sum or unit price bid.

D. Conduct the work in such manner as not to unduly or unnecessarily restrict or impede normal traffic through the streets of the community. Do not locate excavated material and spoil banks in such manner as to obstruct traffic. Keep the traveled way of all streets, roads, and alleys clear and unobstructed. Do not use streets, roads, or alleys for the storage of construction materials, equipment supplies, or excavated earth, except when and where necessary. If required by duly constituted public authority, construct bridges or other temporary crossing structures over trenches at no additional cost to Owner. Such structures shall be of adequate strength and proper construction and shall be maintained in such manner as not to constitute an undue traffic hazard. Private driveways shall not be closed, except when and where necessary, and then only upon advance notice to the Engineer and for the shortest practicable period of time, consistent with efficient and expeditious construction. The Contractor shall be liable for any damage to persons or property resulting from his work.

1.10 Walks and Passageways

When required, make provisions at cross streets for the free passage of vehicles and foot passengers, either by bridging or otherwise. Do not obstruct the sidewalks, gutters, or streets, or prevent in any manner the flow of water in streets. Use all proper and necessary means to permit the free passage of surface water along the gutters. Immediately remove all offensive matter, exercising such precaution as may be directed by the Engineer. All materials excavated shall be so disposed of as to inconvenience the public and adjacent tenants as little as possible and to prevent injury to trees, sidewalks, fences, and adjacent property of all kinds. Erect suitable barriers if necessary to prevent such inconveniences or injury.

1.11 Warning Lights and Arrow Boards

Place sufficient warning lights and arrow boards on or near the work and keep them illuminated during periods of construction and reduced visibility (from twilight in the evening until sunrise). The Contractor is responsible for all damages that any party or the Owner may sustain in consequences of neglecting the necessary precautions in prosecuting this work.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

-END-

SECTION 01550 – PLANT OPERATIONS DURING CONSTRUCTION

PART 1 – GENERAL

1.01 Description

A. This work shall consist of furnishing and installing temporary facilities and services, scheduling of construction, and utilizing construction procedures necessary to maintain wastewater treatment during construction.

B. Developing a plan for construction activities, scheduling, and sequencing construction to maintain wastewater treatment during construction. Specific requirements which may influence the Contractor's Bid Price and scheduling are included in this Section. However, specific procedures are not limited to the ones included in this Section, and additional and more detailed procedures may be required during construction. If requested by the Engineer, provide a written plan describing how these requirements will be met. Include all costs in the bid price for meeting the requirements described in this Section.

1.02 Scope

A. It is essential that treatment in the existing wastewater treatment facilities is not interrupted during construction or diminished in quality by construction procedures or methods.

B. Connections to the existing piping, installation of valves and tees in the existing piping, modifications to existing tanks, and installation or removal of any treatment unit shall be accomplished with minimal interruption of flow through these facilities.

C. Include in the Bid and bear all expenses incurred to maintain wastewater treatment during construction of new facilities, including temporary pumping and piping, temporary electrical service, and all other appurtenances.

D. Should temporary facilities be required, have on site, or at immediate dispose, back-up facilities in the event of failure of the primary temporary units.

E. Procedures as set forth herein are included as a guide only and do not relieve the Contractor from any costs to provide and maintain any or all temporary facilities and equipment that may be required to maintain full plant operation during the construction period. Procedures other than those set forth herein may be used with prior approval of the Engineer. The approval of the Engineer shall be only for compliance with the intent of maintaining full operation of the treatment facilities.

1.03 Construction Schedule

A. Notify the Owner and Engineer one week in advance of any interruptions in access to existing treatment facilities. Such interruptions shall be strictly coordinated with the Plant Superintendent.

1.04 Plant Operations and Maintenance

A. Existing facilities which are required to be in service during their modification will be operated by the Owner. All temporary facilities, such as pumps, piping, flumes, valves and gates, utilized in the treatment process will be operated and maintained by the Contractor. Provide required instructions for the operation of temporary facilities in writing to the Engineer. Operation of this temporary equipment shall be coordinated with the Engineer. Temporary equipment utilized in the treatment process shall be operated 24 hours per day, if required, to maintain the treatment process. Temporary facilities and equipment not required in the treatment process shall be operated and maintained by the Contractor.

B. New facilities which are required to be in service before they are completed and/or accepted by the Owner will be operated by the Contractor and shall be maintained by the Contractor.

C. Operation of new or modified facilities by the Owner before these facilities are completed, tested, and accepted does not imply acceptance of these facilities by the Owner.

D. New or modified facilities and equipment which have been completed, tested, and accepted by the Owner will be operated and maintained by the Owner.

1.05 Temporary Facilities

A. Any and all temporary structures, pumping, piping, and construction required to maintain full wastewater treatment in the existing facilities and to operate new facilities prior to completion of construction shall be furnished and installed by the Contractor.

B. Temporary utilities shall be provided and energy costs paid by the Contractor.

PART 2 – PRODUCTS

2.01 Materials and Equipment

A. All permanently installed materials and equipment shall be in accordance with the applicable sections of these Specifications.

B. Temporary materials and equipment shall be selected by the Contractor and shall conform to the intent of this Section.

PART 3 – EXECUTION

3.01 Demolition

Demolition work shall be in accordance with the Drawings and applicable Specifications.

3.02 Installation

A. Install material and equipment which are to become a permanent part of the treatment facilities as indicated on the Drawings and in accordance with the applicable sections of these Specifications.

3.03 General Procedures

A. Schedule and coordinate the work so that minimal interruptions are made to plant operations, so that the number of process shut downs are minimized, and so that portions of the plant which are shut down or taken out of service are minimized. As a general rule, a shutdown for a specific process will be provided only once, and the Contractor is responsible for completing all work necessary for that item during that time and within the time frame specified.

B. Prior to the start of modifications to any existing facility, assemble onsite all labor, materials, tool, and equipment required to complete the modifications without interruption and/or inordinate delays. Shut downs of existing facilities will not be allowed until the Contractor has verified all these items are onsite and ready for the Work.

C. Coordinate work for connections of new piping to existing piping or new pipe to existing structures so that all new piping necessary is installed up to the connection point and connections can be made with minimal process interruption.

D. Coordinate discharge from dewatering of existing tanks with the Engineer and Plant Superintendent. The Owner is responsible for draining existing tanks and structures unless specifically stated otherwise. The Contractor is responsible for cleaning and removing remaining residuals and debris from the drained tanks to the extent needed to perform the Work, unless described otherwise in these Specifications or in the Drawings.

E. Modification and connections to more than one of the existing facilities shall not be done simultaneously, unless approved by the Engineer. The modification to one existing facility or the connection to one existing pipeline shall be completed before another modification or connection to existing facilities is started.

F. Where bypass pumping is required, the Contractor shall be responsible for determining pumping requirements. Size bypass pumps to pump the peak flow for which a bypassed process or portion of the plant is designed. If requested by the Engineer or Owner, have back-up equipment on-site should the primary equipment fail.

3.04 Timing

Coordinate all construction which requires any portion of the treatment facilities to be taken out of service with the Engineer and Owner. Be prepared to undertake these procedures at times of low flow, if necessary.

3.05 Specific Procedures

A. The existing fiber optics network to the Blower Building will be allowed out of service for a period of up to 8 hours to connect to the new Chemical Feed Building.

B. Work requiring the WWF Basin and WWF Building to be out of service must be performed and completed during the period of November 1 through March 21. These facilities will be completely taken out of service during this time and isolated from flow.

C. The Control Chamber, 63”x98” WWF Influent Sewer, Diversion Structure, WWF Basin Effluent Structure, and entire 78” Outfall Sewer will remain in service during the Contract Time and will be active during wet-weather events.

D. The WWTP influent channel of the Control Chamber will be active at all times during the Work.

E. Only one CSO screen may be out of service at a time for relocation.

F. The existing Chemical Fill Station cannot be taken out of service for demolition until after November 1, 2014. The new Chemical Fill Station and reconnection of hypochlorite and bisulfite piping must be completed by March 21, 2015.

3.06 Site Access

A. Schedule the construction of the new drives and demolition of existing drives and/or construct temporary drives as necessary to provide uninterrupted access to existing facilities. Access shall be provided at all times when the Contractor is not working on the site. Interruptions to access when the Contractor is working on the site shall only occur when connections between new or temporary drives and existing drives are being constructed or removed, and shall be coordinated with the Engineer and Owner.

B. Temporary drives shall be sufficiently stabilized to permit passage of fully loaded semi-trailer trucks without assistance from other vehicles or construction equipment. Temporary drives shall be maintained by the Contractor.

-END-

SECTION 01600 - MATERIAL AND EQUIPMENT

PART 1 - GENERAL

1.01 Transportation and Handling

A. All fixtures, equipment, materials and appurtenances shall be loaded and unloaded by lifting with hoists and skidding so as to avoid shock or damage. Under no circumstances shall such materials be dropped.

B. Handle all fixtures, equipment, materials and appurtenances so that no damage will occur.

1.02 Storage and Protection

A. Obtain storage space(s) for the delivery, storage and handling of all fixtures, equipment, materials and appurtenances used on this Project.

B. The Owner will not receive, store or house fixtures, equipment, materials or appurtenances being delivered to the site for Contractor or his Subcontractor. The delivery, receipt, storage and handling of all fixtures, equipment, materials, and appurtenances shall be the responsibility of the Contractor. All materials shall be stored to prevent dirt and debris from entering and accumulating.

C. All fixtures, equipment, materials, and appurtenances shall be stored and protected in accordance with the manufacturer's instructions. Material and equipment which is not properly stored or protected may be subject to rejection as determined by the Engineer.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

-END-

SECTION 01650 – STARTING OF SYSTEMS

PART 1 - GENERAL

1.01 Section Includes:

A. Starting of equipment and systems.

B. Demonstration, training and instructions.

C. Acceptance of Equipment

1.02 Starting Systems

A. Coordinate schedule for start-up of various equipment and systems.

B. Notify Engineer seven days prior to start-up of each item. Coordinate system or equipment start-up with Plant Superintendent.

C. Verify that each piece of equipment for system has been checked for proper lubrication, drive rotation, belt tension, control sequence, and for conditions which may cause damage.

D. Verify that tests, meter readings, and specified electrical characteristics agree with those required by the equipment or system manufacturer.

E. Verify that wiring and support components for equipment are complete and tested.

F. Execute start-up under supervision of applicable manufacturer's representative and Contractors' personnel in accordance with manufacturers' instructions.

G. When specified in individual Specification sections, require manufacturer to provide authorized representative to be present at site as described in Article 1.04.

1.03 Demonstration, Training and Instructions

A. Demonstrate project equipment and instruct in a classroom environment located at the plant site. Instruction shall be by a manufacturer's representative who is knowledgeable about the equipment and its application to the project.

B. Utilize Operation and Maintenance Manuals as basis for instruction. Review contents of manual with Owner's personnel in detail to explain all aspects of operation and maintenance.

C. Demonstrate start-up, operation, control, adjustments, trouble-shooting, servicing, maintenance, and shutdown of each item of equipment at agreed time, at equipment location.

D. Prepare and insert additional data in Operation and Maintenance Manuals when need for additional data becomes apparent during instruction.

E. The amount of time required for instruction on each item of equipment and system is that specified in individual sections.

F. Provide demonstration such that the Owner may video these if so desired.

1.04 Manufacturer's Service Time

A. Where service by the manufacturer is specified to be furnished as part of the cost of the item of equipment, the work shall be at the Contractor's expense and shall include the services and tasks as describe herein.

B. The services provided shall be by a qualified representative to check the completed installation, place the equipment in operation, and instruct the Owner's plant operators in the operation and maintenance procedures. Such services are to be for a specified period of time and for the number of trips specified. A working day is defined as a normal 8-hour working day on the jobsite and does not include travel time.

C. The purpose of these services is to demonstrate to the Engineer's complete satisfaction that the equipment has been properly installed and will satisfactorily perform the functions for which it is intended.

D. When indicated in the detailed equipment specification, the Contractor shall provide the services of a qualified representative of the manufacturer for a specified number of visits and/or period of days to perform the following tasks:

1. Inspect the installation of the equipment.
2. Place the equipment in operation and make any necessary adjustments.
3. Perform tests specified in the detailed Specification and recommended by the equipment manufacturer.
4. Instruct Owner's personnel in the proper operation and maintenance (O & M) of the equipment (training) as described in Article 1.03.
5. Training shall be performed separate and distinct from start-up and testing procedures.

E. If equipment is not completed for proper start-up and training procedures, the representative shall schedule another visit at no additional cost to the Owner. Training will not be permitted without prior start-up and operation of the equipment. Training shall be performed separate and distinct from start-up and testing tasks. An abstract or outline of the start-up, testing and training procedures shall be provided to the Engineer at least five (5) days prior to the scheduled visit. Manufacturer's Operation and Maintenance Manuals and materials shall be incorporated in the training procedures, with emphasis on items or materials of greatest importance.

F. A typed, bound Start-Up Certification Report covering the manufacturer's representative's findings shall be submitted to the Engineer for review and approval. The report shall include the following:

1. A description of the start-up procedures taken;
2. Any inspections performed;

3. Describe in detail any deficiencies observed along with the corrective measures taken;
4. The results of all field tests, including necessary graphs, charts, tables, etc., specified in the detailed Specification or required by the referenced standards.

G. The report shall certify that the equipment is properly installed and functioning for the purpose intended.

H. The Contractor shall bear all expenses associated with the start-up, testing and training procedures and report described above, including labor, transportation, lodging and material costs.

1.05 Acceptance of Equipment

A. Acceptance of equipment shall be defined as that point in time when the following requirements have been fulfilled and the equipment is placed in operation:

1. All required submittals and documentation have been submitted, and are acceptable to the Engineer.
2. All start-up and training procedures have been satisfactorily performed and the Start-Up Certification Report has been submitted, and is acceptable to the Engineer.
3. All equipment Operation and Maintenance Manuals and materials have been submitted, and are acceptable to the Engineer.
4. All spare parts have been provided to the Owner.

B. The date of formal acceptance by the Owner for a particular item of equipment, or Date of Acceptance, shall be the date of Substantial Completion as described in the General Conditions, unless specifically approved otherwise by the Engineer.

C. Equipment which is absolutely necessary to be placed into operation prior to Substantial Completion may be accepted by the Owner as described in the General Conditions, provide that all the above requirements have been met. One the Start-Up Certification Report has been submitted and is acceptable to the Engineer, a Certificate of Substantial Completion for Partial Work Completed (Partial Work Certificate) may be issued, which indicates the Date of Acceptance. The Contractor will maintain ownership and have total responsibility for the equipment until the Date of Acceptance is agreed to by all parties. The Owner will take ownership and provide regular operation and maintenance of the equipment on the Date of Acceptance. Only equipment which must be placed into operation prior to Substantial Completion in order to maintain adequate treatment through the facility will be considered for acceptance prior to Substantial Completion, as determined by the Engineer.

D. The manufacturer's and Contractor's warranty for each item of equipment shall not begin until the equipment is placed into permanent operation, as determined by the Date of Acceptance established for each piece of equipment.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

Not Used.

-END-

SECTION 01700 - CONTRACT CLOSEOUT

PART 1 - GENERAL

1.01 Description

A. Related requirements are specified in the General Conditions. For cleaning of specific products or work, see Specifications section for that work.

B. All cleaning shall be the responsibility of the Contractor unless specifically noted otherwise.

C. Maintain premises and property free from accumulations of waste, debris, and rubbish, caused by construction activities.

D. At completion of work, remove waste materials, rubbish, tools, equipment, machinery and surplus materials, and clean all sight-exposed surfaces; leave project clean and ready for occupancy or operation as applicable.

1.02 Requirements of Regulatory Agencies

A. Maintain project in accordance with Occupational Safety and Health Act of 1970 as amended, in terms of cleanup.

B. Conduct cleaning and disposal operations to comply with local ordinances and anti-pollution laws.

C. Do not burn or bury rubbish and waste materials on project site. Do not dispose of volatile wastes; such as, mineral spirits, oil or paint thinner in storm or sanitary drains.

PART 2 - PRODUCTS

2.01 Cleaning Materials

A. Use only cleaning materials recommended by manufacturer of surface to be cleaned.

B. Use cleaning materials only on surfaces recommended by cleaning material manufacturer.

PART 3 - EXECUTION

3.01 During Construction

A. Execute cleaning to ensure that structures and building, grounds, roadways and property are maintained free from accumulations of waste materials and rubbish.

B. Wet down materials and rubbish to allay dust and prevent blowing dust at roadways and public properties in accordance with Engineer and Owner's requirements.

C. At reasonable intervals during progress of the work, clean site and property, and dispose of waste materials, debris and rubbish.

D. Provide on-site containers for collection of waste materials, debris and rubbish.

E. All surplus materials must be removed from the job site on a daily basis.

F. Handle materials in a controlled manner with as few handlings as possible; do not drop or throw materials from heights.

G. Schedule cleaning operations so that dust and other contaminants resulting from cleaning process will not fall on wet, newly painted surfaces.

3.02 Final Cleaning

A. Employ experienced workmen or professional cleaners for final cleaning.

B. Conduct inspection of sight-exposed interior and exterior finished surfaces, and of concealed spaces.

C. Remove grease, dust, dirt, stains, labels, fingerprints, and other foreign materials from sight-exposed interior and exterior finished surfaces; polish surfaces so designated to shine finish.

D. Repair, patch and touch-up marred surfaces to specified finish, to match adjacent surfaces.

E. Remove all foreign materials from site area.

F. Broom clean paved surfaces; rake clean other surfaces of grounds.

-END-

SECTION 01720 – PROJECT RECORD DOCUMENTS

PART 1 - GENERAL

1.01 Description

A. This Section includes administrative and procedural requirements for Project Record Documents.

B. Project Record Documents required include the following as applicable:

1. Marked-up copies of Contract Drawings.
2. Marked-up copies of Shop Drawings.
3. Newly prepared drawings.
4. Marked-up copies of Addenda, and Change Orders.
5. Marked-up Product Data submittals.
6. Field Orders.
7. Record Samples.
8. Field records for variable and concealed conditions.
9. Record information on Work that is recorded only schematically.
10. Field Test Reports.
11. Equipment Test Reports

1.02 Related Sections

A. Submittals – Section 01300.

1.03 Maintenance of Documents and Samples

A. Provide files and racks for storage of documents. File Drawings in accordance with Project Filing Format of Uniform Construction Index. Store record documents and samples in the field office apart from the Contract Documents used for construction. Do not use Project Record Documents for construction purposes. Maintain record documents in good order and in a clean, dry, legible condition. Make documents and samples available at all times for the Engineer's inspections.

1.04 Submittals

A. At least two weeks prior to substantial completion, deliver two sets of "Contractor's Record Drawings" to Engineer. The Engineer shall review the Record Drawings for completeness prior to acceptance. If the Engineer determines the Record Drawings are not in conformance with the specifications, the Engineer will return the Record Drawings to the Contractor. The Contractor shall revise the Record Drawings and resubmit to the Engineer prior to substantial completion. The Engineer shall review the revised Record Drawings for completeness. If the revised Record Drawings are not in conformance with the specifications, the Engineer or a third party as determined by the Owner, will then perform all necessary field survey and measurements, field excavations and locations, engineering calculations, and drafting to complete the Record Drawings in conformance with the specifications. The Contractor will be responsible for

payment to the Owner for work to make the corrections and revisions to the incomplete Record Drawings submitted by the Contractor. The Engineer WILL NOT recommend Substantial Completion until Record Drawings are submitted and approved.

B. Equipment Manuals

Deliver Equipment Manuals per Section 01300 – Submittals.

1.05 Record Drawings

A. Markup Procedure: During construction, maintain a set of blue- or black-line white prints of Contract Drawings and Shop Drawings for Project Record Document purposes. Label each drawing "Contractor's Record Drawing" in two-inch high printed letters. Keep Record Drawings current. Do not permanently conceal any work until required information has been recorded.

1. Legibly mark these Drawings to show the actual installations where the installation varies from the installation shown originally. Give particular attention to information on concealed elements that would be difficult to identify or measure and record later. Items required to be marked include as applicable, but are not limited to, the following:
   a. Dimensional changes to the Drawings.
   b. Revisions to details shown on the Drawings.
   c. Depths of foundations below the first floor.
   d. Locations and depths of underground utilities.
      1) All valves (gate, plug, air release, combination sewage, etc.) shall be located and referenced to three (3) permanent surface improvements.
      2) All fittings (tees, wyes, bends, crosses, plugs, caps, etc.) shall be located and reference to three (3) permanent surface improvements.
      3) All force mains shall be located and referenced to the centerline of the road or street at 500 foot minimum intervals.
      4) All structures (manholes, vaults, etc.) shall be located and referenced to three (3) permanent surface improvements.
      5) All sewer laterals shall be located and referenced to the downstream manhole (stationing in feet) and depth of lateral at property line.
   e. Revisions to routing of piping and conduits.
   f. Revisions to electrical circuitry.
   g. Actual equipment locations.
   h. Duct size and routing.
   i. Locations of concealed internal utilities.
   j. Changes made by Change Order or Construction Change Directive.
   k. Changes made following the Engineer's written orders.
   l. Details not on original Contract Drawings.
2. Mark record prints of Contract Drawings or Shop Drawings, whichever is most capable of showing actual physical conditions, completely and accurately. Where Shop Drawings are marked, show cross-reference on Contract Drawings location.
3. Mark record sets with red erasable colored pencil. Use other colors to distinguish between changes for different categories of the Work at the same location.

4. Mark important additional information that was either shown schematically or omitted from original Drawings.
5. Note Construction Change Directive numbers, alternate numbers, Change Order numbers, and similar identification.
6. Contractor may complete as-built drawings in electronic format using an Engineer-approved CAD-based software.

B. Responsibility for Markup: The individual or entity who obtained record data, whether the individual or entity is the Installer, subcontractor, or similar entity, shall prepare the markup on Record Drawings.

1. Accurately record information in an understandable drawing technique.
2. Record data as soon as possible after obtaining it. Record and check the markup prior to enclosing concealed installations.
3. At the time of Substantial Completion, submit Record Drawings to the Engineer for the Owner's records. Organize into sets and bind and label sets for the Owner's continued use.
4. Contractor shall be solely responsible for the measurement and recording of the Record Drawings. The presence of the Engineer or Owner shall not relieve the Contractor in any way of his/her obligation in this regard.

1.06 Record Product Data

A. During the construction period, maintain one copy of each Product Data submittal for Project Record Document purposes.

1. Mark Product Data to indicate the actual product installation where the installation varies substantially from that indicated in Product Data submitted. Include significant changes in the product delivered to the site and changes in manufacturer's instructions and recommendations for installation.
2. Give particular attention to information on concealed products and installations that cannot be readily identified and recorded later.
3. Note related Change Orders and markup of Record Drawings, where applicable.
4. Upon completion of markup, submit a complete set of Product Data to the Engineer for the Owner's records.
5. Where record Product Data is required as part of maintenance manuals, submit marked-up Product Data as an insert in the manual instead of submittal as record Product Data.
6. Each prime contractor is responsible for marking up and submitting record Product Data for its own Work.

1.07 Record Sample Submittal

A. Immediately prior to date of Substantial Completion meet with the Engineer and the Owner's personnel at the site to determine which of the samples maintained during the construction period shall be transmitted to the Owner for record purposes. Comply with the Engineer's instructions for packaging, identification marking, and delivery to the Owner's Sample storage space. Dispose of other samples in a manner specified for disposing surplus and waste materials.

1.08 Miscellaneous Record Submittals

A. Refer to other Specification Sections for miscellaneous record-keeping requirements and submittals in connection with various construction activities. Immediately prior to Substantial Completion, complete miscellaneous records and place in good order, properly identified and bound or filed, ready for use and reference. Submit to the Engineer for the Owner's records.

1. Categories of requirements resulting in miscellaneous records include as applicable, but are not limited to, the following:
   a. Field records on excavations and foundations.
   b. Field records on underground construction and similar work.
   c. Survey showing locations and elevations of underground lines.
   d. Invert elevations of drainage piping.
   e. Surveys establishing building lines and levels.
   f. Authorized measurements utilizing unit prices or allowances.
   g. Records of landscaping and plant treatments.
   h. Ambient and substrate condition tests.
   i. Certification received in lieu of labels on bulk products.
   j. Batch mixing and bulk delivery records.
   k. Testing and qualification of tradesmen.
   l. Documented qualification of installation firms.
   m. Load and performance testing.
   n. Inspections and certifications by governing authorities.
   o. Leakage and water-penetration tests.
   p. Fire-resistance and flame-spread test results.
   q. Final inspection and correction procedures.

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 Recording

A. Post changes and modifications to the Documents as they occur. Do not wait until the end of the Project.

B. The Documents shall be available for review by the Engineer and Owner at all times. The Contractor shall have the Documents readily available for review at the monthly progress meetings. Periodic Payment Claims may be withheld if record documents are not kept updated in a satisfactory manner.

-END-

SECTION 01731 - CUTTING AND PATCHING

PART 1 - GENERAL

1.01 Description

A. This Section includes procedural requirements for cutting and patching.

B. Related Sections include the following:

1. Demolition of selected portions of the Work for alterations – Section 02050.
2. For specific requirements and limitations applicable to cutting and patching individual parts of the Work – Divisions 2 through 16.
   a. Requirements in this Section apply to mechanical and electrical installations. Refer to Divisions 15 and 16 Sections for other requirements and limitations applicable to cutting and patching mechanical and electrical installations.

1.02 Definitions

A. Cutting: Removal of existing construction necessary to permit installation or performance of other Work.

B. Patching: Fitting and repair work required to restore surfaces to original conditions after installation of other Work.

1.03 Submittals

A. Cutting and Patching Proposal: Submit a proposal describing procedures at least 10 days before the time cutting and patching will be performed, requesting approval to proceed. Include the following information:

1. Extent: Describe cutting and patching, show how they will be performed, and indicate why they cannot be avoided.
2. Changes to Existing Construction: Describe anticipated results. Include changes to structural elements and operating components as well as changes in building's appearance and other significant visual elements.
3. Products: List products to be used and firms or entities that will perform the Work.
4. Dates: Indicate when cutting and patching will be performed.
5. Utilities: List utilities that cutting and patching procedures will disturb or affect. List utilities that will be relocated and those that will be temporarily out of service. Indicate how long service will be disrupted.
6. Structural Elements: Where cutting and patching involve adding reinforcement to structural elements, submit details and engineering calculations showing integration of reinforcement with original structure.
7. Engineer's Approval: Obtain approval of cutting and patching proposal before cutting and patching. Approval does not waive right to later require removal and replacement of unsatisfactory work.

1.04 Quality Assurance

A. Structural Elements: Do not cut and patch structural elements in a manner that could change their load-carrying capacity or load-deflection ratio.

B. Operational Elements: Do not cut and patch the following operating elements and related components in a manner that results in reducing their capacity to perform as intended or that result in increased maintenance or decreased operational life or safety.

1. Primary operational systems and equipment.
2. Air or smoke barriers.
3. Fire-protection systems.
4. Control systems.
5. Communication systems.
6. Conveying systems.
7. Electrical wiring systems.
8. Operating systems of special construction in Division 13 Sections.
9. Piping systems.
10. Ventilation systems.

C. Miscellaneous Elements: Do not cut and patch the following elements or related components in a manner that could change their load-carrying capacity, that results in reducing their capacity to perform as intended, or that result in increased maintenance or decreased operational life or safety.

1. Water, moisture, or vapor barriers.
2. Membranes and flashings.
3. Exterior curtain-wall construction.
4. Equipment supports.
5. Piping, ductwork, vessels, and equipment.
6. Noise- and vibration-control elements and systems.

D. Visual Requirements: Do not cut and patch construction in a manner that results in visual evidence of cutting and patching. Do not cut and patch construction exposed on the exterior or in occupied spaces in a manner that would, in Engineer's opinion, reduce the building's aesthetic qualities. Remove and replace construction that has been cut and patched in a visually unsatisfactory manner.

PART 2 - PRODUCTS

2.01 Materials

A. General: Comply with requirements specified in other Sections of these Specifications.

B. Existing Materials: Use materials identical to existing materials. For exposed surfaces, use materials that visually match existing adjacent surfaces to the fullest extent possible.

1. If identical materials are unavailable or cannot be used, use materials that, when installed, will match the visual and functional performance of existing materials.

PART 3 - EXECUTION

3.01 Examination

A. Examine surfaces to be cut and patched and conditions under which cutting and patching are to be performed.

1. Compatibility: Before patching, verify compatibility with and suitability of substrates, including compatibility with existing finishes or primers.
2. Proceed with installation only after unsafe or unsatisfactory conditions have been corrected.

3.02 Preparation

A. Temporary Support: Provide temporary support of Work to be cut.

B. Protection: Protect existing construction during cutting and patching to prevent damage. Provide protection from adverse weather conditions for portions of Project that might be exposed during cutting and patching operations.

C. Adjoining Areas: Avoid interference with use of adjoining areas or interruption of free passage to adjoining areas.

D. Existing Services: Where existing services are required to be removed, relocated, or abandoned, bypass such services before cutting to minimize or avoid interruption of services to occupied areas.

3.03 Performance

A. General: Employ skilled workers to perform cutting and patching. Proceed with cutting and patching at the earliest feasible time, and complete without delay.

1. Cut existing construction to provide for installation of other components or performance of other construction, and subsequently patch as required to restore surfaces to their original condition.

B. Cutting: Cut existing construction by sawing, drilling, breaking, chipping, grinding, and similar operations, including excavation, using methods least likely to damage elements retained or adjoining construction. If possible, review proposed procedures with original Installer; comply with original Installer's written recommendations.

1. In general, use hand or small power tools designed for sawing and grinding, not hammering and chopping. Cut holes and slots as small as possible, neatly to size required, and with minimum disturbance of adjacent surfaces. Temporarily cover openings when not in use.
2. Existing Finished Surfaces: Cut or drill from the exposed or finished side into concealed surfaces.

3. Concrete and Masonry: Cut using a cutting machine, such as an abrasive saw or a diamond-core drill.
4. Excavating and Backfilling: Comply with requirements in applicable Division 2 Sections where required by cutting and patching operations.
5. Mechanical and Electrical Services: Cut off pipe or conduit in walls or partitions to be removed. Cap, valve, or plug and seal remaining portion of pipe or conduit to prevent entrance of moisture or other foreign matter after cutting.
6. Proceed with patching after construction operations requiring cutting are complete.

C. Patching: Patch construction by filling, repairing, refinishing, closing up, and similar operations following performance of other Work. Patch with durable seams that are as invisible as possible. Provide materials and comply with installation requirements specified in other Sections of these Specifications.

1. Inspection: Where feasible, test and inspect patched areas after completion to demonstrate integrity of installation.
2. Exposed Finishes: Restore exposed finishes of patched areas and extend finish restoration into retained adjoining construction in a manner that will eliminate evidence of patching and refinishing.
3. Floors and Walls: Where walls or partitions that are removed extend one finished area into another, patch and repair floor and wall surfaces in the new space. Provide an even surface of uniform finish, color, texture, and appearance. Remove existing floor and wall coverings and replace with new materials, if necessary, to achieve uniform color and appearance.
   a. Where patching occurs in a painted surface, apply primer and intermediate paint coats over the patch and apply final paint coat over entire unbroken surface containing the patch. Provide additional coats until patch blends with adjacent surfaces.
4. Ceilings: Patch, repair, or re-hang existing ceilings as necessary to provide an even-plane surface of uniform appearance.
5. Exterior Building Enclosure: Patch components in a manner that restores enclosure to a weathertight condition.
6. For watertight structures, patch and seal leaks using approved, compatible materials per the manufacturer’s recommendations.

-END-

DIVISION 2 – SITE WORK

SECTION 02050 - DEMOLITION

PART 1 - GENERAL

1.01 Description

A. Demolish, wholly or in part, and dispose of existing buildings, structures, equipment, materials, piping, pavement, fences, guard-rails, and do related work necessary to complete work shown or specified.

B. Demolition shall include the salvaging of designated piping and equipment and the backfilling of trenches, holes, and pits resulting from demolition work.

C. The limits of demolition shall be as indicated on the Drawings or specified in this Section.

D. Removed items to remain the property of the Owner shall be as indicated on the Data Sheet for Demolition.

1.02 Related Work Specified Elsewhere

A. Section 01500 – Construction Facilities and Temporary Controls

B. Section 01550 - Plant Operations During Construction

C. Section 02200 - Earthwork

D. Section 02220 - Trenching, Backfilling and Compaction

1.03 Quality Assurance

A. Accomplish all demolition so there is no injury to any persons and no damage to adjacent structures or property. All demolition methods shall be in full compliance with municipal, county, state, and federal ordinances. Demolition work shall comply with the requirements of the Occupational Safety & Health Administration (OSHA).

B. Comply with all municipal, county, state and federal ordinances regarding the disposal of rubble, scrap metal, and refuse.

C. Develop demolition procedures and submit to the Engineer before demolition is started. The procedures shall provide for safe conduct of the work, protection of property to remain undisturbed, including the installation of dust barriers at occupied areas of buildings, and coordination with other work in progress. The procedures shall include a detailed description of the methods and equipment to be used for each operation and sequence of operations.

1.04 Job Conditions

A. General: Visit the site and inspect the nature and condition of the items to be removed before submitting the Bid.

B. Disconnect utilities at the points indicated on the Drawings or as specified. Where such disconnection will interrupt the utility services to an area not included in the contract, arrangements for such interruption shall be made with the Engineer at least 72 hours in advance of the interruption.

C. Asbestos: If, during the course of this work, the existence of asbestos is observed in the work area, promptly notify the Owner in writing. Do no perform any work pertinent to the asbestos material prior to receipt of special instructions from the Owner.

   1. Should any special measures be required, the cost thereof shall be handled by an appropriate Change Order or a separate contract or subcontract with the Owner.

D. Dust Control: Control the amount of dust resulting from demolition to prevent the spread of dust to occupied portions of buildings and to avoid creation of nuisance in the surrounding area. Do not use water when it will result in, or create, hazardous or objectionable conditions such as ice, flooding, and pollution.

E. Protection of Existing Work: Protect existing work. Damage shall be repaired to match existing work.

PART 2 - PRODUCTS

2.01 Temporary Materials

Temporary fencing, barricades, and other items shall meet the requirements specified in Section 01500, Construction Facilities and Temporary Controls.

2.02 Repair and Replacement Materials

Materials used in the repair or replacement of existing work to remain shall be identical or equal to the materials used in existing work when new.

PART 3 - EXECUTION

3.01 Concrete Removal

A. Concrete shall be removed to the next adjacent joint whenever possible.

B. All concrete to be removed shall be sawed at all locations where it is adjacent to existing concrete and cannot be removed to a straight line.

C. When removing concrete adjacent to buildings, take care to not damage the building. Repair building damage at no additional compensation. Determine the best way to remove concrete at buildings. If the existing sidewalk is an integral part of the building, save the pavement as close to the building as possible, at the direction of the Engineer.

D. Where concrete sidewalk is removed over existing basement vaults, take care to not damage the structural components of the vault.

3.02 Structures and Buildings

A. Remove all parts of existing structures and buildings to be demolished which interfere with new work.

B. Remove walls to not less than two feet below finish grade unless the Drawings indicate otherwise or require complete removal. Break up slabs in basements and tanks which are to be abandoned and filled with earth. Break up and displace slabs in a manner which permits the proper flow of groundwater.

C. When structures and buildings are to be partially demolished, the break between the part removed and the part remaining shall be as indicated on the Drawings.

D. Completely remove concrete bases for tanks, poles, towers, and similar structures if the bases are less than one cubic yard in volume or less than three feet below finish grade. Remove other concrete bases to not less than two feet below finish grade unless the Drawings indicated complete removal.

3.03 Equipment

A. Completely remove equipment which is designated to be removed.

B. Remove equipment concrete bases if the existing bases are not to be used for new equipment.

1. Completely remove isolated equipment bases.
2. Remove bases which are in buildings or on slabs and repair floors as indicated on the Drawings.

C. Remove parts of equipment bases to be modified and modify equipment bases as indicated on the Drawings.

D. Where existing equipment is shown to be removed, all exposed small piping, wiring, and conduit associated specifically with that equipment shall also be removed to the source, even if not shown on the Drawings.

E. Equipment, piping, and materials designated to remain property of the Owner shall be removed in a manner to preserve the existing conditions of such items. Damage caused by removing and transporting such items shall be repaired at the Contractor's expense. Such damage shall include, but not be limited to, bending, warping, burning, and impacting, and any damage caused from dropping, wetting, or otherwise mishandling.

3.04 Piping and Utilities

A. Completely remove piping, conduit, and wiring shown on the Drawings or in structures and buildings which are to be demolished. Completely remove piping, conduit, and wiring in the demolished parts of structures and buildings which are to be partially demolished. Completely remove other piping, conduit, and wiring which are designated to be removed. Removal of piping shall include the removal of all applicable supports and hangars.

B. Underground piping, conduit, and wiring which are to be abandoned and do not interfere with new work may be left in place, unless otherwise shown on the Drawings. Plug and seal cut ends of underground piping to be abandoned. Do not leave abandoned branches of piping and wiring "live". Isolate abandoned branches by closing branch valve at main or by disconnecting branch at main. Plug, cap, and seal active branch at isolating valve or point of disconnection.

3.05 Pavement, Sidewalks, Curbs, and Gutters

A. Completely remove pavement, sidewalk, curbs, and gutters, including base material, which are designated to be removed.

B. Use methods to remove pavement, sidewalks, curbs, and gutters that will assure breaks in pavement, sidewalks, curbs, and gutters not removed are along straight lines. The faces of the remaining pavement, sidewalk, curb, and gutter faces shall be approximately vertical.

3.06 Openings

Plug all openings in walls, floors, and ceilings resulting from the removal of existing equipment, piping, and conduit. Plug openings with pipe plugs, blind flanges, caps, or expansive grout. Plug openings in a manner that will result in a structurally suitable seal and a neat and presentable appearance. All openings in block, brick, stone, or metal walls, roofs, or other material resulting from demolition shall be patched with the same material. Openings left in roofs shall be patched watertight with similar roofing materials.

3.07 Disposal

A. Equipment, piping, and materials which are designated to remain the property of the Owner shall be moved to a location within, or adjacent to, the project site designated by the Owner.

B. All removed equipment, piping, and materials not specifically designated to remain the property of the Owner shall become the property of the Contractor and shall be removed from the site and disposed by the Contractor.

C. Do not allow debris and rubbish to accumulate on the site. Remove debris and rubbish from the site.

D. All material shall be disposed of in accordance with local and state regulations. The contractor shall obtain all permits necessary to dispose of materials.

3.08 Filling

A. Backfill excavations resulting from demolition.

B. Backfill excavations beneath new structures, buildings, piping, and other new work including pavement as specified in Section 02200, Earthwork.

C. Backfill excavations which will not be beneath new structures, buildings, piping, or other work as specified in this paragraph.

1. Backfill excavations more than three feet deep or more than five cubic yards in volume as specified in Section 02200, Earthwork.
2. Place and compact backfill in other excavations to produce an adequate foundation for seeding. The top 6 inches of backfill shall be topsoil.

3.09 Exposed Bolts and Hardware

Bolts and hardware left exposed after demolition of piping or equipment shall be cut off flush to the wall, ceiling, or floor, coated, and voids remaining patched with grout.

3.10 Coating

Where equipment and miscellaneous items are removed from areas which are coated, if an existing area is uncoated and now exposed due to the removal or demolition of an item, that area shall be coated to match existing. All miscellaneous metals associated with demolished items which remain shall be coated.

3.11 Clean-Up

A. Clean-up in areas where other work is to be done following demolition shall be as specified in the applicable Sections.

B. Clean-up the job site in areas where no other work is to be done under this Contract following demolition. Remove all debris and rubbish, temporary facilities, and equipment. Level surface irregularities to eliminate depressions. Leave the work in a neat and presentable condition.

DEMOLITION DATA SHEET

Items selected by the Owner during the work shall remain the property of Owner and are identified below. Contractor shall relocate items to a storage location on-site or adjacent to the project site as designated by the Owner. All items not selected by the Owner become the property of the Contractor unless indicated otherwise on the Drawings.

ITEM	LOCATION

-END-

SECTION 02101 - STORM WATER POLLUTION PREVENTION AND EROSION CONTROL

PART 1 - GENERAL

1.01 Description

A. This item consists of temporary and permanent control measures as shown on the plans or as ordered by the Owner or Engineer during the life of a contract to control water pollution, soil erosion, and siltation through the use of berms, dams, dikes, gravel, mulches, grasses, slope drains, and other erosion control devices or methods.

B. Coordinate temporary erosion control measures contained herein with the permanent erosion control measures specified as part of this contract to the extent practical to assure economical, effective, and continuous erosion control throughout the construction period.

C. Temporary erosion control may include work outside the construction limits such as borrow pit operations, equipment and material storage sites, and waste areas.

D. Material handling and storage associated with construction activity shall meet the spill prevention and spill response requirements in Indiana Administrative Code 327 IAC 2-6.1.

1.02 Submittals

A. Notify Owner and Engineer when land disturbing activities have been completed, the entire site has been stabilized, and all temporary erosion control measures have been removed.

B. Submit schedules as specified herein to the Engineer.

1.04 Quality Assurance

A. Inspection Reports

PART 2 - PRODUCTS

2.01 Grass

A. Temporary Seed: Grass seed which will not compete with the grasses sown later for permanent cover shall be a quick-growing species (such as ryegrass, Italian ryegrass, or cereal grasses) suitable to the area providing a temporary cover. Temporary seeding shall be applied to all disturbed areas to be left idle for fifteen (15) days during the growing season, unless other erosion control measures are indicated on Drawings.

B. Permanent Seed:

1. Type, mixture, and application rate as shown on the Details.
2. Contain no more than 5% inert matter and no objectionable weeds.
3. Deliver permanent seed in new and unopened containers or bags with a seed label tag in accordance with the requirements of the Indiana Seed Law.

C. Sod:

1. Type as shown on the Details, free of weeds, at least two years old and strongly rooted.
2. Use within one week of its cutting before drying out.
3. Must be capable of growth upon planting.

2.02 Mulch

Mulch shall be hay, straw, fiber mats, netting, bark or wood fiber. Straw shall be threshed straw of cereal grain such as oats, wheat, barley, rye, and rice. Mulch shall not contain objectionable weeds, seeds, or other material that may be detrimental to the planting being established. Mulch shall be applied to all disturbed areas to be left idle for 15 days outside of the growing season, unless other measures are indicated on Drawings. Mulch shall be anchored unless held in place by a tackifier or netting.

Apply straw/hay mulch at a rate of 70 lbs. per 1,000 square feet. Apply wood fiber mulch at a rate of 46 lbs. per 1,000 square feet. Apply wood chips at a rate of 230 lbs. per 1,000 square feet.

2.03 Fertilizer

Fertilizer shall provide the minimum percentage of available nutrients (Nitrogen, Phosphorus, and Potash) based on soil content, seed mix, and local conditions and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists. If local conditions do not indicate otherwise, use 12-12-12 analysis fertilizer and an application rate of 400 to 600 pounds per acre.

2.04 Limestone

Apply agricultural lime from a dealer or manufacturer whose brands and grades are registered or licensed by the State of Indiana, Department of Agriculture. For the basis of quality control, agricultural ground (Ag-ground) limestone, having a minimum total neutralizing power (TNP) of 90+ percent, at least 40 percent passing a No. 100 (150 µm) sieve and 95 percent passing a No. 8 (2.36 mm) sieve, 100 percent of Ag-ground shall be applied. Application shall be at 92 pounds per 1000 sq ft (2 ton/acre). This rate shall be standard grade and rate. Other available forms of liming materials may be applied depending on their potential to neutralize soil acidity. Changes to the lime requirements will be determined by the pH test, as indicated on the soil analysis results. A slightly acid soil (pH 6.5) is recommended. When required by local soil conditions, apply agricultural lime to the surface.

2.05 Topsoil

A. Topsoil shall be:
   a. Natural, fertile, agricultural soil, capable of sustaining vigorous plant and lawn growth.
   b. Of uniform composition throughout, without admixture of subsoil.
   c. Free of stones, lumps, clods, and sticks larger than one inch, sod, live plants and roots, and other extraneous matter.

B. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site and approved by the Engineer. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches; do not obtain from bogs, marshes, or any area of hydric soil characteristics.

2.06 Temporary Slope Drains and Erosion Control Blanket

Where construction disturbs grassy slopes equal or steeper than 3:1, protect the slopes with an erosion control blanket. Use North American Green SC150 or approved equal. When necessary, route runoff away from steep slopes through the use of a temporary slope drain. Construct slope drains of strong flexible pipe, anchored every ten feet maximum, and include a tee or flared end section.

2.07 Silt Fence/Silt Socks

Use silt fence and silt socks to prevent soil erosion at top of slopes and at locations indicated on the Drawings.

2.08 Inlet Protection

Install inlet protection bags, Curb Inlet Protection/Curb, Drop Inlet Protection, or Gravel Donut inlet protection at all stormwater inlets within the construction area or impacted by construction area stormwater runoff to prevent sediments, construction debris, and other potential stormwater pollutants from entering storm sewer inlets and catch basins.

2.09 Temporary Curb and Paved Area Inlet Protection

Protect curb and paved area inlets receiving runoff from construction areas using stone bags, block and gravel, or insert baskets to prevent sediments, construction debris, and other potential storm water pollutants from entering storm sewers.

2.10 Rip Rap Check Dam

Install Rip Rap check dams to reduce erosion potential and capture potential pollutants in drainage channels.

2.11 Concrete Washout Area

Provide a designated concrete washout area for use of washing out concrete trucks in order to contain potential stormwater pollutants. This area shall be a minimum of 10' x 10' by 3' deep with a polyethylene lining, unless otherwise shown on the Drawings.

Alternatively, use a pre-fabricated containment system that is installed and maintained in accordance with the manufacturer's instructions. Include identifying signage, and orange safety fencing around the washout area perimeter. Remove contents periodically and reuse on site or dispose of properly.

2.12 Straw Bale Filters

Use straw bales filters for the slowing and filtering of storm water before it enters storm water conveyances such as driveway culverts or other inlet structures that drain small drainage areas.

2.13 Outlet Protection

Construct outlet protection to prevent erosion, and to provide energy dissipation and retain sediment in areas of concentrated flow, where storm water pipes outfall.

2.14 Pumping Bags

Use pumping bags to filter sediment from dewatering operations. Do not discharge sediment laden water from dewatering operations directly to any waterbody or storm water conveyance system.

2.15 Other

All other materials shall meet commercial grade standards and shall be approved by the Engineer before being incorporated into the project.

PART 3 - EXECUTION

3.01 General

Comply with all federal, state and local erosion control laws.

3.02 Schedule

Prior to the start of construction, submit schedules for accomplishing temporary and permanent erosion control work as applicable for clearing and grubbing, grading, construction, and paving. Also submit a proposed method of erosion and dust control on haul roads and a plan for disposal of waste materials. Do not be start work until the erosion control schedules and methods of operations for the applicable construction have been accepted by the Engineer.

3.03 Authority of Owner

The Owner has the authority to limit the surface area of erodible earth material exposed by clearing and grubbing, to limit the surface area of erodible earth material exposed by excavation, borrow, and fill operations, and to direct the Contractor to provide immediate permanent or temporary control measures to minimize contamination of adjacent streams or other watercourses, lakes, ponds, or other areas of water impoundment.

3.04 Dust Control

Minimize dust by the use of water to dampen surfaces, in order to prevent wind erosion. Implement dust control methods on a routine basis where conditions warrant or when requested by the Owner, Engineer, or Resident Project Representative.

3.05 Sediment Tracking

Clear accumulated sediment from public and private roadways that is a result of construction operations' sediment-laden run-off or vehicle tracking. Redistribute or dispose of sediment in a manner that is in accordance with all applicable statutes and regulations. Rinsing streets with water is not an acceptable practice unless the water is collected and disposed of properly.

3.06 Grass

A. Restore all non-paved surfaces that were disturbed during construction, unless shown otherwise on the Drawings, with permanent seeding or sod.

B. Prior to seeding, disturbed areas must be graded, and have or receive a minimum of six (6) inches of topsoil, as specified herein. Use excavated material which meets the specified requirements for topsoil or topsoil from another source.

C. Scarify the planting area to a minimum depth of six (6) inches. Mix soil amendments such as fertilizer and lime if required, in the top two to four inches of topsoil with a disk or rake operated across the slope.

D. Apply seed uniformly with a drill or cultipacker seeder, or by broadcasting; cover newly seeded areas with anchored mulch as specified.

E. Keep seeded and fertilized areas adequately watered to a minimum of one inch depth per week until germination of all seed is completed and uniform grass cover is accomplished.

F. Do not place frozen sod, and do not place sod on frozen or dry soil. Do not place sod when the air temperature is less than 32 degrees Fahrenheit.

G. Scarify the planting area to a minimum depth of four inches, and mix soil amendments such as fertilizer and lime if required, in the top two to four inches of topsoil with a disk or rake operated across the slope. Immediately prior to installing sod, water the planting area with a fine spray to a minimum penetration of one inch.

H. Lay sod with closely fitted abutting joints without stretching and overlapping, and stagger the ends of the strips. Trim and fit sod into irregular areas to eliminate gaps.

I. On sloped areas, lay sod starting from the bottom of the slope and lay sod horizontal to the contour. Where slopes are greater than a ratio of horizontal to vertical of 3 to 1, staple or stake each sod strip at the corners and in the middle.

J. After initial watering, tamp or roll sod with a roller to eliminate irregularities. Repeat watering at regular intervals to keep sod moist until it is rooted and to maintain growth until final acceptance.

3.07 Erosion Control Blanket/Matting

Place the erosion control blanket on a seedbed free of sticks, rocks and other objects larger than 1.0 inch and install in accordance with manufacturer's instructions.

3.08 Construction Details, General

A. Incorporate all permanent erosion control features into the project at the earliest practicable time as outlined in the accepted schedule. Except where future construction operations will damage slopes, perform the permanent seeding and mulching and other specified slope protection work in stages as soon as substantial areas of exposed slopes can be made available. Use temporary erosion and pollution control measures to correct conditions that develop during construction that were not foreseen during the design stage, that are needed prior to installation of permanent control features, or that are needed temporarily to control erosion that develops during normal construction practices but are not associated with permanent control features on the project.

B. Where erosion is likely to be a problem, schedule and perform clearing and grubbing operations so that grading operations and permanent erosion control features can follow immediately thereafter if the project conditions permit; otherwise, temporary erosion control measures may be required between successive construction stages.

C. The Owner may limit the area of clearing and grubbing, excavation, borrow, and embankment operations in progress, commensurate with the Contractor's capability and progress in keeping the finished grading, mulching, seeding, and other such permanent control measures current in accordance with the accepted schedule. Should seasonal limitations make such coordination unrealistic, take temporary erosion control measures immediately to the extent feasible and justified.

D. In the event that temporary erosion and pollution control measures are required due to the Contractor's negligence, carelessness, or failure to install permanent controls as a part of the work as scheduled or are ordered by the Owner, such work shall be performed by the Contractor at his/her own expense.

E. The Owner may increase or decrease the area of erodible earth material to be exposed at one time as determined by analysis of project conditions.

F. Acceptably maintain the erosion control features during the construction period, as determined by the Engineer.

H. Discharge of sediment-laden water from trenches or other excavations by means of a pump or similar means into a manufactured filter bag in accordance with the manufacturer's recommendations unless the pumped water is routed through another erosion control measure such as a sediment trap or outlets onto a well-

established vegetated area without eroding. Filter bags shall either be biodegradable or be properly disposed of from the site.

I. Do not discharge pollutants such as fuels, lubricants, bitumen, raw sewage, wash water from concrete mixing operations (concrete washout), water from trench or pit dewatering, and other harmful materials into or near storm water conveyances, wetlands, rivers, streams, and impoundments or into natural or manmade channels leading thereto.

J. Do not apply pesticides when working in or adjacent to a river, stream, ditch, or other open storm water conveyance.

K. Temporarily or permanently stabilize unvegetated areas that are scheduled or likely to be left inactive for fifteen (15) days or more with measures appropriate for the season to minimize erosion potential.

L. Construction Details are included at the end of this Section

3.09 Maintenance Inspection Procedures

A. Inspections

1. Perform an inspection of erosion control measures in place at least once every seven days.
2. Inspect all erosion control measures in place the next business day after any storm event greater than 0.5 inches of rain has occurred.
3. Conduct a weekly inspection of the construction site with the Resident Project Representative to identify areas contributing to storm water discharges associated with construction activity.
4. Inspect disturbed areas, material storage areas, and equipment storage areas that are exposed to precipitation on a regular basis for evidence of, or the potential for, pollutants entering the drainage system.
5. Inspect storm water discharge locations to determine if erosion control measures are effective in preventing significant impacts to receiving waters.
6. Inspect erosion control devices installed as specified to ensure that they are operating properly.
7. Inspect haul routes and construction entrance(s) to work areas daily for evidence of off-site vehicle tracking of mud and dirt.
8. The Resident Project Representative will periodically inspect the staging area to ensure that solid and liquid wastes are being properly disposed of and are not allowed to be discharged into stormwater runoff.

B. Maintenance: Maintain all erosion control measures throughout the project and until such time as the disturbed area has been completely stabilized or other provisions have altered the need for these measures.

1. Replace mulch materials to their original level when the level has been substantially reduced due to decomposition of the organic mulches and displacement or disappearance of both the organic and inorganic mulches.
2. Remove rubbish and channel obstructions from bare and vegetated channel within the project limits. Repair damage from scour or bank failure, rodent holes

and breaching of diversion structures. Excessive wear, movement or failure of erosion control blankets shall be repaired immediately. Remove deposits of sediment from the channel.

3. Repair any damage to silt fence barriers immediately and monitor barriers daily during prolonged rainfall.
4. Repair or replace any silt fence fabric which has decomposed or become ineffective prior to its expected usable life.
5. Remove sediment deposits after each storm event. Sediment must be removed when deposits reach approximately half the height of the silt fence barrier.
6. Till and smooth to conform to the existing grade and reseed any sediment deposits remaining in place after the silt fence barrier is no longer required.
7. Maintain the construction entrances in a condition to prevent tracking or flowing of sediment onto roads. This could require periodic top dressing with additional surface materials as conditions demand. Repair and clean out any features used to trap sediment and remove all sediment spilled, dropped, washed or tracked on road and return to the point of likely origin.
8. Remove accumulated sediments and debris from inlet protection devices after each storm event.
9. Periodically remove concrete from the concrete washout area, as needed to maintain available space for the future washout and rainwater.
10. Repair any and all rills that may appear. Re-grade to eliminate rill and stabilize ground by seeding or other methods as approved by Engineer.
11. Remove and dispose of all temporary erosion and sediment control practices within 30 days after site stabilization is achieved or after the temporary practices are no longer needed, as determined by the Engineer. Permanently stabilize trapped sediment to prevent further erosion.

-END-

SECTION 02102 – MATERIAL HANDLING AND SPILL PREVENTION PLAN

PART 1 - GENERAL

1.01 Summary

A. Purpose: The purpose of this plan is two-fold: 1. To help protect the health and safety of those working on the site as well as the environment. 2. Prevent the contamination of storm water runoff. Pollutants generated onsite may include gasoline, diesel fuel, oils, grease, paints, pesticides, nutrients, concrete washout, soil, solvents, paper, plastic, Styrofoam, metals, glass, and other forms of liquid or solid wastes. This plan outlines procedures to help prevent health and safety issues, contamination of storm water by onsite pollutants, help prevent fuel and chemical spills, and provide a response procedure should a spill occur.

B. Material handling and storage associated with construction activity shall comply with the spill prevention and spill response requirements in Indiana Administrative Code 327 IAC 2-6.1.

C. Related Sections

1. Section 02101 – Storm Water Pollution Prevention and Erosion Control.
2. Section 02110 – Site Clearing

PART 2 - PRODUCTS

Not Used.

PART 3 - EXECUTION

3.01 Prevention and Readiness

A. Prepare a contact list in the event of a spill on the site. The contact list will have names and contact numbers. The contact list will specify first responders and a chain of command. Include information on what circumstances require the initiation of the contact list and chain of command.

B. Maintain a list of qualified contractors, Vac-trucks, tank pumpers, and other equipment or businesses qualified to perform clean-up operations. Absorbent materials and supplies need to be available onsite in sufficient quantities to address minor spills. Train all employees in proper spill response procedures.

C. All construction personnel and equipment operators must be aware of and trained for prevention of spills.

3.02 Spill Response

A. Dispose of all materials used in the course of a cleanup in a manner approved by Indiana Department of Environmental Management (IDEM).

B. Using water to flush spilled material will not be permitted unless authorized by a Federal, State, or local agency. Tarps can be used to cover spilled material during rain events.

C. Minor Spills

Approximately 10 gallons or less of pollutant with no contamination of ground or surface waters. Minor spills can be generally controlled by the first responder with help from other site personnel. At the discovery of the spill:

1. Contain spill to prevent material from entering storm or groundwater. Do not flush with water or bury.
2. Use absorbent material to clean-up spills and dispose of properly. Spills on impervious surfaces should be contained with a dry absorbent. Spills on clayey soils should be contained by constructing an earthen dike and should be disposed of as soon as possible to prevent migration deeper into the soil and groundwater. Dispose of contaminated soils or absorbents properly in accordance with all Federal, State, and local regulations.
3. Contact 911 if this spill could be a safety issue.
4. Contact supervisors and designated inspectors immediately.
5. Contaminated solids shall be removed to an approved landfill.

D. Major or Hazardous Spills

More than 10 gallons with the potential for death, injury, or illness to humans or animals or has the potential for surface or groundwater pollution.

1. Control or contain the spill without risking bodily harm.
2. Temporarily plug storm drains if possible to prevent migration of the spill into the storm water system.
3. Immediately contact the local Fire Department at 911 to report any hazardous material spill.
4. Contact supervisors and designated inspectors immediately. Other county or municipal officials responsible for storm water facilities should be contacted as applicable. The Contractor is responsible for having these contact numbers available at the job site. A written report shall be submitted to the Owner as soon as possible.
5. As soon as possible but within 2 hours of discovery, contact the Indiana Department of Environmental Management, Office of Emergency Response 1-888-233-7745. The following information shall be noted for future reports to IDEM or the National Response Center:
   a. Name, address and phone number of person making the spill report,
   b. The location of the spill,
   c. The time of the spill,
   d. Identification of the spilled substance,

e. Approximate quantity of the substance that has been spilled or may be further spilled,
f. The duration and source of the spill,
g. Name and location of the damaged waters,
h. Name of spill response organization,
i. What measures were taken in the spill response, and
j. Other information that may be pertinent.

E. Additional regulation or requirements may be required. A spill response professional should be consulted to ensure that all appropriate and required steps have been taken. Contaminated material should only be removed from the site after approval is given by Emergency Response.

3.03 Spill Prevention and Material Handling Practices

A. Vehicle and Equipment Fueling

1. Description and Purpose - Vehicle equipment fueling procedures and practices are designed to prevent fuel spills and leaks, and reduce or eliminate contamination of storm water. This can be accomplished by using offsite commercial facilities, fueling in designated areas only, enclosing or covering stored fuel, implementing spill controls, and training employees and subcontractors in proper fueling procedures.
2. Limitations - Onsite vehicle and equipment fueling should only be used where it is impractical to send vehicles and equipment offsite to a commercial fueling station.
3. Implementation
   a. Use offsite commercial fueling stations when possible. These businesses are better equipped to handle fuel and spills properly. Performing this work offsite eliminates the need for a separate fueling area at a site.
   b. Discourage “topping-off” of fuel tanks.
   c. Keep available absorbent spill cleanup materials and spill kits in fueling areas and on fueling trucks. Dispose of spill cleanup materials after use, in accordance with all Federal, State, and local regulations.
   d. Drip pans or absorbent pads should be used during vehicle and equipment fueling, unless the fueling is performed over an impermeable surface in a dedicated fueling area.
   e. Use absorbent materials on small spills. Do not hose down or bury the spill. Remove the absorbent materials promptly and dispose of properly.
   f. Avoid mobile fueling of mobile construction equipment; rather, transport the equipment to designated fueling areas.
   g. Train employees and subcontractors in proper fueling and cleanup procedures.
   h. Dedicated fueling areas shall be protected from storm water run-on and runoff, and shall be located at least 50 feet away from the downstream drainage facilities, storm water conveyances, or waterways.
   i. Fueling must be performed on level-grade areas.
   j. Protect fueling areas with berms and dikes to contain spills.
   k. Nozzles used in vehicle and equipment fueling shall be equipped with an automatic shutoff to control drips.

l. Fueling operations shall not be left unattended.
m. Federal, State, and local regulations shall be observed for any stationary above ground storage tanks.
n. All petroleum products shall be stored in tightly sealed containers which are clearly labeled.

4. Inspection and Maintenance
   a. Vehicles and equipment shall be inspected daily for leaks. Leaks must be repaired immediately or removed from the project site.
   b. Maintain spill cleanup materials onsite and in close proximity to fueling areas.
   c. Immediately clean up spills and properly dispose of contaminated materials.

B. Solid Waste Management

1. Description of Purpose - Solid waste management procedures and practices are designed to prevent or reduce the discharge of pollutants to storm water from solid or construction waste by providing designated waste collection areas and containers, arranging for regular disposal, and training employees and subcontractors.
2. Suitable Applications - This Best Management Practice (BMP) is suitable for construction sites where the following wastes are generated or stored:
   a. Solid waste generated from trees and shrubs removed during land clearing, demolition of existing structures (rubble), and building construction.
   b. Packaging materials including wood, paper, and plastic.
   c. Scrap or surplus building materials including scrap metals, rubber, plastic, glass pieces, and masonry products.
   d. Domestic wastes including food containers such as beverage cans, coffee cups, paper bags, plastic wrappers, and cigarettes.
   e. Construction waste including brick, mortar, timber, steel and metal scraps, pipe and electrical cuttings, non-hazardous equipment parts. Styrofoam and other packaging for construction materials.
   f. Sediments and other materials collected in erosion and sediment control BMPs (silt fence, inlet protection, catch basin sumps, etc.)
   g. Natural debris such as excess soil, stone, sand, leaves, branches, brush or wood.
3. Implementation - The following steps will help keep a clean site and reduce storm water pollution:
   a. Develop a plan for proper waste disposal. If a commercial disposal facility will not be utilized, then a Storm Water Pollution Prevention Plan must be developed for the selected disposal area.
   b. Select designated waste collection areas onsite.
   c. Inform trash-hauling contractors that only watertight dumpsters are acceptable for onsite use.
   d. Inspect dumpsters for leaks and repair any and all dumpsters that are not watertight.
   e. Provide an adequate number of containers with lids or covers that can be placed over the container to prevent loss of wastes from wind and to prevent the collection of rainwater.

f. Plan for additional containers and more frequent pickup during the demolition phase of construction as applicable.
g. Collect site trash daily, especially during rainy and windy conditions.
h. Remove solid waste promptly from erosion and sediment control devices that tend to collect litter.
i. Ensure that toxic liquid wastes (used oils, solvents, and paints) and chemicals (acid, pesticides, additives, curing compounds) are not disposed of in dumpsters designed for construction debris.
j. Do not hose out dumpsters on the construction site. Dumpster cleaning should be conducted by the trash hauling contractor off site.
k. Arrange for regular waste collection before containers overflow.
l. Clean up immediately if a container spills, leaks, or overflows.
m. Make sure that construction waste is collected, removed, and disposed of only at authorized disposal areas. Solid waste storage areas should not be located in areas prone to flooding or ponding.
n. Locate solid waste dumpsters a minimum of 50 feet away from storm water inlets or other drainage facilities.
o. Minimize the potential for spills or leaks to drain immediately into a drainage facility.
p. No construction waste shall be buried on-site.
q. Dump trucks hauling material from the construction site shall cover the material with a tarpaulin.

4. Inspection and Maintenance
   a. Inspect construction waste areas regularly.
   b. Arrange for regular waste collection.

C. Vehicle Maintenance Areas

1. Purpose - To prevent spills during the normal maintenance of construction machinery.
2. Implementation - Where and when feasible, maintenance shall be performed offsite in covered facility with an impervious floor.
   a. Use a dedicated site for machinery maintenance.
   b. Maintenance areas shall be located at least 50 feet from storm water inlets or water bodies.
   c. Maintain spill kits and absorbent materials in close proximity to maintenance areas. Utilize drip pans and absorbent pads to prevent oils or other maintenance fluids from reaching the soil surfaces.
   d. Inspect equipment daily for leaks or worn hoses. Repair or replace as needed to prevent onsite spills.
   e. Properly dispose of all spilled fluids and fluids removed from machinery.

D. Fluids, Paints, Solvents and Other Chemicals Storage and Use

1. Purpose - To prevent spills during the use and storage of the materials.
2. Implementation
   a. Store materials in manufacturer's containers.
   b. Maintain Material Safety Data Sheets (MSDS) on all products.
   c. Store materials in a weather proof/vandal resistant locker or building.
   d. Keep materials away from flammable sources.

e. Follow manufacturer's instructions for the proper use and storage of all materials.
f. For bulk material stored onsite, provide diking or double containment to capture leaks or failures.
g. No washout of solvent from paint supplies shall be completed near or into a storm water inlet or other drainage facility.
h. All paint containers and curing compounds shall be tightly sealed and stored when not required for use. Excess paint shall not be discharged to the storm system but shall be properly disposed according to the manufacturer’s instructions and in accordance with all Federal, State, and local regulations.

E. Disposal of Sediment-Laden Water

1. Purpose - To prevent the purposeful discharge of sediment-laden water into waters of the United States.
2. Implementation:
   a. Sediment-laden water from pumping operations shall not be discharged into or near storm water conveyances, wetlands, rivers, streams, and impoundments or into natural or manmade channels leading thereto.
   b. Dewatering of sediment-laden water from trenches, or other excavations by means of a pump or similar means, shall discharge into a manufactured pumping bag for filtering in accordance with the manufacturer's recommendations unless the pumped water is routed through another erosion control measure such as a sediment trap.
   c. Pumping operations that are moving clean water through a site are not required to have a pumping bag or similar device at the outlet. The point of discharge shall be protected to prevent soil erosion.

F. Concrete Washout Area

1. Provide a designated concrete washout area for use of washing out concrete trucks in order to contain potential storm water pollutants. One (1) of the following methods shall be used:
   a. A minimum of 10-foot x 10-foot x 3-foot deep area (or larger as required to contain liquid and solid waste from concrete washout operations) with a polyethylene lining. The base of the system should be constructed and prepared so that it is free of rocks and other debris that may cause tears or punctures in the polyethylene lining.
   b. The concrete washout area shall be a pre-fabricated containment system that shall be installed and maintained in accordance with the manufacturer's instructions.
   c. A polyethylene-lined roll-off dumpster may be used when other methods are not practical.
   d. Subcontract with a concrete supplier that collects all washout water and pumps it back into the mixer drum for proper disposal off-site. In this instance, a concrete washout area would not be required.
2. The concrete washout area shall include orange safety fencing around its perimeter. Signage directing contractors and suppliers to the designated concrete washout location shall also be posted.

3. Locate washout areas at least 50 feet from storm drains, open ditches, or water bodies.
4. Inspect system daily and after each storm event. Inspect the integrity of the overall structure including, where applicable, the containment system. Inspect the system for leaks, spills, and tracking of soil by equipment. Inspect the polyethylene liner for failure. The liner may need to be replaced after every cleaning if removal of material has damaged the liner. Repair the concrete washout structure, as needed, or construct a new system.
5. Concrete wastes shall be allowed to set. Hardened wastes shall be broken up and then properly disposed of by Contractor. Liquid that collects in the washout area could be high in alkalinity and could contain pollutants. Liquid must be disposed of properly. Upon removal of waste, inspect the structure.
6. Do not wash sweepings from exposed aggregate concrete into the street or storm drain. Collect and return sweepings to aggregate base stockpile or dispose in the trash.
7. Discuss the concrete management techniques (such as handling of concrete waste and washout) with the ready-mix concrete supplier before any deliveries are made.
8. Incorporate requirements for concrete waste management into material supplier and subcontractors' agreements. Inspect construction activities on a regular basis to ensure suppliers, contractors, and others are utilizing designated washout areas. If concrete waste is being disposed of improperly, identify the violators and take appropriate action.
9. Place a non-collapsing, non-water holding cover over the washout facility prior to a predicted rainfall event to prevent accumulation of water and possible overflow of the system (optional).
10. Avoid mixing excess amounts of fresh concrete.
11. Perform washout of concrete trucks offsite or in designated areas only. Washout of concrete trucks must never be disposed of in a ditch, stream, wetland, waterway, or storm water conveyance.
12. Excess concrete shall not be dumped onsite, except in designated areas.
13. When concrete washout systems are no longer required, the concrete washout systems shall be closed. Dispose of all hardened concrete and other materials used to construct the system. Any holes, depressions, and other land disturbances associated with the system should be backfilled, graded, and stabilized.

G. Fertilizers

1. Apply fertilizers only in the minimum amounts recommended by the manufacturer.
2. Work fertilizers into the soil to limit exposure to storm water.
3. Store fertilizers in a covered shed and transfer partially used bags to a sealable container to avoid spills.

H. Chlorinated Water, as applicable

1. Following completion of the disinfection and testing of water lines, the heavily chlorinated water will be neutralized and disposed of in accordance with American Water Works Association (AWWA) C 651, Appendix C.

-END-

SECTION 02111 –RECORDING OF CONSTRUCTION AREAS

PART 1 - GENERAL

1.01 Scope

A. Prior to construction, Contractor shall walk each work site with a member of the Owner's staff (and Engineer) to record existing site conditions. Contractor shall furnish and provide one copy of audio-visual DVD recordings of all site conditions located within the construction area as shown on the Drawings and as specified herein.

B. Before Contractor begins construction activities, Contractor shall provide all labor, materials, equipment, services and perform all operations necessary to furnish the Owner and Engineer a complete color DVD recording of the surface features and conditions within the proposed construction zone of influence.

C. The audio-visual DVD recordings shall include all DVD's, DVD storage cases, DVD index labels and run sheet logs. The purpose of this coverage shall be to accurately document the pre-construction conditions of the surface features.

D. The pre-construction videotape documentation shall be done by a responsible commercial firm known to be skilled and regularly engaged in the business of color audio-video construction documentation. The firm shall furnish such information as the Owner (and Engineer) deems necessary to determine the ability of the firm to produce professional video in accordance with Contract Specifications.

PART 2 - PRODUCTS

2.01 Equipment

A. Recordings shall be still frame capable, color, DVD format videodiscs. The recorded videodiscs shall be compatible for playback with any Standard DVD player or on personal computer. The discs shall be new.

B. The camcorder used for the recordings shall be high quality color camcorder with ¼", 1/3", or ½" charged coupled device-imaging system. Camera must have optical stabilization; electronic stabilization is not acceptable. Camera must be capable of 20x minimum optical magnification. Camera must be capable of producing NTSC 720 lines resolution/60 fields/30 frames per second. Minimum illumination capabilities of at least 3-lux.

PART 3 - EXECUTION

3.01 Information to be Included

A. The zone of influence shall be defined as an area located within the permanent and temporary construction easement, an area 30 feet beyond either side of the

centerline of the construction area, the road Right-of-Way, and shall also include those areas adjacent to these areas which may be affected by routine construction operations or as requested by the Owner and/or the Engineer.

B. The surface features within the construction zone of influence shall include, but not be limited to, all visible roadways, pavements, curbs, driveways, sidewalks, culverts, headwalls, retaining walls, buildings, landscaping, trees, shrubbery and fences.

C. A runsheet log must be provided that accurately catalogs the contents of each videodisc. Information in the runsheet must include:

1. Street name, easement, or address.
2. Drawing sheet number or numbers relative to the line entry of a particular area of coverage.
3. Roll numbers.
4. Real time code indexing for each segment of the project. Real time code indexing will indicate hours, minutes, and seconds to cross reference with playback equipment to locate specific points of interest on the project.
5. Direction of travel for each specific segment.
6. Viewing side for each specific segment.
7. Starting point for each specific segment.
8. Ending point for each specific segment.
9. Project information, i.e., project title, owner, date.

D. All DVD's must be labeled with appropriate project information and be able to be cross-referenced with runsheets. Information on videodisc labels shall include:

1. Roll number.
2. Project Title.
3. Location of project.
4. Month and year of coverage.
5. As multiple copies of each videodisc will be made available, DVD's must be marked as sets, i.e.: Engineer's set, Owner's set, Contractor's set.
6. Quick reference list of contents of a particular videodisc.

3.02 Miscellaneous Details

A. The recording of the project shall take place prior to the placement of equipment and materials on the jobsite. All videodiscs shall be logged and presented to the Engineer and Owner before the actual construction is started for their review. Particular and detailed attention shall be given to any defects noted, such as cracks, disturbed areas, damaged items, or as may be required by Owner and Engineer. It is the intent of this coverage to accurately and clearly document pre-existing conditions and especially any items that may result in construction claims.

B. To preclude the possibility of tampering or editing in any manner, all recordings must, by electronic means, display continuously and simultaneously generated transparent digital information to include the date and time of recordings, as well as the corresponding engineering stationing numbers. The date information will contain the month, day and year.

C. Accompanying the recording shall be a corresponding and simultaneously recorded audio track containing the commentary of the camera operator. Each disc shall begin with the current date, project name, municipality, and the general location, i.e., name of street, viewing side, and direction of progress. The commentary shall assist in the maintenance of viewer orientation, identification of surface features, and objective description of the points of interest being shown on the video portion of the recording.

3.03 Recording

A. All recording shall be done during times of good visibility. No recording shall be done during periods of visible precipitation, or when more than 10 percent of the ground area is covered with snow, unless authorized by the Engineer.

B. Houses and buildings shall be identified visually by house number, when visible, in such a manner that structures of the proposed system, i.e., manholes on a sewer system, gate valves and hydrants on a water system can be located by reference. In all instances, locations shall be identified by audio or visual means at intervals not to exceed 100 linear feet.

C. To produce the proper detail and perspective, adequate lighting will be required to fill in the shadow area caused by trees, utility poles, road signs, and other such objects in residential areas or as directed by the Engineer.

D. The rate of speed in the general direction of travel of the conveyance used during taping shall be directly proportional to the number, size, and value of the surface features within that construction area's zone of influence. The rate of speed shall not exceed 48 feet per minute in residential areas, or 100 feet per minute in non-residential areas. The rate of travel for Haul Routes, Rainfall Studies, and Road Surface View shall be approximately five (5) miles per hour. Panning rates and zoom-in, zoom-out rates shall be electronically or manually controlled sufficiently such that during playback will produce clarity of the object viewed. The playback picture shall be in focus and be of extreme clarity at all times.

E. Where conventional wheeled vehicles are used, camera is to be mounted securely to produce steady viewing. Camera lens is to be a minimum of eight (8) feet from ground of viewing area, or at a level to facilitate best perspective and line of sight. Vehicles used while performing documentation must be plainly marked with Company name and phone number. Caution signs, flags, and strobes may be utilized on vehicle as necessary.

F. Contractor shall be able to televise and tape areas with paved roads, along co-owned easements through parks, lawns, and open fields. If recording on private property, Contractor shall give the Owner sufficient prior notice of such entry so that property owners may be advised of and their permission obtained for the work. If permission is denied, runsheet log will be duly noted.

G. The Owner and/or Engineer shall have the authority to designate what area may be omitted or added for recording.

H. The Owner and/or Engineer shall have the authority to reject all or any portion of the recording not conforming to Specifications.

-END-

SECTION 02200 - EARTHWORK

PART 1 - GENERAL

1.01 Scope

A. Furnish all labor, tools, equipment and materials necessary to complete all stripping, storage and redistribution of topsoil, cut and fill operations, rough and finish grading and construction of drainage swales as applicable in conformity with the lines and grades and slopes as shown on the Drawings.

B. Keep open excavations free of water, both surface and subterranean by use of pumps and earth damming around such excavations to drain surface water away from the excavations.

C. Protect open excavations by roping areas off, or with barricades or railings to prevent injury to personnel. Comply with any and all applicable Occupational Safety and Health Administration (OSHA) regulations.

D. Include in the bid the cost to furnish, install, operate and maintain dewatering equipment that may be required to perform the Work as shown on the Drawings and as specified in the Contract Documents. The cost for dewatering shall not be considered a separate pay item.

1.02 Quality Assurance

A. Employ and pay for the services of an independent testing laboratory to perform specified services, necessary subgrade bearing tests and field density tests to ensure that proper compaction is obtained.

B. If, based on testing services reports and inspection, subgrade or fills which have been placed are below specified density, provide additional compaction and testing at no additional cost to the Owner.

1.03 Submittals

A. Submit compaction test results to the Engineer for approval.

PART 2 - PRODUCTS

2.01 Materials

A. Backfill

1. Suitable earth removed from the excavation, free of rocks, boulders, stones larger than 2", and other debris.
2. Native lean clay and silty clay may be used for the top 2 feet of backfill around new and existing structures.

3. Topsoil and soil containing decomposed organic materials shall be considered suitable for topsoil fill material only.
4. Aeration of some backfill may be required for compaction.

B. Granular Fill

1. Clean granular material: Sand, pit run gravel.
2. Contain a maximum 2%, by weight, passing a No. 220 sieve and 100% passing a 3/4" sieve.

C. Topsoil

1. Natural, fertile, agricultural soil, capable of sustaining vigorous plant and lawn growth.
2. Uniform composition throughout, without admixture of subsoil.
3. Free of stones, lumps, clods and sticks larger than one inch, live plants and their roots, sticks and other extraneous matter.

2.02 Excavation Classification

A. This work shall consist of excavation, hauling, disposal, or compaction of all materials encountered within the limits of the work. All excavation will be classified as hereafter described.

1. Common Excavation: All excavation not included as rock excavation or excavation which is otherwise classified.
2. Rock Excavation: Igneous, metamorphic, and sedimentary rock which cannot be excavated without blasting, or the use of a modern power shovel of no less than one cubic yard capacity, properly used, having adequate power and in good running condition, or the use of other equivalent power equipment. It shall also include all boulders or detached stones each having a volume of one half (1/2) cubic yard or more.
3. Unclassified Excavation: Excavation and disposal of all materials of whatever character encountered in the work.
4. Borrow: Approved material required for the construction of embankments or for other portions of the work obtained from offsite and in accordance with all local, state, and federal regulations. Unless otherwise designated in the contract, the Contractor shall make his own arrangements for obtaining borrow and shall pay all costs involved. All Contractor operations including erosion and sediment control shall be conducted in accordance with all local, state, and federal regulations.

PART 3 - EXECUTION

3.01 Preparation

A. Remove all topsoil at construction areas. Stockpile topsoil for use in finish grading operation. Do not use topsoil for fill.

B. Do not place fill materials until the subgrade and construction has been inspected and approved by the Engineer.

3.02 Excavation

A. Excavate true to line and grade, and level at bottom of the excavation. Excavate to undisturbed structurally stable subsoil. Notify Engineer where excavation, in order to reach such subsoil, must continue deeper than required by the elevations indicated on the Drawings. No additional payments will be made for unauthorized excess excavation.

B. Excavate to the dimensions indicated for new construction plus sufficient space as applicable to permit erection of forms, shoring, masonry, foundations, structure installations, and excavation inspections.

C. Conduct bearing tests of undisturbed subgrade according to Contract Documents and Engineer.

D. Foundations and Paved Areas

1. If suitable bearing subsoil is not encountered at the depth indicated on Drawings for new structures, immediately notify the Engineer. Do not proceed further until instructions are given by the Engineer and required tests are completed.
2. Do not place foundations, structures, and paved areas on soft earth; if soft earth is encountered, remove soft pockets and backfill with lean concrete or backfill with compacted granular fill for footings, structures, paved areas, and within five feet of paved areas.

E. Proof roll subgrade below structure and paved areas with heavy rubber-tired proof roller vehicle per Article 3.05 prior to placing stone.

F. Place crushed stone on the subgrade after it has been proof rolled.

G. Provide shoring or piling as required to protect excavation bank.

H. When freezing temperatures are expected, do not excavate to the full depth indicated on the Drawings, unless the foundation can be poured immediately after excavation has been completed, or the bottom of the excavation is adequately protected from frost.

I. Do not store excavated or other material nearer than 4 feet from the edge of any excavation. Store and retain materials as to prevent materials from falling or sliding back into the excavation. Install substantial stop log or barricades when mobile equipment is utilized or allowed adjacent to excavations.

J. Provide adequate barriers and physically protect excavations. Barricade or cover all wells, pits, shafts, and similar excavations and backfill upon completion of exploration and similar operations.

K. Drainage and Dewatering

1. Prevent surface and subsurface water from flowing into excavations and from flooding adjacent areas.
2. Remove water from excavation as fast as it collects.
3. Maintain the ground water level below the bottom of the excavation to provide a stable surface for construction operations, a stable subgrade for the permanent Work, and to prevent damage to the Work during construction.
4. Provide and maintain pumps, sumps, suction and discharge lines and other dewatering system components necessary to convey water away from excavations.

3.03 Filling and Backfilling

A. Backfill against the walls of new and existing structures with compacted free-draining granular fill to a horizontal distance of 24-inches minimum from the outside face of the wall.

B. Use native excavated lean clay and silty clay backfill material compacted for the top 2 feet of backfill. Backfill material shall not exceed optimum moisture content. Test moisture content before placing backfill.

C. Suspend earth work operations when satisfactory results cannot be obtained because of rain, freezing weather or other unsatisfactory conditions in the field.

D. Material in layers shall be of the proper moisture content before compaction. Should the material be too wet to permit proper compaction, delay all work on all portions thus affected until the material has dried to the required moisture content.

E. In the construction of filled areas, place starting layers in the deepest portion of the fill. As placement progresses, construct layers approximately parallel to the finished grade line.

F. Boulders, if encountered, must be disposed of outside of the construction area.

G. The Contractor shall be responsible for the stability of fill above top of footing. Do not backfill until walls are braced or shored and the Engineer has approved the backfilling operation. If fill is to be provided on both sides of walls, fill on both sides at same time.

H. Install vapor barrier on drainage fill prior to installing floor slabs. Drainage fill under floor slabs, slabs on grade, walks and paving shall be placed to indicate depths but not less than four (4) inches.

I. Fill excess cuts under slabs with crushed stone and thoroughly compact.

3.04 Compaction

A. Fill areas shall be compacted using equipment capable of compacting each specified lift its full depth. Moisture during compaction operations shall be maintained at optimum content.

B. Compacting equipment shall be approved equipment of such design, weight and quantity to obtain the required density in accordance with soil compaction requirements. Under no circumstances shall a bulldozer or similar tracked vehicle be used as compacting equipment.

C. Water distribution equipped with a suitable sprinkling device shall be used to add moisture to the soil if required.

D. For fill areas adjacent to and around new and existing structures: Continue compaction operations up to the top 24" of fill until the fill is compacted to not less than 90% Modified Proctor of the maximum dry density, and compact the final 24" of fill to not less than 95% Modified Proctor of the maximum dry density as determined in accordance with ASTM D-1557. Unless otherwise specified herein, fills shall be placed in successive horizontal layers of 12 inches maximum in loose depth for the full width of the section.

E. For footings, paved areas, and within five (5) feet of paved areas: Place fill in 8" maximum balanced lifts and compact each layer to 95% of Modified Proctor dry density in accordance with ASTM D-1557.

F. For all other areas: Continue compaction until the fill is compacted to not less than 90% Modified Proctor of the maximum dry density, as determined in accordance with ASTM D-1557. Unless otherwise specified herein, fills shall be placed in successive horizontal layers of 12 inches maximum in loose depth for the full width of the section.

G. Compact backfill within 3 feet of new and existing structures using a hand-guided compactor. Operate equipment in such manner that hardpan, cemented gravel, clay, or other chunky soil material are broken up into small particles and become incorporated with the material in the layer.

H. Compaction by flooding is not acceptable.

I. Perform compaction tests as required by the Contract Documents and Engineer.

3.05 Proof Rolling

A. Perform proof rolling of subgrade below structure and paved areas with a pneumatic-tire roller conforming to the requirements of INDOT Specification 203.26 using two complete coverages unless otherwise directed. Correct any and all roller marks, irregularities, and failures.

B. After completion of filling and compaction operation, proof roll area with smooth wheel vehicle to leave a smooth surface sealed to shed all water.

3.06 Grading

A. Furnish, operate, and maintain equipment necessary to control uniform layers, section, and smoothness of grade for maximum compaction and drainage.

B. Rough Grading

1. Evenly grade to elevations 6 inches below the finish grade elevations indicated.
2. Protect all constructed items during grading operations, and repair at no additional cost to the Owner if damaged.
3. All areas in the project including excavated and filled sections and adjacent transition areas shall be reasonably smooth, compacted, and free from irregular surface changes.
4. The degree of finish shall be that ordinarily obtainable from either blade-grader or scraper operations, except as otherwise specified.
5. The finished subgrade surface generally shall be not more than 0.3 feet above or below the established grade or approved cross-section, with due allowance for topsoil and seeding or sod as applicable.
6. The tolerance for areas within 10 feet of structures shall not exceed 0.15 feet above or below the established sub-grade.
7. All ditches, swales and gutters as applicable shall be finished to drain readily.
8. Unless otherwise indicated on the Drawings, the subgrade shall be evenly sloped to provide drainage away from the building walls in all directions at a grade not less than 1/2" per foot.
9. Provide grade rounding at top and bottom of banks and at other breaks in grade.

C. Protection

1. Protect newly graded areas from the action of the elements.
2. Settlement or washing that occurs prior to acceptance of the work shall be repaired, and grades re-established to the required elevations and slopes.
3. Fill to required subgrade levels any areas where settlement occurs.

D. Finish Grading

1. Proceed to finish elevations shown on Plans with a tolerance of plus or minus .04 ft. (1/2 inch).
2. Rake subsoil clean of stones and debris. Scarify to depth of 3".
3. Spread stockpiled topsoil over prepared subgrade to a minimum depth of six inches, and roll until suitable for seeding or placement of sod as applicable.
4. Maintain surfaces and replace additional topsoil necessary to repair erosion.

-END-

SECTION 02220 - TRENCHING, BACKFILLING AND COMPACTION FOR UTILITIES

PART 1 - GENERAL

1.01 Summary

A. Section Includes: Performing surface preparation and excavation work as required for the installation of utilities and appurtenances including excavation, trenching, bedding, backfilling and other related work.

B. Related Sections

1. Section 02101 - Storm Water Pollution Prevention and Erosion Control
2. Section 15060 – Process and Yard Piping

1.02 References

A. American Society for Testing and Materials (ASTM), latest editions

1. ASTM C403 - Standard Test Method for Time of Setting of Concrete Mixtures by Penetration Resistance
2. ASTM D698 - Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort
3. ASTM D6024 - Standard Test Method for Ball Drop on Controlled Low Strength Material (CLSM) to Determine Suitability for Load Application
4. ASTM D6103 - Standard Test Method for Flow Consistency of Controlled Low Strength Material (CLSM)

B. Indiana Department of Transportation (INDOT) Standard Specifications, latest edition

1. Section 213 – Flowable Backfill
2. Section 904 – Aggregates

C. Occupational Safety & Health Administration (OSHA) Regulations (Standards – 29 CFR), latest editions

1. Part 1926 – Safety and Health Regulations for Construction

1.03 Definitions

A. Bedding – Granular material placed beneath the pipe to establish line and grade and to provide pipe support.

B. Final (Trench) Backfill – Granular or other specified material placed from the top of the Initial Backfill to the top of the trench, or to just beneath the surface that is to be restored.

C. Granular Backfill – Class 1 or Class 2 material as described in 2.01 A and B.

D. Haunching – Granular or other specified material placed from the top of the bedding to the springline (center) of the pipe, installed uniformly in lifts on each side of the pipe, and shoveled under the sides of the pipe to provide resistance against soil and traffic loading.

E. Initial Backfill – Granular or other specified material placed from the springline of the pipe to the specified height above the crown of the pipe, to provide adequate pipe support and to protect the pipe from damage due to compaction of the final backfill.

F. Pavement/Structure Loading Zone - the area within 5 feet of any edge of pavement, curb, gutter, sidewalk, building, or other structure.

1.04 Submittals

A. Product Data

1. Class I material source and gradation
2. Class II material source and gradation

B. Quality Control Submittals

1. Backfill Compaction Test Results
2. Delivery Tickets

1.05 Quality Assurance

A. Qualifications

1. Provide the services of a qualified, independent testing laboratory to perform all field tests.

1.06 Warranty

A. Refill and restore to the original grade settlement in the backfill which takes place within the 1-year warranty period at no additional cost to the Owner. Restore the surface area where settlement has occurred, including, but not limited to seeding, fertilizing, erosion control and restoration of streets, drives, yards, and sidewalks.

B. Guarantee all disturbed and replaced trees and shrubs for a period of 1 year from date of substantial completion of project.

PART 2 - PRODUCTS

2.01 Bedding and Backfill Material Classifications

A. Class I: Angular, 6 to 40 millimeters (1/4 to 1-1/2 inches) graded stone such as crushed stone. No. 8 gravel possessing a minimum 50 percent mechanical crush

count, and meeting the following nominal sizes and percents passing will be considered an equivalent Class I material:

1. 100 percent passing 1-inch sieve
2. 75-95 percent passing 3/4-inch sieve
3. 40-70 percent passing 1/2-inch sieve
4. 0-15 percent passing No. 4 sieve

B. Class II: Coarse sands and gravel-sand mixtures with a maximum particle size of 40 millimeters (1-1/2 inches), including variously graded sands and gravels containing small percentages of fines, generally granular and non-cohesive, either wet or dry. Soil types GW, GP, SW and SP are included in this class. Provide Class II material which meets the requirements of INDOT Standard Specifications Section 904 classification for Structure Backfill.

C. Excavated Material: Excavated material suitable for use as trench backfill must be clean and free of rocks and frozen soil lumps larger than 6 inches, wood, debris, or other extraneous material.

2.02 Sheeting and Bracing

A. Provide sheeting, shoring and bracing capable of sustaining the lateral forces of the trench and pit banks and that comply with all applicable OSHA requirements. Protective systems for excavations 20 feet deep or greater must be designed and certified by a registered Professional Engineer.

PART 3 - EXECUTION

3.01 Preparation

A. Planning

1. Maintain traffic flow at all streets and service drives during construction.
2. Do not cut farm fences when gates are available within a reasonable distance to move equipment from one field to another.
3. Comply with the terms and limits of easements. Obtain property access permission prior to accessing or traversing yards or fields outside easements.

B. Protection

1. Before any excavation is started, provide adequate protection for all lawns, trees, landscape work, shrubs, fences, hydrants, sidewalks, utility poles, and other objects that are to remain in place.
2. Maintain such protection for as long as necessary to prevent damage from operations.
3. Movable items such as mailboxes and roadway signs may be temporarily relocated during construction unless shown otherwise on the Drawings. Reinstall movable items in their original location immediately after backfilling and compacting is complete. Replace movable items damaged during construction with new items at the Contractor's expense.

4. Verify the location of existing storm sewers, sanitary sewers, water mains, gas mains, electric ducts, telephone ducts, utility services, and other underground structures. Determine the exact location of and the means of protection for these facilities and structures. Protect, support and maintain operation of these facilities during construction.

C. Site Preparation

1. Complete site clearing and grubbing.
2. Remove existing pavement and walks from the areas of excavation.
3. Strip topsoil and vegetation from the areas of excavation.
   a. Clean topsoil may be stockpiled for reuse.
   b. Do not mix grass, weeds, roots, brush, and stones larger than 1-inch in diameter with stockpiled topsoil. Dispose of root contaminated topsoil.

3.02 Excavating

A. Excavate carefully and cautiously to avoid damaging existing underground utilities and structures.

1. Repair, or have repaired, existing utilities and structures broken or otherwise damaged during Construction.
2. Immediately bring to the attention of the Engineer any unforeseen conflicts with existing utilities exposed during excavation and preparation of trenches and pits.
3. If proposed utility cannot be installed at locations shown on the Drawings, make adjustments in its alignment or relocate the existing utilities as approved by the Engineer.

B. Store excavated materials suitable and necessary for backfilling in a neat pile adjacent to the excavation in a manner that will not interfere with traffic. Do not place such materials at heights or within the proximity of excavations where they may cause earth slides or cave-ins. Do not stockpile excavated material closer than 2 feet from the top edge of the excavation wall at ground surface.

C. Remove excavated material not suitable for backfilling and excess suitable material from the job site. Dispose of the materials in accordance with all local, state, and federal regulations.

D. Provide and maintain adequate dewatering equipment to remove and dispose of surface and ground water entering excavations. Use appropriate measures to prevent surface water from entering the excavation and to provide adequate drainage of the area adjacent to the excavation. Filter water from dewatering operations to remove sediment before discharge in accordance with Section 02101 - Storm Water Pollution Prevention and Erosion Control.

3.03 Sheeting and Bracing

A. Properly shore, sheet, brace, or cut back at the proper slope, all excavations to safely install utilities and to protect adjacent streets and structures.

B. The Contractor is responsible and accountable for all sheeting and bracing used and for damages to persons or property resulting from the improper quality, strength, placement, maintenance and removal of the sheeting, shoring, and bracing, including damage to trees, shrubs, walkways and other property.

3.04 Trenching

A. Excavate trenches to the depths and widths shown or as required for the proper installation of the pipe and appurtenances.

B. Excavate trenches in straight lines. Keep sides of trenches as near vertical as possible and properly sheet and/or brace, if required. Perform open cut excavation except where otherwise approved or noted on Drawings.

C. Provide a continuous, uniform bearing support for the pipe on bedding within the trench, dished to provide circumferential support to the lower third of each pipe. Dig out holes to receive pipe bells.

D. Remove rock and soft material encountered in the trench which, in the opinion of the Engineer is incapable of providing adequate bearing to support the pipe. Remove material to accommodate the minimum specified bedding depth below the required elevation and fill with Class I or Class II material as specified. Field measure with the Engineer the locations where additional granular backfill is required due to rock or soft material, prior to backfilling.

E. Do not open more than 50 feet of trench in advance of the installed pipe, unless otherwise directed or permitted by the Engineer. Excavate the trench within 6 inches of full depth for a distance of at least 30 feet in advance of the pipe installation, unless otherwise directed or permitted.

F. Support all sewer, gas, water or other pipes or conduits crossing the trench to prevent damage and service interruptions. The manner of supporting such pipes or conduits will be subject to the approval of the Owner and/or the inspector of the Utility involved.

G. Provide adequate sheeting and bracing in trenches and pits to protect life, property and the Work. Renew and maintain sheeting, planking, timbering, shoring, bracing, and bridging, and do not remove until sufficient backfill has been placed to protect the pipe.

3.05 Trench Backfill

A. Specifications regarding trench backfilling also apply to excavated pits.

B. Do not backfill trenches until all piping and utilities have been inspected by the Engineer.

C. Backfill all trenches within State Highway right-of-way in accordance with INDOT Specifications. Backfill all trenches within the right-of-way of other public authorities having jurisdiction in accordance with requirements of the public authority.

D. For any trench that intersects any portion of the pavement loading zone use Class I or Class II backfill materials.

E. For any utility located in proximity to a building foundation use the Geotechnical recommendations or use 2:1 structure loading zone rule for the placement of compacted bedding and backfill materials.

F. Comply with details shown on the Drawings for the placement of bedding and backfill materials for each pipe material.

G. Placement and Compaction Requirements:

1. Place Bedding, Haunching, and Initial Backfill materials in 6 to 8-inch balanced lifts to ensure proper compaction and filling of all voids.
2. Use procedures and equipment for the Standard Proctor compaction test in accordance with ASTM D698/AASHTO T99.
3. Outside the pavement/structure loading zone:
   a. Place final backfill in maximum 12-inch lifts.
   b. Compact each layer to a minimum of 90 percent of the maximum Standard Proctor dry density.
   c. Additional compaction if required to minimize settling. Limited mounding of backfill above finish grade may be performed to compensate for settlement with the approval of the Engineer.
   d. Place 6 inches of topsoil over areas to be seeded.
4. Within the pavement/structure loading zone:
   a. Place final backfill in 6 to 8-inch lifts, except place final 12 inches in 6-inch lifts.
   b. Compact each layer to 95 percent of the maximum Standard Proctor dry density, except the final 12 inches under pavement, compact each 6-inch lift to 100 percent of the maximum Standard Proctor dry density.
   c. Prepare upper portion of trench for pavement replacement as applicable.
5. Stone and unpaved driveways and alleys:
   a. Place final backfill in 6 to 8-inch lifts.
   b. Compact each layer to 95 percent of the maximum Standard Proctor dry density.
   c. Replace the last 12 inches of surface with the same material as the original surface unless otherwise specified and compact to 100 percent of the maximum Standard Proctor dry density.
6. Structure Footers:
   a. Use Class I material
   b. Place in 6 to 8-inch lifts
   c. Compact each layer to 100 percent of the maximum Standard Proctor dry density.

H. Compaction Procedures

1. Place trench backfill in balanced lifts to ensure proper compaction and filling of all voids.
2. Class I material: Shovel slice or otherwise carefully place; walk or hand tamp into place.

3. Class II material: For the first 24 inches of backfill over the pipe, use hand-operated tamping devices. Use standard mechanical methods (powered tampers, vibrators, etc.) for the remainder of the trench.
4. Do not flood or puddle with water to consolidate backfill.
5. When compaction test results are unsatisfactory, re-excavate, re-compact the backfill and retest until the specified compaction is obtained.

I. Maintain backfilled trenches in a smooth and uniform condition until paving or seeding operations are completed.

3.06 Field Quality Control

A. Tests

1. Class II Compaction Tests: Perform compaction tests for Class II trench backfill material in accordance with ASTM D698 and as follows:
   a. At each road crossing: vertically at 2-foot intervals in the trench
   b. At every 1,000 feet longitudinally in roadways along the pipe alignment and vertically at 2-foot intervals in the trench
   c. Notify the Engineer 24 hours prior to the tests so that he may be present for the compaction tests.
   d. No additional payment will be made for compaction tests. Compaction tests are considered incidental to the Work.

3.07 Material Disposal

A. All existing utility infrastructure and appurtenances (piping, structures, etc.) that are to be replaced or removed to allow for new construction are the responsibility of the Contractor unless otherwise designated below. As these materials are excavated, remove them from the job site and dispose of them in accordance with applicable local, state and federal rules and regulations.

-END-

SECTION 02900 - LANDSCAPING

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and install topsoil, fertilizer, lawn seed, mulch, trees, bushes, ornamental plants, and stone as applicable, and do related work necessary to complete work shown or specified.

1. The Contractor shall repair or replace lawn areas, trees, and ornamental plants damaged or destroyed during construction of the work included in this Contract, unless otherwise shown on the Drawings.
2. Areas to be seeded shall be as shown on the Drawings.
3. New plantings (trees, shrubs, etc.) shall be as shown on the Drawings.
4. Any areas of 100 square feet or more to be seeded shall be hydroseeded.

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise shown or specified.

C. Definitions: Lawn areas include grassed areas which are cut and maintained on a routine basis. Lawn areas include lawns at homes, businesses, and government facilities and grass shoulders of streets, roads, and highways.

1. Replacement of underbrush in fields and woods, along farm fences and roads, and in similar areas is not required, unless otherwise shown on the Drawings.

D. Soil testing is required for project area disturbance that exceeds one and one half (1.5) acres, in order to determine soil amendments needed, such as fertilizer and lime. When required, Contractor shall coordinate soil testing services and implement the resulting recommendations.

1.02 Product Delivery, Storage, and Handling

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products at no additional cost to the Owner.

C. Deliver packaged materials in containers showing weight, analysis, and name of manufacturer. Protect materials from deterioration during delivery and while stored at site.

1.03 Job Conditions

A. Seed between February 15 and June 1 and between August 15 and November 1. Do not sow seed during adverse weather conditions. Do not broadcast seed

during high wind. Do not sow seed when the moisture content of the soil is too low or too high for seed germination.

B. Plant trees and ornamental plants during the proper time and under the proper conditions for the particular tree or plant.

C. Proceed with and complete landscape work as rapidly as portions of site become available, working within seasonal limitations for each kind of landscape work required.

D. Prepare a proposed planting schedule. Schedule dates for each type of landscape work during normal seasons for such work in area of site. Correlate with specified maintenance periods to provide maintenance from date of substantial completion. Once accepted, revise dates only as approved in writing, after documentation or reasons for delays.

1.04 Related Work Specified Elsewhere

A. Section 02200 - Earthwork

B. Section 02220 - Trenching, Backfilling & Compaction

C. Section 02101 - Storm Water Pollution Prevention and Erosion Control

1.05 Submittals

A. Contractor shall submit schedules and other items as specified herein to the Engineer.

B. Submit seed vendor's certified statement for each grass seed mixture required, stating botanical and common name, percentage by weight, and percentages of purity, germination, and weed seed for each grass seed species.

C. Where required as specified herein in paragraph 1.01D, Contractor shall submit vendor's certified analysis for soil amendments and fertilizer materials. Submit other data substantiating that materials comply with specified requirements.

PART 2 - PRODUCTS

2.01 Quality Assurance

A. Package standard products with manufacturer's certified analysis. For other materials, provide analysis by recognized laboratory made in accordance with methods established by the Association of Official Agriculture Chemists, wherever applicable.

B. Provide trees and shrubs grown in a recognized nursery in accordance with good horticultural practice. Provide healthy, vigorous stock free of disease, insects, eggs, larvae, and defects such as knots, sun-scald, injuries, abrasions, or disfigurement.

C. Provide shrubs of sizes shown or specified. Trees and shrubs of larger size may be used if acceptable to Engineer and if sizes of roots or balls are increased proportionately.

D. Engineer reserves right to inspect trees and shrubs either at place of growth or at site before planting, for compliance with requirements for name, variety, size, and quality.

2.02 Topsoil

A. As applicable, Contractor shall stockpile topsoil excavated during construction operations that meets the requirements specified herein, for reuse in landscape work. If quantity of stockpiled topsoil is insufficient, provide additional topsoil as required to complete landscape work.

B. Topsoil shall be

1. Natural, fertile, agricultural soil, capable of sustaining vigorous plant and lawn growth.
2. Of uniform composition throughout, without admixture of subsoil.
3. Free of: stones, lumps, clods, and sticks larger than one inch, sod, live plants and roots, and other extraneous matter.

C. Obtain topsoil from local sources or from areas having similar soil characteristics to that found at project site and approved by the Engineer. Obtain topsoil only from naturally, well-drained sites where topsoil occurs in a depth of not less than 4 inches; do not obtain from bogs, marshes, or any area of hydric soil characteristics.

2.03 Limestone

A. Limestone shall meet the requirements specified in Storm Water Pollution Prevention and Erosion Control – Section 02101.

B. Agricultural lime shall be obtained by the Contractor from a dealer or manufacturer whose brands and grades are registered or licensed by the State of Indiana, Department of Agriculture. For the basis of quality control, agricultural ground (Ag-ground) limestone, having a minimum total neutralizing power (TNP) of 90+ percent, at least 40 percent passing a No. 100 (150 µm) sieve and 95 percent passing a No. 8 (2.36 mm) sieve, 100 percent of Ag-ground shall be applied. Application shall be at 92 pounds per 1000 sq ft (2 ton/acre). This rate shall be standard grade and rate. Other available forms of liming materials may be applied depending on their potential to neutralize soil acidity. Changes to the lime requirements will be determined by the pH test, as indicated on the soil analysis results. A slightly acid soil (pH 6.5) is recommended. When required by soil testing, agricultural lime shall be applied to the surface.

2.04 Weed Barrier

A. Nonwoven polypropylene, minimum 3 ounces per square yard.

B. Ultra violet (UV) resistant.

C. Manufacturers:

1. Reemay, Inc., Typar Grounds Keeper.
2. American Engineering Fabrics, Inc.; AEF Landscape Fabric.
3. Shaw Fabric Products, LLC, Groundscape.
4. Or approved equal.

2.05 Fertilizer

A. Fertilizer shall be meet the requirements specified in Storm Water Pollution Prevention and Erosion Control – Section 02101.

B. Fertilizer shall provide the minimum percentage of available nutrients (Nitrogen, Phosphorus, and Potash) based on soil content, seed mix, and local conditions and shall conform to all federal and state regulations and to the standards of the Association of Official Agricultural Chemists. If local conditions do not indicate otherwise and soil testing is not required, use 12-12-12 analysis fertilizer and an application rate of 400 to 600 pounds per acre.

2.06 Grass Seed

A. Seed shall not contain more than 5% inert matter. Seed shall not contain noxious weeds. Seed shall be delivered in new and unopened containers or bags, and shall bear a seed label tag in accordance with the requirements of the Indiana Seed Law.

B. Seed shall be the type, mixture, and application rate as shown on the Drawings.

2.07 Mulch

A. Mulch shall meet the requirements specified in Storm Water Pollution Prevention and Erosion Control – Section 02101.

B. Mulch shall be hay, straw, fiber mats, netting, bark or wood fiber. Straw shall be threshed straw of cereal grain such as oats, wheat, barley, rye, and rice. Mulch shall not contain objectionable weeds, seeds, or other material that may be detrimental to the planting being established. Mulch shall be applied to all disturbed areas to be left idle for 15 days outside of the growing season, unless other measures are indicated on Drawings. Mulch shall be anchored unless held in place by a tackifier or netting. Straw/hay mulch shall be applied at a rate of 70 lbs. per 1,000 square feet. Wood fiber mulch shall be applied at a rate of 46 lbs. per 1,000 square feet. Wood chips shall be applied at a rate of 230 lbs. per 1,000 square feet.

2.08 Non-Asphaltic Tackifier

Colloidal tackifier shall be as recommended by fiber mulch manufacturer for slurry application, nontoxic and free of plant growth or germination-inhibitors.

2.09 Trees and Ornamental Plants

A. New trees and ornamental plants shall be as shown on the Drawings.

2.10 Plant Materials

A. Provide trees, shrubs, and other plants complying with recommendations and requirements of ANSI Z60.1 “Standard for Nursery Stock” and as specified.

B. Provide shrubs of the size shown or listed and with not less than minimum number of canes required by ANSI Z60. 1 for type and height of shrub required.

1. Provide balled and burlapped trees and shrubs, unless otherwise shown on Drawings.
2. Container grown deciduous shrubs will be acceptable in lieu of balled and burlapped deciduous shrubs subject to specified limitations for container grown stock.

2.11 Crushed Stone for Maintenance Strips

A. Crushed stone shall consist of clean, tough, durable fragments of crushed limestone or dolomite. Crushed stone shall not contain more than 15% flat or elongated pieces and shall not contain particles with an adherent coating. Flat or elongated pieces will be described as pieces having a length in excess of four times its width. Determination of the width will be made by hand manipulating the pieces through a standard sieve. The smallest sieve opening through which the piece will pass will be considered the width of the particle. The percentage of these particles will be determined by dividing the weight of flat or elongated particles retained on the No. 4 sieve by the total weight of material retained on the No. 4 sieve.

B. Crushed stone sizes shall be as specified in this paragraph.

1. No. 9 Stone: Percentage passing sieves having square openings shall be as follows:

Sieve Size	Percentage Passing
3/4"	100
1/2"	85
3/8"	55
No. 4	10
No. 200	03

PART 3 - EXECUTION

3.01 Planting of Trees and Shrubs

A. Layout shrub locations and areas for multiple plantings. Stake locations and outline areas and secure Engineer's acceptance before start of planting work. Make minor adjustments as may be requested at no additional cost to the Owner.

B. Excavate pits, beds, and trenches with vertical sides and with bottom of excavation slightly raised at center to provide proper drainage. Loosen hard subsoil in bottom of excavation.

1. For balled or burlapped (B&B trees and shrubs), make excavations at least half as wide as the ball diameter and equal to the ball depth, plus the following allowance for setting of ball on a layer of compacted backfill:
   a. Allow for 3 inch setting layer of planting soil mixture.
2. For container grown stock, excavate as specified for balled and burlapped stock, adjusted to size of container width and depth.

C. Dispose of excess subsoil removed from landscape excavations.

D. Fill excavations for trees and shrubs with water and allow water to percolate out before planting.

E. Before mixing planting soil, clean topsoil and excavated subsoil of: roots, plants, sod, stones, clay lumps, and other extraneous materials harmful to plant growth. Mix soil amendments and fertilizers with planting soil mixture at rates required for optimum plant growth. Delay mixing fertilizer if planting does not follow placing of planting soil within a few days. Mix planting soil before backfilling, and stockpile excess planting soil at site.

1. Planting soil mixture shall be composed of equal parts of topsoil, peat humus, and excavated subsoil.

F. Set balled and burlapped stock on layer of compacted planting soil mixture, plumb and in center of pit or trench with top of ball at same elevation as adjacent finished landscape grades. Remove burlap from sides of balls; retain on bottoms. When set, place additional backfill around base and sides of ball, and work each layer to settle backfill and eliminate voids and air pockets. When excavation is approximately two-thirds full with backfill, water thoroughly before placing remainder of backfill. Repeat watering until no more water is absorbed. Water again after placing final layer of backfill.

G. Set container grown stock as specified for balled and burlapped stock, except cut cans on two sides with an approved can cutter; remove bottoms of wooden boxes after partial backfilling so as not to damage root balls.

H. Dish top of backfill to allow for mulching.

I. Mulch pits, trenches, and planted areas. Provide not less than 2 inch thickness of mulch and work into top of backfill and finish level with adjacent finish grades.

J. Prune, thin out, and shape shrubs in accordance with standard horticultural practice. Prune trees to retain required height and spread. Unless otherwise directed by Engineer, do not cut tree leaders, and remove only injured or dead branches from flowering trees, if any. Prune shrubs to retain natural character and accomplish their use in the landscape design.

K. Remove and replace excessively pruned or misformed stock resulting from improper pruning.

3.02 Preparation of Seeded Lawn Areas

A. Prior to preparation of areas to be seeded, remove existing grass, vegetation, and turf. Dispose of such material outside of Owner's property. Do not include any removed material into the soil being prepared for seeding.

B. Loosen subgrade of areas to be seeded to a minimum depth of four (4) inches. Remove stones over ½ inch in any dimension and sticks, roots, rubbish, and other extraneous matter. Limit preparation to areas which will be planted promptly after preparation.

C. Place six (6) inches of topsoil over the area to be seeded.

1. Spread planting soil mixture to minimum depth required to meet lines, grades, and elevations shown, after light rolling and natural settlement.
2. Place approximately one-half of the total amount of planting soil required. Work into top of loosened subgrade to create a transition layer and then place remainder of planting soil. Mix soil amendments such as fertilizer and lime if required, in the top two to four inches of topsoil with a disk or rake operated across the slope.

D. Grade areas to be seeded to smooth, even surface with loose, uniformly fine texture. Roll and rake and remove ridges and fill depressions as required to meet finish grades. Limit fine grading to areas which can be planted immediately after grading.

E. Moisten prepared areas to be seeded before planting if soil is dry. Water thoroughly before planting lawns. Do not create a muddy soil condition.

F. Restore areas to be seeded to specified condition if eroded or otherwise disturbed after fine grading and prior to planting.

3.03 Grass Seeding

A. Seed areas which have a slope of 4 feet or more horizontal to 1 foot vertical with grass seed, unless otherwise shown or specified.

B. Loosen the seed bed, if not loose, to a depth of from 1 to 2 inches below finished grade.

C. Any areas to be seeded over 100 square feet shall be hydroseeded.

1. Seed and fertilizer shall be added to water and thoroughly mixed at the rates determined by a professional landscape contractor. Wood cellulose fiber mulch shall be added at the rates recommended by the manufacturer after the seed fertilizer and water have been thoroughly mixed to produce a homogeneous slurry. Slurry shall be uniformly applied under pressure over the entire area. The hydroseeded area shall not be rolled.

D. Sow grass seed at the rate of not less than four pounds per 1,000 square feet.

E. Seeds and fertilizers can be sown with standard agricultural drills. Grass seeds may be sown broadcast or with a special seeder attachment on agricultural drills, but shall not be covered with more than ½ inch of soil, whether drilled or raked in. If not covered by the drill, all uncovered seed shall, immediately alter sowing, be slightly raked or harrowed to cover the seed.

3.04 Mulching

A. Apply mulching material following seeding and at the rates specified herein.

B. Punch mulching material into the soil so the mulch is partially covered. The punching operation shall be performed longitudinally with a mulch tiller. Use proper mulch tilling equipment. Evenly distribute mulch.

C. Hold the mulch in place with non-asphaltic tackifier. Apply adhesive immediately after the mulch is placed. Apply adhesive at a rate of 6 to 7 gallons per 1,000 square feet.

3.05 Watering

A. Thoroughly water seed immediately after seeding.

B. Water seed, grass, plants, and trees on a daily basis or as directed by the Engineer to establish and maintain growth until project is completed.

C. If plant water pumping and piping systems are in place and operational, the Contractor may use these systems with the approval of the Owner for landscape watering. If they are not operational, the Contractor shall be responsible for obtaining water for landscaping purposes. As applicable, treated plant effluent may be used.

3.06 Placing Stone at Maintenance Strip

A. Prior to placing stone, install weed barrier in accordance with manufacturer's instructions.

B. Place stone on area indicated on Drawings. Depth of stone shall be as indicated on Drawings.

C. Place stone to produce a regular surface. The finished surface of No. 9 stone shall not vary more than 1 inch from a true plane.

3.07 Maintenance and Protection

A. Maintain landscaped areas. Water as specified in this Section.

B. Provide protection against traffic and construction operations by erecting barricades immediately after landscaping is completed and by placing warning signs.

C. If landscaping is damaged or destroyed, the affected landscaping shall be repaired or replaced to the satisfaction of the Engineer.

3.08 Cleanup

Clean up the job site following landscaping. Remove rubbish, excess materials, temporary structures, and equipment. Leave the work in a neat and presentable condition.

-END-

SECTION 03300 - CAST-IN-PLACE CONCRETE

PART 1 : GENERAL

1.01 Summary

A. Section includes cast-in-place concrete, including formwork, reinforcement, concrete materials, mixture design, placement procedures, and finishes.

B. Related Sections:

1. Division 2 Section "Earthwork".

1.02 Action Submittals

A. Product Data: For each type of product indicated.

B. Design Mixtures: For each concrete mixture.

C. Steel Reinforcement Shop Drawings: Placing drawings that detail fabrication, bending, and placement.

D. Construction and Contraction Joint Location Plan. Coordinate location of joints with reinforcing steel shop drawings.

1.03 Informational Submittals

A. Material certificates.

B. Material test reports.

1.04 Quality Assurance

A. Manufacturer Qualifications: A firm experienced in manufacturing ready-mixed concrete products and that complies with ASTM C 94 requirements for production facilities and equipment.

B. Testing Agency Qualifications: An independent agency, qualified according to ASTM C 1077 and ASTM E 329 for testing indicated.

C. ACI Publications: Comply with the following unless modified by requirements in the Contract Documents:

1. ACI 301, "Specifications for Structural Concrete," Sections 1 through 5.
2. ACI 117, "Specifications for Tolerances for Concrete Construction and Materials."

D. Concrete Testing Service: Engage a qualified independent testing agency to perform material evaluation tests and to design concrete mixtures.

PART 2 : PRODUCTS

2.01 Form-Facing Materials

A. Smooth-Formed Finished Concrete: Form-facing panels that will provide continuous, true, and smooth concrete surfaces. Furnish in largest practicable sizes to minimize number of joints.

B. Rough-Formed Finished Concrete: Plywood, lumber, metal, or another approved material. Provide lumber dressed on at least two edges and one side for tight fit.

2.02 Steel Reinforcement

A. Reinforcing Bars: ASTM A 615, Grade 60, deformed.

B. Bar Supports: Bolsters, chairs, spacers, and other devices for spacing, supporting, and fastening reinforcing bars and welded wire reinforcement in place. Manufacture bar supports from steel wire, plastic, or precast concrete according to CRSI's "Manual of Standard Practice.

2.03 Concrete Materials

A. Cementitious Material: Use the following cementitious materials, of the same type, brand, and source, throughout Project:

1. Portland Cement: ASTM C 150, Type I or Type III gray. Supplement with the following:

a. Fly Ash: ASTM C 618, Class C.
b. Ground Granulated Blast-Furnace Slag: ASTM C 989, Grade 120.

B. Normal-Weight Aggregates: ASTM C 33, graded.

1. Maximum Coarse-Aggregate Size: 3/4 inch nominal.
2. Fine Aggregate: Free of materials with deleterious reactivity to alkali in cement.

C. Water: ASTM C 94 and potable.

2.04 Admixtures

A. Air-Entraining Admixture: ASTM C 260.

B. Chemical Admixtures: Provide admixtures certified by manufacturer to be compatible with other admixtures and that will not contribute water-soluble chloride ions exceeding

those permitted in hardened concrete. Do not use calcium chloride or admixtures containing calcium chloride.

1. Water-Reducing Admixture: ASTM C 494, Type A.
2. Retarding Admixture: ASTM C 494, Type B.
3. Water-Reducing and Retarding Admixture: ASTM C 494, Type D.
4. High-Range, Water-Reducing Admixture: ASTM C 494, Type F.
5. High-Range, Water-Reducing and Retarding Admixture: ASTM C 494, Type G.
6. Plasticizing and Retarding Admixture: ASTM C 1017, Type II.

2.05 Waterstops

A. Self-Expanding Butyl Strip (Type RX) Waterstops (Bentonite Strip Waterstop): Manufactured rectangular or trapezoidal strip, butyl rubber with sodium bentonite or other hydrophilic polymers, for adhesive bonding to concrete.

1. Products: Subject to compliance with requirements, provide one of the following:

a. Colloid Environmental Technologies Company (CETCO); Volclay Waterstop-RX.
b. Carlisle Coatings & Waterproofing, Inc.: MiraSTOP
c. Greenstreak; Swellstop

2.06 Vapor Retarders

A. Sheet Vapor Retarder: Polyethylene sheet, ASTM D 4397, not less than 10 mils thick.

2.07 Curing Materials

A. Evaporation Retarder: Waterborne, monomolecular film forming, manufactured for application to fresh concrete.

B. Absorptive Cover: AASHTO M 182, Class 2, burlap cloth made from jute or kenaf, weighing approximately 9 oz./sq. yd. when dry.

C. Moisture-Retaining Cover: ASTM C 171, polyethylene film or white burlap-polyethylene sheet.

D. Water: Potable.

E. Clear, Waterborne, Membrane-Forming Curing Compound: ASTM C 309, Type 1, Class B, dissipating.

2.08 Related Materials

A. Expansion- and Isolation-Joint-Filler Strips: ASTM D 1751, asphalt-saturated cellulosic fiber.

B. Crystalline Waterproofing Dry Pac: Per manufacturer's recommendations.

2.09 Concrete Mixtures

A. Prepare design mixtures for each type and strength of concrete, proportioned on the basis of laboratory trial mixture or field test data, or both, according to ACI 301.

B. Admixtures: Use admixtures according to manufacturer's written instructions.

1. Use water-reducing, high-range water-reducing, plasticizing admixture in concrete, as required, for placement and workability.
2. Use water-reducing and retarding admixture when required by high temperatures, low humidity, or other adverse placement conditions.
3. Use water-reducing admixture in pumped concrete, concrete for heavy-use industrial slabs and parking structure slabs, concrete required to be watertight, and concrete with a water-cementitious materials ratio below 0.50.

C. Proportion normal-weight concrete mixture as indicated in General Structural Notes.

2.10 Fabricating Reinforcement

A. Fabricate steel reinforcement according to CRSI's "Manual of Standard Practice."

2.11 Concrete Mixing

A. Ready-Mixed Concrete: Measure, batch, mix, and deliver concrete according to ASTM C 94 and ASTM C 1116, and furnish batch ticket information.

1. When air temperature is between 85 and 90 deg F reduce mixing and delivery time from 1-1/2 hours to 75 minutes; when air temperature is above 90 deg F, reduce mixing and delivery time to 60 minutes.

PART 3 : EXECUTION

3.01 Formwork

A. Design, erect, shore, brace, and maintain formwork, according to ACI 301, to support vertical, lateral, static, and dynamic loads, and construction loads that might be applied, until structure can support such loads.

B. Construct formwork so concrete members and structures are of size, shape, alignment, elevation, and position indicated, within tolerance limits of ACI 117.

C. Chamfer exterior corners and edges of permanently exposed concrete.

3.02 Embedded Items

A. Place and secure anchorage devices and other embedded items required for adjoining work that is attached to or supported by cast-in-place concrete. Use setting drawings, templates, diagrams, instructions, and directions furnished with items to be embedded.

3.03 Steel Reinforcement

A. General: Comply with CRSI's "Manual of Standard Practice" for placing reinforcement.

1. Do not cut or puncture vapor retarder. Repair damage and reseal vapor retarder before placing concrete.

3.04 Joints

A. General: Construct joints true to line with faces perpendicular to surface plane of concrete.

B. Construction Joints: Install so strength and appearance of concrete are not impaired. Contractor shall submit to the Engineer proposed locations of all joints prior to placement of concrete.

C. Waterstops: Install in construction joints and at other joints indicated according to manufacturer's written instructions.

3.05 Concrete Placement

A. Before placing concrete, verify that installation of formwork, reinforcement, and embedded items is complete and that required inspections have been performed.

B. Deposit concrete continuously in one layer or in horizontal layers of such thickness that no new concrete will be placed on concrete that has hardened enough to cause seams or planes of weakness. If a section cannot be placed continuously, provide construction joints as indicated. Deposit concrete to avoid segregation.

1. Consolidate placed concrete with mechanical vibrating equipment according to ACI 301.

C. Cold-Weather Placement: Comply with ACI 306.1.

D. Hot-Weather Placement: Comply with ACI 305.

3.06 Finishing Formed Surfaces

A. Rough-Formed Finish: As-cast concrete texture imparted by form-facing material with tie holes and defects repaired and patched. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces not exposed to public view.

B. Smooth-Formed Finish: As-cast concrete texture imparted by form-facing material, arranged in an orderly and symmetrical manner with a minimum of seams. Repair and patch tie holes and defects. Remove fins and other projections that exceed specified limits on formed-surface irregularities.

1. Apply to concrete surfaces exposed to public view.

C. Rubbed Finish: Apply the following to smooth-formed finished as-cast concrete where indicated:

1. Smooth-Rubbed Finish: Not later than one day after form removal, moisten concrete surfaces and rub with carborundum brick or another abrasive until producing a uniform color and texture. Do not apply cement grout other than that created by the rubbing process.

D. Related Unformed Surfaces: At tops of walls, horizontal offsets, and similar unformed surfaces adjacent to formed surfaces, strike off smooth and finish with a texture matching adjacent formed surfaces. Continue final surface treatment of formed surfaces uniformly across adjacent unformed surfaces unless otherwise indicated.

3.07 Finishing Floors And Slabs

A. General: Comply with ACI 302.1R recommendations for screeding, restraightening, and finishing operations for concrete surfaces. Do not wet concrete surfaces.

B. Trowel Finish: After applying float finish, apply first troweling and consolidate concrete by hand or power-driven trowel. Continue troweling passes and restraighten until surface is free of trowel marks and uniform in texture and appearance. Grind smooth any surface defects that would telegraph through applied coatings or floor coverings.

1. Apply a trowel finish to surfaces indicated.
2. Finish surfaces to the following tolerances, according to ASTM E 1155, for a randomly trafficked floor surface:

a. Specified overall values of flatness, F(F) 30; and of levelness, F(L) 20; with minimum local values of flatness, F(F) 24; and of levelness, F(L) 15; for suspended slabs and slabs-on-grade.

C. Trowel and Fine-Broom Finish: Apply a first trowel finish to surfaces indicated. While concrete is still plastic, slightly scarify surface with a fine broom.

1. Comply with flatness and levelness tolerances for trowel-finished floor surfaces.

D. Broom Finish: Apply a broom finish to exterior concrete platforms, steps, ramps, and elsewhere as indicated.

3.08 Concrete Protecting And Curing

A. General: Protect freshly placed concrete from premature drying and excessive cold or hot temperatures. Comply with ACI 306.1 for cold-weather protection and ACI 305 for hot-weather protection during curing.

B. Evaporation Retarder: Apply evaporation retarder to unformed concrete surfaces if hot, dry, or windy conditions cause moisture loss approaching 0.2 lb/sq. ft. x h before and during finishing operations. Apply according to manufacturer's written instructions

after placing, screeding, and bull floating or darbying concrete, but before float finishing.

C. Cure concrete according to ACI 308.1, by one or a combination of the following methods:

1. Moisture Curing: Keep surfaces continuously moist for not less than seven days.
2. Moisture-Retaining-Cover Curing: Cover concrete surfaces with moisture-retaining cover for curing concrete, placed in widest practicable width, with sides and ends lapped at least 12 inches, and sealed by waterproof tape or adhesive. Cure for not less than seven days. Immediately repair any holes or tears during curing period using cover material and waterproof tape.
3. Curing Compound: Apply uniformly in continuous operation by power spray or roller according to manufacturer's written instructions. Recoat areas subjected to heavy rainfall within three hours after initial application. Maintain continuity of coating and repair damage during curing period.

3.09 Concrete Surface Repairs

A. Defective Concrete: Repair and patch defective areas when approved by Engineer. Remove and replace concrete that cannot be repaired and patched to Engineer's approval.

3.10 Field Quality Control

A. Testing and Inspecting: Contractor shall engage a qualified testing and inspecting agency to perform field tests and inspections and prepare test reports. Submit proposed testing agency to Engineer for sole determination if testing agency is acceptable.

END OF SECTION 03300

DIVISION 4 - MASONRY

SECTION 04000 - MASONRY

PART 1 - GENERAL

1.01 Scope of the Work

A. The Work required under this Specification includes the furnishing of all labor, equipment, materials and services necessary for and incidental to the completion of all masonry work as shown and noted on the Drawings and as covered in this Specification.

B. Set all masonry embedded steel items provided by others.

C. Furnish and install grout reinforcing, anchor bolts, wire ties, waterproof mastics, etc., relative to masonry.

D. Commencing Work: Before starting the work and from time to time as the work progresses, examine the work installed by others, insofar as it applies to this work, and shall promptly notify the Engineer in writing if any condition exists that will prevent him giving satisfactory results in his own work.

1.02 Reference Sections

A. Section 03300 – Cast-In-Place Concrete

B. Section 05500 – Miscellaneous Metals

C. Section 07600 – Flashing and Sheet Metal

D. Section 07900 – Joint Sealants

1.03 Special Requirements

Applicable provisions of the General Requirements shall govern all Work specified herein and are made a part of this Section as if included in their entirety.

1.04 Measurements

The Contractor shall take all measurements he may require at the building and shall in all cases verify these measurements with the Engineer. He shall consult with the various other Contractors whose work adjoins his work, and he shall be responsible for the proper working out of all details.

1.05 Workmanship

A. All workmanship and finish must be first class in every way particular and strictly in accordance with the best practice. All work shall be made in accordance with

the approved Drawings. All work made in sections shall be carefully fitted together. All units shall be properly laid out and spaced between terminals.

B. All work shall be thoroughly cleaned to the entire satisfaction of the Owner.

C. The Contractor shall protect all adjoining work of other trades, and he shall make good any damages as a result of his operation.

1.06 Securing To Other Work

The Contractor shall do all cutting and fitting and work of similar character required in the fitting and setting of his materials in place, and he shall do all cutting and fitting required in connection with the fitting of his materials to the adjoining work of other Contractors.

1.07 Guarantee

A. All work under this heading shall be guaranteed against any and all defects in workmanship and material which may appear one year after completion. The Contractor shall substitute, without additional expense to the Owner, any materials or workmanship which show defects within said period of time with finished and approved new materials.

B. All masonry that is cracked, on the interior or exterior of the building, as noted at final inspection or within the one year warranty period, shall be replaced when and as directed by the Engineer. This includes all repairs to other surfaces damaged due to faulty masonry.

1.08 Job Conditions

A. All masonry walls are to be kept dry during erection by covering with a strong non-staining waterproof membrane at the end of each day or shut-down period. Covering materials shall overhang at least two (2) feet on each side of the wall and shall be secured against displacement by the wind or other elements. When Work is resumed, top surface of Work shall be cleaned of all loose mortar and in drying weather, thoroughly wet.

B. Building-in Work:

1. Consult other trades in advance and make provisions for installation of their Work in order to avoid cutting and patching. Build-in Work specified under other Sections of the Specifications as the Work progresses. Build-in anchors as required. Set steel lintels in beds of mortar accurately to line and level except at control joints. Neatly grout at metal sash fins and rake out slightly to receive caulking. Sash returns must be uniform and true.
2. Masonry Contractor shall check and verify all masonry recessed opening dimensions and be responsible for proper sizes to receive the necessary equipment.

1.09 Cold Weather Masonry Work

A. The Guide Specification for Cold Weather Masonry construction and the Recommended Practice for Cold Weather Masonry Construction shall be followed and shall become a part of these Specifications.

B. This requirement includes the following procedures:

Work Day Temp.	Construction Requirements	Protection Requirement
Above 40ºF	Normal Masonry Construction	Cover walls with plastic or canvas at end of Work day to prevent water entering masonry.
40ºF - 32ºF	Heat mixing water to produce mortar temperatures between 40ºF - 120ºF	Cover walls and materials to prevent wetting and freezing. Covers should be plastic or canvas.
32ºF -25ºF	Heat mixing water and sand to produce mortar to produce mortar temperatures between 40ºF - 120ºF	With wind velocities over 15 MPH provide windbreaks during the Work day and cover walls and materials at end of Work day to prevent wetting and freezing. Maintain masonry above freezing for 16 hours using auxiliary heat or insulated blankets.
25ºF - 20ºF	Mortar on boards should be maintained above 40ºF	
25ºF - below	Heat mixing water and sand to produce mortar temperatures between 40ºF - 120ºF	Provide enclosures and supply sufficient heat to maintain masonry above 32ºF for 24 hours

1.10 Sample Panel

A. Construct for review two field samples - 3 feet by 4 feet, using materials and joint treatment as specified or directed. Clean panel as job brick is to be cleaned. Protect one sample from rain and moisture until it is inspected. Reviewed sample panel shall be left for comparison with work erected.

B. Second field sample shall be tested for efflorescence - saturate panel with water five or six days after it is laid and observe if the panel effloresces within three days.

C. Lay sample sufficiently in advance of start of masonry work to permit changes in material and methods and inspection of new samples until final authorization to begin masonry is given.

1.11 Submittals

Submit samples and technical literature of all flashings, reinforcing, expansion joint materials and the like for approval. Submit shop drawings for reinforcing steel required for masonry installation.

PART 2 - PRODUCTS

2.01 Materials

All materials on the job site shall be so stored and handled so as to preclude the inclusion of any foreign materials in the work and to prevent any damage from the weather or the ground. Manufactured materials, such as lime and cement, shall be delivered and stored in the original packages plainly marked with the brand manufacturers name. Materials in broken containers or in packages showing water marks or other evidence of damage will be wholly rejected.

A. Mortar: All mortar throughout, unless specified otherwise, shall be of a first class quality of lime and portland cement, Type "S". Mortar shall comply with the current requirements of ASTM C270.

B. Hollow Load Bearing Concrete Masonry Units: Shall be used at foundations below slab and shall meet the requirements of the Standard Specifications for Concrete Masonry of the Indiana Concrete Masonry Association and ASTM C-90, normal weight, moisture controlled. Minimum average net-area compressive strength of 2800 psi. Bull-nose block shall be used on all exposed corners and openings.

C. Brick Masonry Units: Exposed face brick for exterior walls shall conform to the requirements of ASTM C216, Grade SW, Type FBS. Size, color, and texture shall match the existing Blower Building and be selected by Owner.

D. Insulation: Polystyrene board, faced shells with aged R-value not less then 4.17 per inch with minimum density of 1.0 lb/cu.ft. Polystyrene board shall be adhered to the concrete masonry units. All joints in the board insulation shall be sealed.

E. Masonry Cleaner: Cleaner shall be diluted muriatic acid, "Sure Klean", "Thoroclean", or approved equal.

F. Flashing: The heads and sills of all louvers of all types and exterior doors in masonry walls shall be thoroughly flashed by the Contractor. Provide thru-wall flashing at all other locations where indicated on Drawings. Flashing shall be equal to "Cop-R-Tex Duplex" (3 ounce) as manufactured by Wasco/York, York Manufacturing, Stanford, Maine. Provide plastic weeps at 24" O.C. Provide thru-wall flashing and weeps at other locations where indicated on Drawings.

G. Masonry Wall Joint Reinforcement:

1. Per ASTM A 951/A 951M. Hot-dip galvanized, carbon steel. Wire Size for Side Rods and veneer ties shall be 0.187-inch diameter, for cross rods and tabs shall be 0.148-inch diameter. Spacing of Cross Rods, Tabs, and Cross Ties not more than 16 inches o.c. Provide in lengths of not less than 10 feet (3 m), with prefabricated corner and tee units.
2. Masonry Joint Reinforcement for Single-Wythe Masonry shall be either ladder or truss type with single pair of side rods.
3. Masonry Joint Reinforcement for Multiwythe Masonry:
   a. Shall be tab type, either ladder or truss design, with one (1) side rod at each face shell of backing wythe and with rectangular tabs sized to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.
   b. Adjustable (two-piece) type, either ladder or truss design, with one (1) side rod at each face shell of backing wythe and with separate adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm). Size ties to extend at least halfway through facing wythe but with at least 5/8-inch (16-mm) cover on outside face.

H. Anchors and Ties:

1. Materials: Provide ties and anchors specified in this Article that are made from materials that comply with the following unless otherwise indicated.
   a. Hot-Dip Galvanized, Carbon-Steel Wire: ASTM A 82/A 82M with ASTM A 153/A 153M, Class B-2 coating.
   b. Stainless-Steel Wire: ASTM A 580/A 580M, Type 304.
   c. Steel Sheet, Galvanized after Fabrication: ASTM A 1008/A 1008M, Commercial Steel, with ASTM A 153/A 153M, Class B coating.
   d. Stainless-Steel Sheet: ASTM A 666, Type 304.
   e. Steel Plates, Shapes, and Bars: ASTM A 36/A 36M.
   f. Stainless-Steel Bars: ASTM A 276 or ASTM a 666, Type 304.
2. Wire Ties, General: Unless otherwise indicated, size wire ties to extend at least halfway through veneer but with at least 5/8-inch (16-mm) cover on outside face. Outer ends of wires are bent 90 degrees and extend 2 inches (50 mm) parallel to face of veneer.
3. Individual Wire Ties: Rectangular units with closed ends and not less than 4 inches (100 mm) wide.
   a. Where wythes do not align or are of different materials, use adjustable ties with pintle-and-eye connections having a maximum adjustment of 1-1/4 inches (32 mm).
   b. Wire: Fabricate from 3/16-inch- (4.76-mm-) diameter, hot-dip galvanized steel wire.

I. Grout: Conform to ASTM C-476 with a 28 day compressive strength of 3000 psi.

J. Lintels: Steel lintels shall be furnished and installed as required. Steel lintels for masonry openings will be furnished by the Structural Steel Contractor and shall be installed by the Masonry Contractor.

1. All openings in walls which are not spanned with steel beams, angles, or channels shall have reinforced masonry lintels of indicated size, and if the opening is in an exterior wall, a steel angle shall be provided in addition for the face brick as indicated, all to be furnished by the Contractor. Face brick used with steel lintels shall be back checked. Said brick shall have the beds shaped to fit the course.

K. Exterior Grilles and Frames: Exterior grilles and frames where required will be furnished by others as specified in other parts of these Specifications. They shall be set in place and anchored by the Masonry Contractor.

L. Wood Blocking: Any wood blocking shown to be installed in masonry shall be furnished by others and installed by the Masonry Contractor. Said woods shall be pressure treated wood as covered in the section "WOOD TREATMENT" of these Specifications.

M. Miscellaneous Metal Items:

1. All anchors, and miscellaneous metal items requiring anchorage in masonry will be furnished by the Miscellaneous Metals Contractor and installed by the Masonry Contractor. Masonry Contractor to provide and install all anchor bolts for wood parapet coping.

N. Control Joints: Masonry control joints shall be provided where indicated on Drawings. Use prefabricated control joint fillers of solid sections of natural or synthetic rubber, plastic, or other rubber like material. Durometer hardness shall not be less than 70 when tested in accordance with ASTM D2240. Use key of shape indicated and of dimensions that completely fill and fit neatly, without forcing, in masonry unit jamb sash grooves and provide control joint width of 3/8-inch with tolerance of 1/16-inch. Use shear section of 5/8-inch minimum thickness. Fill joints with sealant per Section 07900.

O. Weeps: Provide weeps at the base of all thru-wall flashing points a maximum of 2'-0" O.C.

P. Concrete Sills: Provide precast concrete sills where indicated on Drawings. Sills shall slope away from windows.

Q. Vertical Reinforcements:

1. Vertical reinforcement shall be placed and held in place to provide a minimum distance equal to the nominal diameter of the bar between other parallel bars of the masonry.
2. Lapped splices shall be per General Structural Notes.

PART 3 - EXECUTION

3.01 Preparation

Provide all necessary scaffolding, staging ladders, etc. necessary for the Work and comply with all State and Municipal Codes governing masonry Work. All walls or other parts shall be securely braced and protected against storm and wind during construction. Such bracing shall be maintained in place until permanent floors and roofs are set in place, and the bracing is no longer necessary for the safety and stability of the walls.

3.02 Workmanship

A. Walls and partitions shall be built true to dimensions, plumb and square. Work shall be laid in line, in level course and plumb. Required cuttings of all masonry units shall be done with power equipment which will produce true edges free of chipping and damaged surfaces. Do all necessary cutting, carefully and accurately to accommodate installation of electric outlets, conduits, plumbing fixtures, pipes, brackets, etc. Units must be carefully handled at all times. Damaged walls due to chases, conduit runs, etc., shall be solidly repaired with cement mortar where not exposed. Exposed damaged units must be replaced.

B. Where resilient base is to be applied at wall surfaces, provide a smooth, level surface to receive base. If it becomes necessary to "Stop-off" a horizontal run of masonry, it shall be done by racking back one-half (1/2) unit length in each course. Joints in all exposed concrete block Work shall be firmly and neatly tolled when mortar is thumb print hard to a lightly concave profile. Cut all joints off flush and brush off surplus mortar as Work progresses.

3.03 Handling and Storage

Masonry items shall be handled in such a manner as to prevent undue chipping and breaking. Storage piles, stacks or bins, shall be located to avoid or be protected from heavy and unnecessary traffic. Face brick and stone shall be stored on platforms or in any other manner approved to protect these materials from contact with the soil.

3.04 Erection and Installation

A. All masonry items shall be laid plumb and true to line, with level and accurately spaced courses and reveals. All corners shall be plum and true with each course breaking joint with the course below, except for interior block walls to be laid in stack bond. Bond shall be kept plumb throughout for all masonry items. Units with greater than 12% absorption shall be dampened before laying. Work required to be built in with the masonry, including anchors, wall plugs, and accessories, shall be built in as the erection progresses.

   The Contractor shall furnish and install all temporary bracing and shoring required to protect masonry work during erection and installation.

B. Temperature: No masonry shall be erected when the ambient temperature is below 32°F on a rising temperature or below 40°F on a falling temperature, or when there is a probability of such a condition existing within 48 hours, unless special

provisions are made for heating the materials and protecting the work. No frozen masonry work shall be built upon, or be allowed to remain in the structure. No brick work or other units having a film of water or frost on the surface shall be laid in the walls. No admixture will be put in the mortar without written approval of the Engineer. Note: This includes anti-freeze.

C. Lightweight and Concrete Block: Lightweight block and concrete block shall be used as noted hereinbefore and shown on the Plans. Interior walls meeting exterior walls, or other interior walls, shall be bonded into the block work. All masonry partition walls shall be extended to the floor and roof deck above. All walls shall be built true to line and plumb.

1. Leave all necessary openings for all piping of all types, heating and cooling lines, electrical conduits, etc., as required by the Mechanical and Electrical trades. All lightweight block and concrete block shall be laid with full buttered ends and shall be shoved to a bearing on a full bed of mortar with joints approximately 3/8" and all joints shall be rodded. This includes all foundation walls.
2. All exposed block walls shall be laid in a running bond. The mortar joints shall be rodded as noted above. Said block shall be bonded every other course in adjoining walls. Cuts shall be not less than 6" unless approved by the Engineer.
3. Header blocks, pilaster block and other shapes shall be furnished and installed where shown on the Plans and as directed by the Engineer.
4. Cores of block shall be filled with mortar and grout as noted on the Drawings and as required by the Engineer. <u>All exterior corners at door jambs, window jambs, etc., shall be bull nosed.</u> Block resting on steel shall be back checked with the beds shaped to fit the course, unless noted otherwise.
5. All interior walls in the building shall be left at completion in a suitable condition to receive the wall finish. Where no wall finish is specified, the walls shall be cleaned down.

D. Laying Masonry Units:

1. Lay units in full beds of mortar under both shells, and with full head joints, plumb, level and true to line in regular bond, properly jointed with other connection Work. Units with open cells exposed in wall will not be permitted.
2. Walls less than 12" in thickness shall be constructed of single width units. Provide special shapes in locations as shown on the Drawings and as may be required to form all returns and offsets using the required shapes and sizes to Work to corners and openings. Notched units are required at control joints. Make joints uniform. Joints of units shall be cut flush and shall be finished with a hardened metal tool to form a slightly concave joint. All joints shall be tooled.
3. Lay concrete block in running bond in such a manner that main bearing web comes in proper relation for bearing with units below. Use thoroughly dry units. Do not wet prior to laying. Bond block each course at all corners and all coursing of walls and partitions shall be in line (of the same elevation throughout the entire job).
4. Intersecting bearing or non-bearing walls shall be properly toothed and bonded together with full mortar beds. Tie walls together with metal wall tie reinforcing placed across the joint between the two (2) walls. Place in alternate courses vertically, sixteen inches (16") O.C., full height. Break vertical joints at each block course.

5. Interior partitions shall be wedged to the underside of the roof deck. Cover the top of all masonry when discontinuing Work for more than four (4) hours. Patch all masonry disturbed due to the installation of Work of other trades. Install insulation material where an "Air Seal" is indicated on the Drawings.

E. Bearing walls for uniform loads shall have the last sixteen inches (16") of walls under loading solid concrete block for a distance of sixteen inches (16") each side of load and two feet (2') deep.

F. General Requirements:

1. Fill hollow metal door frame jambs with grout in masonry walls. Grout-in and set lintels and other built-ins as Work proceeds; lintels to bear minimum of eight inches (8") each side of opening.
2. Install all loose lintels, inserts, wall flashing, wall reinforcement, and reglets. Set and build in such items as anchor bolts, nailing plugs, anchors and bearing plates for structural steel, louvers, mechanical and electrical equipment necessary for masonry while constructing so as to avoid cutting into masonry after erection.
3. Fill all exterior concrete block walls from top of footing to roof line with masonry insulation, excluding reinforced cores.

3.05 Cutting and Patching

Cutting and patching of masonry, required to accommodate the work of others, shall be performed by masonry mechanics, and shall be carried out under this Section of the Specifications. Masonry items of all types that require a reduction in size shall be cut by an approved type brick saw. No masonry item, that must be reduced by size, will be accepted that has not been cut with a brick saw. Cutting with any other type tool is absolutely prohibited.

3.06 Unfinished Work

Unfinished work shall be stepped back for adjoining with new work. Toothing may be resorted to only when specifically approved by the Engineer. Before new work is started, all loose mortar shall be removed and the exposed joint thoroughly wetted not less than 12 hours before laying the new work.

3.07 Protection

Surfaces of masonry not being worked on shall be properly protected at all times during the construction operation. At such times as rain or snow is imminent and the work is discontinued, the tops of all exposed masonry walls and similar surfaces shall be covered with a strong waterproof membrane well secured in place. <u>This is imperative and must be strictly adhered to by the Contractor.</u>

3.08 Pointing and Cleaning

A. At the completion of the Work, all holes in joints of all exposed masonry surfaces shall be pointed by completely filling with mortar. After pointing, all exposed masonry surfaces shall be wetted and then cleaned down.

B. Glazed Block and Blockwork: Glazed Block shall be cleaned with a solution as recommended by the masonry manufacturer or with a 10% volume of muriatic acid and water, leaving said surfaces free of mortar daubs and with tight mortar joints throughout. Blockwork shall be honed down with metal lath or pieces of block to thoroughly clean and prepare said walls for finish surface.

1. Immediately after cleaning, these masonry surfaces shall be thoroughly rinsed down with clean water protecting all adjacent work.
2. Any joints that have the finish burned off or damaged shall be cut out and pointed, and the Masonry Contractor shall waterproof the entire area of exterior walls in questions until a stopping point in the building has been reached with clear "Hydrocide SX" as manufactured by Sonneborn Building Products, or an approved clear silicon water repellent material.

3.09 Miscellaneous

Any additional masonry work required from cutting and patching by the Mechanical and Electrical Contractors, and not shown on the Drawings will be the responsibility of the Mechanical and Electrical Contractors.

3.10 Cavities

It is intended that the cavity between facing and back-up shall prevent transference of moisture and that it shall also permit some movement of the structure without cracking the facing. Therefore, take necessary precautions to prevent mortar from clogging or from bridging the cavities.

3.11 Mortar

A. Mix all materials in a mechanical bath mixer for a minimum of five (5) minutes. Adjust the consistency of the mortar to the satisfaction of the mason. Use minimum amounts of water. If the mortar begins to stiffen from evaporation or from absorption of a part of the mixing water, re-temper the mortar immediately by adding water, and remix the mortar. All mortar shall be used within 2 1/2 hours of the initial mixing. It shall not be used after it has begun to set.

B. Joints shall be of dimensions specified. They shall be full mortar bed joints and vertical joints. Press units into beds so that a full contact is made with the mortar and completely fills end joints. Surfaces to receive exterior synthetic finish system (if shown on the Drawings) shall have flush joints. Close all hair cracks and crevices. All vertical joints in alternate courses shall be aligned plumb over one another.

3.12 Control Joints

A. Control joints will be required throughout the building for all exposed concrete block walls. Spacing shall be as indicated on the Drawings. Control joints shall consist of using double "T" rubber or PVC gasket as indicated in the Drawings, and of a raked vertical joint. Joint shall be caulked as called for under the caulking section.

B. Incorporated within limitations of spacing noted above, control joints must also be placed at points of extreme stress concentration such as change in wall heights; change in wall thickness; at chases required for pipes, vents and columns, abutments of columns and wall and overweakened plans in foundation walls.

3.13 Anchors, Ties, Reinforcement

A. Install all horizontal joint reinforcement maximum width to suit full wall thickness complete with corner units and special units all in accordance with the manufacturer's instructions. Horizontal reinforcement shall be lapped 8" minimum and shall pass through control joints unless otherwise noted on the Drawings. Anchors, wall and column ties shall be installed as indicated on the Drawings and as required for a complete installation.

B. In all exterior walls and all interior load bearing walls, provide continuous horizontal joint reinforcing in the following locations, properly lapped at end joints and with all corners turned. The first and second bed joints (8" C. to C.) immediately above and below all openings; the bed joints of the first and second courses below the bearing line, when wall receives uniformly distributed floor or roof loads; every second bed joint (16" O.C.) throughout remainder of such walls except as may be noted otherwise on the Drawings.

C. In all non-bearing interior walls, install reinforcing as designated above and below openings as specified above.

D. Bonded walls (4" + 8") or (4" + 4") shall be tied and reinforced with material as approved by the governing Building Codes.

-END-

DIVISION 5 – METALS

SECTION 05520 - MISCELLANEOUS METALS

PART 1 - GENERAL

1.01 Summary

A. This section covers the work necessary for miscellaneous metal work including, but not limited to, the following:

1. Anchor Bolts and Fastenings
2. Miscellaneous Metal Supports
3. Aluminum Handrail
4. Aluminum Grating and Treads
5. Miscellaneous Metal Shapes
6. Aluminum Ladders
7. Aluminum Stairs

B. Perform all work as indicated below unless otherwise noted, and any additional work to produce a complete, finished job.

1.02 References

A. Meet and comply with all applicable ASTM, ANSI, and OSHA Standards.

B. Public Works Projects – steel or foundry products used or supplied in performance of the contract shall be U.S. manufactured products in accordance with IC.5-16-8-2.

C. Codes and standards referred to in this Section include:

1.	AISC	Code of Standard Practice for Steel Buildings and Bridges
2.	AISC	Design, Fabrication, and Erection of Structural Steel for Buildings, including "Commentary
3.	AISC	Structural Joints using ASTM A 325 or A 490 Bolts
4.	Aluminum Assoc.	Aluminum Design Manual
5.	ANSI A14.3	American National Standards for Ladders - Fixed
6.	ASTM A6	General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use
7.	ASTM A36	Carbon Structural Steel
8.	ASTM A53	Pipe, Steel, Black and Hot-Dipped, Zinc-Coated, Welded and Seamless
9.	ASTM A123	Zinc (Hot-Dip Galvanized) Coatings on Iron and Steel Products
10.	ASTM A167	Stainless and Heat-Resisting Chromium-Nickel Steel Plate, Sheet, and Strip
11.	ASTM A276	Stainless Steel Bars and Shapes
12.	ASTM A325	Structural Bolts, Steel, Heat Treated, 120/105 ksi Minimum Tensile Strength

13. ASTM A501 Hot-Formed Welded and Seamless Carbon Steel Structural Tubing
14. ASTM B211 Aluminum and Aluminum-Alloy Bar, Rod, and Wire
15. ASTM B429 Aluminum-Alloy Extruded Structural Pipe and Tube
16. AWS Standard Qualification Procedure
17. AWS D1.1 Structural Welding Code- Steel
18. NAAMM Metal Stair Manual
19. Indiana Building Code
20. OSHA Safety Standards

1.03 Submittals

A. Provide all submittals, including the following, as specified in Division 1.

1. Certified copies of test reports of factory tests required by the applicable standards.
2. Shop drawings and performance data and physical characteristics for miscellaneous metals fabrication.
   a. Include details of dimensions, cuts, connections, camber, holes, and other pertinent data. Indicate welds by standard AWS symbols, and show size, length, and type of each weld.
   b. Provide setting drawings, templates, and directions for the installation of anchor bolts and other anchorages to be installed by others.
3. Welding certification as specified in this Section.

1.04 Quality Assurance

A. Submit design calculations where specified. Construct all work in accordance with Indiana Building Code, Current Edition.

B. The recognized authority is by application of following publications:

1. UBC with Indiana Building Code Revisions
2. American Society for Testing Materials
3. OSHA

C. Codes and Standards: Comply with provisions of following, except as otherwise indicated:

1. AISC "Code of Standard Practice for Steel Buildings and Bridges". Paragraph 4.2.1 of this code is hereby modified by deletion of the following sentence: "This approval constitutes the owner's acceptance of all responsibility for the design adequacy of any connections designed by the fabricator as a part of his preparation of these shop drawings."
2. AISC "Specifications for the Design, Fabrication, and Erection of Structural Steel for Buildings", including "Commentary" and Supplements thereto as issued.
3. AISC "Specifications for Structural Joints using ASTM A 325 or A 490 Bolts", approved by the Research Council on Riveted and Bolted Structural Joints of the Engineering Foundation.
4. American Welding Society (AWS) D1.1 "Structural Welding Code- Steel.

5. ASTM A 6 "General Requirements for Delivery of Rolled Steel Plates, Shapes, Sheet Piling and Bars for Structural Use".
6. Structural aluminum construction shall conform to the Aluminum Association's Aluminum Design Manual "Specifications for Aluminum Structures – Allowable Stress Design".

D. Qualifications for Welding Work: Qualify welding processes and welding operators in accordance with AWS "Standard Qualification Procedure".

1. Provide certification that welders to be employed in work have satisfactorily passed AWS qualification tests. If recertification of welders is required, retesting will be Contractor's responsibility.

E. Structural Performance: Design (where required) fabricate, and install metal fabrications and miscellaneous metals to withstand the structural loads specified without exceeding the allowable design working stress of the materials involved, including anchors and connections. Apply each load to produce the maximum stress in each respective component of each metal fabrication.

1.05 Delivery, Storage, and Handling

A. All metal fabrications shall be prominently marked for identification in assembly either by painting or attached tag.

B. Metals shall be handled and stored in such manner as to prevent damage, corrosion, or deterioration of paint finishes.

C. All aluminum pipe and elbows shall be packed and shipped in individual plastic film to protect the anodized finish.

E. Delivery, storage and handling all materials in accordance with manufacturer's recommendations.

1.06 Project Conditions

A. Metalwork shall be finished straight, smooth, and even and free from defects and to the sizes specified and required.

B. Frame all work. Materials shall be manufactured and delivered in ample time for installation of work built into structures.

C. Provide all necessary angles, brackets, metal inserts, anchor bolts, frames, adjusting screws, bolt gaskets to property secure metal work to the masonry, structural steel framing or other parts of the structure and all other items necessary for the complete installation of the work intended whether or not specified herein or shown on the Drawings. Rivets are not allowed.

D. Welding for steel, and in particular anodized aluminum and stainless steel, shall be neat, symmetrical, clean and unobtrusive in appearance.

PART 2 - PRODUCTS

2.01 Materials

A. Unless specified otherwise, materials shall meet the following requirements:

1. Structural steel and mild steel ASTM A36.
2. Steel pipe to ASTM A53.
3. Steel tubing to ASTM A501.
4. Galvanizing 1.25 ounces per square foot of surface area to ASTM A123.
5. Aluminum to alloy designation of Aluminum Association:

	Description	Alloy Type
a.	Extruded Shapes	6061-T6
	Structural Welded Rod	5554
b.	Smooth Plates	5053-H32
	Welded Rod	5356
c.	Tread Plate	6061-T6
	Welding Filter Alloy	4043

6. Stainless steel shapes, plates, and anchor bolts shall conform to requirements of ASTM A167, type as follows:

	Description	Alloy Grade
a.	Exterior and Submerged Areas	Grade 304
b.	Interior Hazardous Areas	Grade 316
c.	Interior Areas & Architectural Uses	Grade 302/304
d.	Anchor Bolts	Grade 304

C. Handrailing grout: non-shrink type, containing no ferrous metal or aluminum metal.

2.02 Handrail

A. All handrails shall be 3-rail aluminum unless otherwise indicated.

1. Handrail shall have clear anodized finish to Aluminum Association Specification M10-C22-A41.
2. Handrail shall be designed to withstand a 200 lb. concentrated load in any direction to the top rail. The midrail at a corner return shall be able to withstand a 200 lb. load without loosening.
3. Posts and railings shall be a minimum of 1 1/2" Schedule 40 aluminum pipe alloy 6063-T6, ASTM B429 or ASTM B221.
4. Toe plate is required on all walkways of tanks, channels, platforms, areas covered by OSHA requirements, and where shown on the Drawings. Toe plate shall be a minimum of 4" high and shall be an extrusion that attaches to the

posts with clamps which allow for expansion and contraction between posts. Toe plates shall be set 1/4" above the walking surface.

5. Expansion bolts shall be stainless steel type 304 wedge bolts.
6. Top rail shall be continuous across top of posts with bottom rail fitted between posts. All jointing shall suite the circular configuration of members. Top rail shall be 3'-6" and the lower rails equally spaced above the concrete, decking or finish floor respectively, unless otherwise indicated. Maximum spacing between posts shall be six (6) feet.
7. Provide expansion joints at 24' maximum centers placed not more than 6" maximum from handrail post centers.
8. Stair railings shall have a distance of 34 inches from the upper surface of the top rail to the top of the step measured in line with the face of the riser at the forward edge of the tread.

2.03 Removable Safety Chains and Posts

A. Removable safety chains shall be 3/16" proof coil chain 1/2" 1-18" c/c, oval shaped, stainless steel links and snap hooks.

B. Posts shall be 1-1/2", Iron Pipe Size (IPS) aluminum pipe with clear anodized finish to Aluminum Association Specification AA C22 A31 of Alloy Type 6063-T6 with 0.145" wall thickness.

2.04 Grating

A. Grating shall be made of aluminum alloy Type 6063-T6, ASTM B221. Grating shall be Type 15-SGI-4 unless otherwise shown. Grating shall consist of straight extruded bearing bars or shapes placed edge-wise, interconnected rigidly by interlocking cross-bridges or spacers and serrated or scored on top to produce a skid resistant surface. Grating shall be designed to support a uniform safe load of not less than 200 pounds per square foot with a maximum deflection of 1/400 of the span including grating with openings or patchwork.

1. Interconnect bearing bars in each panel with banding bars connected to each bearing bar. Banding bars 3/16" thick shall be same as main bearing bars. Finish all openings in the grating which require cutting of more than three (3) main bars, or a side and end bar, in the same manner as the ends of the grating panels. Fabricate in such a manner that where a number of panels are to be laid side by side the carrier of spacer bars, running at right angles to the bearing bars, line up so as to preserve a continuous appearance.
2. Bearing bars shall be at least 3/32" thick at thinnest section and 5/16" wide at the wearing surface. Clear opening between bearing bars shall not exceed 1".
3. Band all openings or patchwork for valve bonnets, stems, etc., with clearance of not less than 1" left all around. Reinforce all openings of patchwork to meet the design deflection of 1/240 of the span to the approval of the Engineer.
4. Gratings shall be made in sections not exceeding 10 feet in length or not exceeding 80 pounds in weight per section.
5. Minimum thickness of any grating shall be 1 inch.

B. Where covered grating is indicated in the Drawings, grating shall be covered on the underside with 1/8" thick aluminum plate. The aluminum plate shall have the

same dimensions as the grating to which it is attached. The plate shall be attached to the grating with stainless steel hold-down clips and 1/4-inch stainless steel hardware or spot-welded. Clip spacing and placement shall be sufficient to prevent any sag or excessive stress in the aluminum plate.

C. Perforated covered grating shall be the same as covered grating, with 1/4-inch holes drilled at 2-inch centers in the aluminum plate to allow for drainage, and the plate shall be installed on the top side of the grating, and screwed permanently to the grating support angles.

2.05 Tread Plate

A. Tread plate covers and frames shall be made of aluminum alloy Type 6063-T6. Tread plate cover shall be the 3/64" raised diamond pattern.

2.06 Stair Treads and Platforms.

A. Aluminum grating capable of withstanding a uniform load of 100 lbf. per square foot or a concentrated load of 300 lbf. on an area of 4 square inches located in the center of the tread or platform, whichever produces the greater stress. Provide slip-resistant safety nosing at the forward edge of the tread.

2.07 Special Grating and Tread Plate Support

A. Special grating and tread plate supports such as angles, channels, I-beams and other metal parts shall be aluminum alloy Type 6061-T6.

2.08 Anchor Bolts and Fastenings

A. Unless specified otherwise, nuts and bolts, washers, rivets and screws shall be stainless steel.

B. Fastening for stainless steel and aluminum work shall be stainless steel.

C. Stainless steel shall be ASTM A276, Type 304 standards.

D. Structural high strength bolts shall be ASTM A325 standards.

E. Anchors or fastenings required to fix equipment and miscellaneous metals after concrete has been poured shall be the epoxy adhesive type, or alternative anchorage according to the equipment manufacturer's instructions.

F. Epoxy Adhesive Anchors Standard:

1. Hilti: HIT-HY150, or HY20 for masonry
2. Simpson Strong Tie: ET-Epoxy Tie Adhesive with Stainless Steel Rod
3. or approved equal.

2.09 Aluminum Framed Stairs

A. General: Construct stairs to conform to sizes and arrangements indicated. Join pieces together by welding, unless otherwise indicated. Provide complete stair assemblies, including metal framing, hangers, columns, railings, newels, balusters, struts, clips, brackets, bearing plates, and other components necessary for the support of stairs and platforms, and as required to anchor and contain the stairs on the supporting structure.

1. NAAMM Stair Standard: Comply with "Recommended Voluntary Minimum Standards for Fixed Metal Stairs" in NAAMM "Metal Stair Manual" for class of stair designated, except where more stringent requirements are indicated.
2. Commercial class, unless otherwise indicated.
3. Fabricate treads and platforms of exterior stairs to accommodate slopes to drain in finished traffic surfaces.

B. Stair Framing: Fabricate stringers of structural channels, or plates, or a combination thereof, as indicated. Provide closure for exposed ends of stringers. Construct platforms of structural channel headers and miscellaneous framing members as indicated. Bolt or weld headers to strings, newels, and framing members to strings and headers; fabricate and join so that bolts, if used, do not appear on finish surfaces.

1. Where masonry walls support stairs, provide temporary supporting struts designed for erection of stair components before installation of masonry.

C. Floor Plate Treads and Platforms: Provide aluminum grating as specified elsewhere in this Section.

D. Stair Railings and Handrails: Comply with applicable requirements specified elsewhere in this section for aluminum handrails and as follows.

1. Railings may be bent at corners, rail returns, and wall returns, instead of using prefabricating fittings.
2. Connect railing posts to stair framing by direct welding, unless otherwise indicated.

2.10 Aluminum Ladders

A. General: Fabricate ladders for the locations shown, with dimensions, spacings, details and anchorages as indicated. Comply with requirements of ANSI A14.3.

B. Siderails: Continuous Aluminum channels, C3 X 0.258, with rounded, chamfered, or eased edges, spaced 18 inches apart. Ends of siderails shall have caps or flatbars welded on.

C. Bar Rungs: Round bars, 1-inch diameter, spaced 12 inches o.c.

D. Fit rungs in centerline of side rails, plug weld and grind smooth on outer rail faces.

E. Support each ladder at top and bottom and at intermediate points spaced not more than 5'-0" o.c. by means of welded or bolted steel brackets.

1. Size brackets to support design dead and live loads indicated and to hold centerline of ladder rungs clear of the wall surface by not less than 7 inches.

F. Provide slip-resistant surface on top of each rung, either by coating the rung with aluminum oxide granules set in epoxy resin adhesive, or by using a type of manufacturing rung which is filled with aluminum oxide grout.

G. Ladder rungs shall be designed to withstand a concentrated live load of 250 pounds per a maximum deflection of 1/8 inch.

2.12 Miscellaneous Supports

A. Miscellaneous supports, whether or not included in the previous list, shall be mill finished aluminum Type 6061-T6 or materials approved by the Engineer.

PART 3 - EXECUTION

3.01 Installation

A. Erect miscellaneous structural steel items in accordance with AISC Code.

B. Erect structural aluminum items in accordance with Aluminum Association Specifications.

C. All field welding shall be in accordance with AWS D1.1.

D. Pipe railing shall be set plumb, straight and true.

F. Field assembly shall meeting the following requirements:

1. Frames shall be accurately assembled to the lines and elevations indicated.
2. The various members forming parts of a complete frame or structure after being assembled shall be aligned and adjusted accurately before being fastened.

G. Unless otherwise indicated on the Drawings, use stainless steel hardware in submerged conditions, including expansion bolts, equipment anchors, nuts, bolts, and washers used for mounting piping, equipment, and other submerged items.

H. Install all items as shown on the Drawings and in accordance with the manufacturer’s requirements.

3.02 Protective Coatings

A. All items not fabricated from aluminum, stainless steel or galvanized steel, shall be thoroughly cleaned and prepared and given one (1) shop coat of an approved primer in accordance with Section 09900 – Protective Coatings, before shipment.

Do not shop coat portions of steel work to be built into concrete except for 1 inch adjacent to the exposed portions. Coat or touch up abrasion marks where shop paint has been removed or chipped during erection or transportation, using the same coating as specified for shop coating.

B. Where dissimilar metals are in contact, or when aluminum is in contact with concrete, mortar, masonry, steel, or pressure-treated wood, protect dissimilar surfaces as specified in Section 09900 – Protective Coatings.

3.03 Handrail

A. The Contractor shall install handrailing in a workmanlike manner utilizing the following construction procedures:

<u>Aluminum Handrailing</u>

1. Fix aluminum handrailing to suit locations shown on the Drawings.
2. Where the plans call for removable handrail, provisions shall be made such that the railing will meet all aforementioned criteria but that it can be removed with hand tools.
3. Posts shall not interrupt the continuation of the top rail at any point along the railing, including corners and end terminations. The top surface of the top railing shall be smooth and shall not be interrupted by projecting fittings.
4. Expansion bolts shall be spaced 10d apart and 5d edge distance for no reduction in pullout strength. A safety factory of 4 shall be used in expansion bolt pullout values published by the manufacturer.
5. Where aluminum posts are to be floor mounted, provide base flanges bolted into top of concrete, as recommended by the manufacturer. Where aluminum posts are to be supported on the side of concrete walls or steel members, secure posts to side with sidemount brackets, as recommended by the manufacturer.
6. All welds shall be ground off to a smooth even finish, care being taken to avoid warp or twist in the members when fabricating.
7. The Contractor shall be responsible for coordinating the openings and layout of the handrail with the actual equipment, piping, and materials provided. Handrail installed which prohibits safe or convenient operation of equipment or conflicts with equipment piping, or materials shall be re-fabricated to eliminate the conflict. Existing handrail which is cut or modified and results in open-ended rails shall have all holes and openings plugged or capped with like materials and all sharp edges smoothed.
8. Where existing handrail is cut and horizontal rails protrude more than 6", a vertical end-rail with bends shall be added (welded or riveted) to connect the horizontal rails.
9. All handrailing shall be favorably reviewed by the Engineer.

3.04 Removable Safety Chains

A. The Contractor shall install removable stainless steel safety chains complete with approved stainless steel snap hooks fastened at each end. Handrail posts shall be provided with 1" diameter eyes fixed horizontally for the snap hooks.

3.05 Grating

A. Install grating in a workmanlike manner utilizing the following construction procedures:

1. All sides, edges, and openings cut in existing grating sections being modified shall be banded. Band all new openings cut in existing grating to provide clearance of not less than 1" left all around. Reinforce all new openings to meet the design deflection of 1/240 of the span to the approval of the Engineer.
2. Extra stiffeners required to meet load and/or deflection requirements but not shown on the Drawings shall be the responsibility of the Contractor.
3. Install clips to secure grating to supports unless grating is to be removable.
4. Install additional supports needed, at no additional cost, to meet the deflection and span limitation requirements after field verification of actual installed equipment, piping, and materials.
5. Installed grating shall not have gaps between the grating edges and walls or other grating sections greater than the spacing in the grating bars.
6. Installed grating shall not protrude more than 1/8-inch above or below the adjacent surface or section of grating.
7. Failure of installed grating to meet the above requirements will result in the rejection of the grating. New sections of grating shall be provided until these requirements are met.
8. Obtain favorable review from the Engineer in writing prior to ordering grating. Furnish to grating manufacturer plans and field dimensions for the preparation of shop drawings.
9. Clip panels together sufficiently with clips made for this purpose to prevent differential movement panel to panel when subjected to moving loads.
10. Support grating on top at concrete wall or steel angle members set into concrete in accordance with the Drawings.

3.06 Tread Plate

A. Frame tread plate covers and frames to the sizes required on the Drawings. Frames shall consist of angle mitered at corners, complete with anchors and packing bars. Covers shall be fitted with lifting handles, heavy duty strap hinges and shock absorbing holders.

3.07 Special Grating and Tread Plate Supports

A. Special grating and tread plate supports shall be to the sizes and details shown on the Drawings.

3.08 Miscellaneous Supports

A. Miscellaneous supports to the sizes and details and locations respectively, as shown on the Drawings to the favorable review of the Engineer.

3.09 Fasteners

A. Install stainless steel bolts and washers for all aluminum connections.

-END-

DIVISION 6 – WOOD AND PLASTICS

SECTION 06501 – FIBERGLASS WEIRS AND BAFFLES

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and install fiberglass weirs, baffles and appurtenances necessary to complete work shown or specified.

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.

1.02 Submittals

A. Submittals shall be as specified in Section 01300.

B. Submit the following:

1. Certified copies of test reports of factory tests required by the applicable standards.
2. Shop drawings with physical characteristics for fiberglass weirs and baffles and dimensioned layouts.
3. Structural calculations.

1.03 Product Delivery, Storage, and Handling

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

C. Follow manufacturer's instructions for storage of material

PART 2 - PRODUCTS

2.01 Fiberglass Weirs and Baffles

A. Furnish all necessary fiberglass weirs and baffles of the dimensions shown on the drawings and specified in this Section. Weirs and baffles shall be reinforced fiberglass plastic laminate molded by the matched die method.

B. Glass reinforcement shall consist of chemically bonded surfacing mat and either chopped strand, chopped strand mat, woven roving, or woven cloth, or any combination thereof as required by the finished product. Surfacing mat shall be

Type A or Type C, 10 to 20 mils thick, with a silane finish and a styrene-soluble binder; and the glass content of this layer shall not exceed 23% by weight. Chopped strands and chopped strand mat shall be Type E glass, with silane finish and styrene-soluble binder. Strand shall not be larger than Number 130. The glass content of the finished laminate shall not be less than 30% by weight. Woven cloth or woven roving (60 end maximum) shall be Type E glass with silane type finish.

C. Mechanical properties shall equal or exceed the following:

Laminate Physical Properties 70°F

Ultimate Tensile Strength - psi x 10^3 (min.)	12
Flexural Strength - psi x 10^3 (min.)	19
Flexural Modulus of Elasticity - psi x 10^6 (min.)	0.8
Barcol Hardness (min.)	35

1. The procedure to be used in determining the properties listed above shall be in accordance with ASTM Standards, Part 9, and the following designations: Ultimate Tensile Strength - ASTM Designation D638, latest edition; Flexural Strength - ASTM Designation D790, latest edition; Modulus of Elasticity - ASTM Designation D790, latest edition.
2. Hardness tests shall be made of the resin-rich surface of the product.
3. Flexural tests shall be made with the resin-rich surface in compression.
4. Test samples shall be full thickness of the item produced and shall not be machined on the surface.

D. The laminate shall contain a glass content of not less than 30% and not more than 32% using Type E glass with chrome or silane finish. Powdered reinforcements shall consist of 47.5 ± 10% of resin mixture. Final laminate thickness shall be within ±10% of the nominal specified thickness.

E. All surfaces shall be resin rich, free of voids and porosity, without dry spots, crazes, or unreinforced areas, and shall provide for increased corrosion resistance and weathering. All machined or cut edges on weir and baffles shall be resin sealed.

F. Weirs shall be 1/4-inch thick unless otherwise noted on the Drawings. Baffles shall not be less than 1/4-inch thick. Weirs and baffles shall be reinforced with fiberglass, aluminum, or stainless steel structural sections as required for strength and to maintain rigidity in the intended service.

G. Mounting holes shall be located on 12-inch centers for weirs, 36-inch centers for straight baffles, and 40-inch centers for curved baffles, unless otherwise shown on the Drawings. Weirs and baffles shall be adjustable in both horizontal and vertical directions. Weirs which are to be face mounted shall have mounting holes not less than 2-1/2 inches or more than 2-3/4 inches in diameter.

H. Ultraviolet resistance is required in all laminates. A UV stabilizer shall be added to the resin to retard UV degradation. A synthetic polyester surface veil shall be applied to all exposed surfaces for chemical and additional ultraviolet resistance.

I. When metal reinforcements are used, they shall be free of rust, oil, and any foreign matter. They shall be completely encapsulated with a minimum of 1/8" thick laminate.

J. Standard color shall be as approved by the Owner and Engineer.

PART 3 - EXECUTION

3.01 Installation

A. Install fiberglass weirs and baffles in accordance with manufacturer's recommendations, as shown on the drawings, and as specified in this Section.

B. Secure weirs and baffles with stainless steel hardware.

C. Use 5-inch diameter fiberglass washer between fiberglass weir or baffle and stainless steel washer when face mounting weirs and baffles.

D. When multiple sections of weir or baffle are required, leave a 1/2-inch to 3/4-inch slot between the ends of adjacent weirs and baffle. Cover opening between ends of weirs and baffles with a fiberglass butt plate, which is of the same height as the applicable weir or baffle and not less than 6 inches wide.

E. Weirs and baffles shall be installed level and plumb, unless otherwise shown on the drawings. Weirs shall be within 0.005 foot of the elevation shown on the drawings.

F. Weir edges shall be smoothed and leveled to uniformly match a stillwater surface at the weir elevation shown on the Drawings. Field testing of weirs shall consist of filling tanks with water to the top of the weir to verify level and uniform flow distribution across the length of the weir. Weirs that are not level and have ununiform distribution of flow shall be adjusted until acceptable.

G. Apply immersible-grade sealant as approved by the Engineer between weirs and wall or trough to provide a watertight seal.

3.02 Cleaning and Adjusting

Weirs, baffles, and troughs shall be cleaned and adjusted for proper operation to the satisfaction of the Engineer.

- END -

SECTION 06610 – FRP GRATING, HANDRAIL, & LADDERS

PART 1 - GENERAL

1.01 Work Included

A. Furnish and install fiberglass reinforced plastic (FRP) grating, handrail, and ladders and cages (if required), with all appurtenances, accessories and incidentals necessary to produce a complete, operable and serviceable installation as shown on the Contract Drawings and as specified herein, and in accordance with the requirements of the Contract Documents.

1.02 References

A. The publications listed below (latest revision applicable) form a part of this specification to the extent referenced herein. The publications are referred to within the text by the designation only.

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM) Test Methods:

- ASTM E-84: Surface Burning Characteristics of Building Materials
- ASTM D-495: High Voltage, Low-Current, Dry Arc Resistance of Solid Electrical Insulation
- ASTM D-635: Rate of Burning and/or Extent and Time of Burning of Self-Supporting Plastics in a Horizontal Position
- ASTM D-638: Tensile Properties of Plastics
- ASTM D-696: Coefficient of Linear Thermal Expansion for Plastics
- ASTM D-790: Flexural Properties of Unreinforced and Reinforced Plastics
- ASTM D-2344: Apparent Interlaminar Shear Strength of Parallel Fiber Composites byShort Beam Method

INTERNATIONAL CODE COUNCIL, INC.

- The International Building Code, 2003

THE OCCUPATIONAL HEALTH AND SAFETY ADMINISTRATION

- Federal Register, Volume 39, No. 125, Section 1910.23 & 1910.27

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1.03 Submittals

A. Furnish shop drawings of all products and accessories in accordance with the provisions of this Section.

B. Furnish manufacturer's shop drawings clearly showing material sizes, types, styles, part or catalog numbers, complete details for the fabrication and erection of components including, but not limited to, location, lengths, type and sizes of fasteners, clip angles, member sizes, and connection details.

C. Submit the manufacturer’s published literature including structural design data, structural properties data, grating load/deflection tables, corrosion resistance tables, certificates of compliance, test reports as applicable, concrete anchor systems and their allowable load tables, and design calculations for systems not sized or designed in the contract documents.

D. The Contractor may be requested to submit sample pieces of each item specified herein for acceptance by the Engineer as to quality and color. Sample pieces shall be manufactured by the method to be used in the Work.

1.04 Quality Assurance

A. All items to be provided under this Section shall be furnished only by manufacturers having a minimum of ten (10) years experience in the design and manufacture of similar products and systems. Additionally, if requested, a record of at least five (5) previous, separate, similar successful installations in the last five (5) years shall be provided.

B. Manufacturer shall be certified to the ISO 9001-2000 standard.

C. Manufacturer shall provide proof of certification from at least two other quality assurance programs for its facilities or products (UL, DNV, ABS, USCG, AARR).

D. Manufacturer shall provide proof, via independent testing less than six months old, that materials proposed as a solution do not contain heavy metals in amounts greater than that allowed by current EPA requirements.

1.05 Warranty

A. Manufacturer shall provide a 3 year limited warranty on all FRP products against defects in materials and workmanship.

1.06 Product Delivery and Storage

A. Delivery of Materials: Manufactured materials shall be delivered in original, unbroken pallets, packages, containers, or bundles bearing the label of the manufacturer. Adhesives, resins and their catalysts and hardeners shall be crated or boxed separately and noted as such to facilitate their movement to a dry indoor storage facility.

B. Storage of Products: All materials shall be carefully handled to prevent them from abrasion, cracking, chipping, twisting, other deformations, and other types of damage. Adhesives, resins and their catalysts are to be stored in dry indoor storage facilities between 70 and 85 degrees Fahrenheit (21 to 29 degrees Celsius) until they are required.

PART 2 - PRODUCTS

2.01 General

A. All FRP items furnished under this Section shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

B. Fiberglass reinforcement shall be continuous roving in sufficient quantities as needed by the application and/or physical properties required.

C. Resin shall be Isophthalic Polyester, with chemical formulations as necessary to provide the corrosion resistance, strength and other physical properties as required.

D. All finished surfaces of FRP items and fabrications shall be smooth, resin rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

E. All FRP products shall have a tested flame spread rating of 25 or less per ASTM E 84 Tunnel Test. Data performed only on the resin shall not be acceptable.

2.02 Molded FRP Grating

A. Product shall be Fibergrate, as manufactured by Fibergrate Composite Structures, Inc., Dallas, TX; or approved equal.

B. Manufacture: Grating shall be of a one piece molded construction with tops and bottoms of bearing bars and cross bars in the same plane. Grating shall have a square mesh pattern providing bidirectional strength. Grating shall be reinforced with continuous rovings of equal number of layers in each direction. The top layer of reinforcement shall be no more than 1/8" below the top surface of the grating so as to provide maximum stiffness and prevent resin chipping of unreinforced surfaces. Percentage of glass (by weight) shall not exceed 35% so as to achieve maximum corrosion resistance, and as required to maintain structural requirements.

C. After molding, no dry glass fibers shall be visible on any surface of bearing bars or cross bars. All bars shall be smooth and uniform with no evidence of fiber orientation irregularities, interlaminar voids, porosity, resin rich or resin starved areas.

D. Gratings shall have tested burn time of less than 30 seconds and an extent of burn rate of less than or equal to 10 millimeters per ASTM D635. Data performed only on the resin shall not be acceptable.

E. Non–slip surfacing: Grating shall be manufactured with a concave, meniscus profile on the top of each bar providing maximum slip resistance.

F. Grating bar intersections are to be filleted to a minimum radius of 1/16” to eliminate local stress concentrations and the possibility of resin cracking at these locations.

G. Resin system: The resin system used in the manufacture of the grating shall be Corvex®, or approved equal.

H. Manufacturer may be required to submit corrosion data from tests performed on actual grating products in standard chemical environments. Corrosion resistance data of the base resin from the manufacturer is not a true indicator of grating product corrosion resistance and shall not be accepted. IFR products shall be U.L. listed if available for the grid configuration and surface specified.

I. Color: yellow

J. Depth: 1 1/2" with a tolerance of plus or minus 1/16".

K. Mesh Configuration: 1 1/2" x 1 1/2" with a tolerance of plus or minus 1/16" mesh centerline to centerline

L. Load/Deflection: Grating design loads shall be less than manufacturers published maximum recommended loads. Maximum recommended loads shall be determined by acoustic emission testing. Grating shall be designed for a uniform load of 100 psf or concentrated load of 300 lb. Deflection is not to exceed 0.375” or L/D = 120, whichever is less.

M. The manufacturer shall certify that the stiffness of all panels manufactured are never more than 2.5% below the published load-deflection values.

N. Substitutions: Other products of equal strength, stiffness, corrosion resistance and overall quality may be submitted with the proper supporting data to the engineer for approval.

O. Measurements: Grating supplied shall meet the dimensional requirements and tolerances as shown or specified. The Contractor shall provide and/or verify measurements in field for work fabricated to fit field conditions as required by grating manufacturer to complete the work. When field dimensions are not required, contractor shall determine correct size and locations of required holes or cutouts from field dimensions before grating fabrication.

P. Layout: Each grating section shall be readily removable, except where indicated on drawings. Manufacturer to provide openings and holes where located on the contract drawings. Grating openings which fit around protrusions (pipes, cables, machinery, etc.) shall be discontinuous at approximately the centerline of opening so each section of grating is readily removable.

Q. Sealing: All shop fabricated grating cuts shall be coated with vinyl ester resin to provide maximum corrosion resistance. All field fabricated grating cuts shall be coated similarly by the contractor in accordance with the manufacturer's instructions.

R. Hardware: All fasteners and clips shall be Type 316 stainless steel provided by the manufacturer and shall be spaced at a maximum of four feet apart with a minimum of four per piece of grating, or as recommended by the manufacturer.

2.03 FRP Handrail System

A. FRP handrail system shall be pultruded system Dynarail, as manufactured by Fibergrate Composite Structures, Inc., Dallas, TX; or approved equal.

B. All posts and rails are to be DYNAFORM® FRP structural shapes manufactured by the pultrusion process. The structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions specified in the Contract Documents.

C. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

D. Resins shall be DYNAFORM® ISO-FR, an isophthalic polyester with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

E. All finished surfaces of FRP items and fabrications shall be smooth, resin rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

F. All pultruded structural shapes shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin, 2) a synthetic surfacing veil to help produce a resin rich surface, and 3) an appropriate UV resistant coating for outdoor exposures.

G. Top and bottom rails are to be 1.75" x 0.125" (44.4 mm x 3.2 mm) wall square tube, the posts are to be 2.125" x 0.1875" (53.9 mm x 4.8 mm) wall square tube and kickplate is to be ½" deep x 4" wide with two reinforcing ribs.

H. The completed handrail installation shall meet the following load requirements with a minimum factor of safety of 2.0:

o Concentrated Load: 200 lb (891 N) applied in any direction at the top rail.

o Uniform Load: 50 lb/lf (730.5 N/m) of the top rail in any direction.

o Loads are assumed not to act concurrently.

B. All rails, posts, and kick plates are to be integrally pigmented yellow.

C. Pultruded structural shapes used in the handrail are to have the minimum longitudinal mechanical properties listed below:

Property	**ASTM Method**	**Value**	**Units**
Tensile Strength	D-638	30,000 (206)	psi (MPa)
Tensile Modulus	D-638	2.5×10^6 (17.2)	psi (GPa)
Flexural Strength	D-790	30,000 (206)	psi (MPa)
Flexural Modulus	D-790	1.8×10^6 (12.4)	psi (GPa)
Flexural Modulus (Full Section)	N/A	2.8×10^6 (19.3)	psi (GPa)
Short Beam Shear (Transverse)	D-2344	4,500 (31)	psi (MPa)
Shear Modulus (Transverse)	N/A	4.5×10^5 (3.1)	psi (GPa)
Coefficient of Thermal Expansion	D-696	8.0×10^{-6} (1.4×10^{-6})	in/in/°F (cm/cm/°C)
Flame Spread	E-84	25 or less	N/A

I. All fasteners used in the railing system are to be 316 SS. Rivets to be 18-8 SS.

2.04 FRP Ladder and Cage System

A. FRP ladder and cage system (if required) shall be Dynarail, as manufactured by Fibergrate Composite Structures, Inc., Dallas, TX; or approved equal.

B. All ladder side rails, rungs, ladder mounting brackets and cage straps are to be FRP structural shapes manufactured by the pultrusion process. Cage hoops and brackets shall be produced by the open molded hand lay-up method. All structural shapes shall be composed of fiberglass reinforcement and resin in qualities, quantities, properties, arrangements and dimensions as necessary to meet the design requirements and dimensions as specified in the Contract Documents.

C. Fiberglass reinforcement shall be a combination of continuous roving, continuous strand mat, and surfacing veil in sufficient quantities as needed by the application and/or physical properties required.

D. Resins shall be DYNAFORM® ISO-FR, an isophthalic polyester with chemical formulation necessary to provide the corrosion resistance, strength and other physical properties as required.

E. All finished surfaces of FRP items and fabrications shall be smooth, resin rich, free of voids and without dry spots, cracks, crazes or unreinforced areas. All glass fibers shall be well covered with resin to protect against their exposure due to wear or weathering.

F. All pultruded ladder components shall be further protected from ultraviolet (UV) attack with 1) integral UV inhibitors in the resin and 2) a synthetic surfacing veil to help produce a resin rich surface.

G. Ladder side rails shall be 1-3/4" square tube with a wall thickness of 1/4" or greater. The rungs shall be 1-1/4" diameter pultruded structural shapes, continuously fluted to provide a non-slip surface. Rungs that are gritted as a secondary operation shall not be permitted. Ladder wall and floor mount shall be fabricated from pultruded angles, 3/8" minimum thickness.

H. The ladder cage vertical bars shall be 1.5" wide by 5/8" pultruded I-beam shapes to offer protection to workers from exposed hardware. Cage hoops and cage brackets shall be manufactured by the open mold hand lay-up process. All cage hoops shall be 3" wide by 1/4" thick minimum.

I. Type 316 stainless steel bolts shall be provided for attaching ladder cage vertical bars to hoops, ladder hoops to brackets, ladder cage brackets to the ladder, and wall brackets to the ladder.

J. All rungs shall be both mechanically attached to the ladder with stainless steel rivets and chemically bonded with epoxy.

K. All ladder and cage components are to be integrally pigmented yellow. All wall and floor mount brackets shall be Dynaform® ISOFR light gray, or approved equal.

L. Pultruded structural shapes used in the ladder system are to have the minimum longitudinal mechanical properties as listed in Section 2.03-J of this same specification.

M. The completed ladder and cage system installation shall meet the following load requirements set forth in OSHA 1910.27. The ladder shall also be capable of supporting a concentrated vertical load of 1,200 pounds applied at the mid-span of the rung. Manufacturer shall be required to provide supporting test data for rung capacity.

N. All fasteners used in the ladder system are to be 316 SS. Rivets will be 18-8 stainless steel.

PART 3 - FABRICATION

3.01 Handrail

A. The handrail post/rail connection is to be fabricated such that the rails are unbroken and continuous through the post without the use of packs or splices. The bottom rail is to be installed through the post at a prepared hole made to fit the outside dimensions of the rail. The top rail is to fit into a machined, u-shaped pocket formed into top of the post such that the rail is located at the center of the post. All exposed post corners are to be radiused to eliminate sharp edges. The rails are to be joined to the post through a combination of bonding and riveting. No sharp,

protruding edges are to remain after assembly of the handrail. Spacing of the posts shall not exceed 6'-0" (1.83 m).

B. The bases of the posts are to be attached according to the contract drawings. The bases of the posts are to be reinforced to a height of 8.5" (254 mm).

C. When required, rails are to be spliced using a 10" (152.4 mm) length of 1.5" x 1/8" (38.1 mm x 3.2 mm) FRP square tube bonded and riveted into place using epoxy adhesive and 18-8 stainless steel rivets.

D. To avoid embrittlement at cold temperatures and loss of strength at high temperatures, no PVC or CPVC connectors should not be used as a load carrying component of the handrail system.

E. All shop fabricated cuts are to be coated with a vinyl ester resin to provide maximum corrosion resistance. Field cuts are to be similarly coated by the contractor in accordance with the manufacturer’s instructions.

3.02 Ladder and Cage System

A. All ladders and cages shall be designed and laid out in strict accordance with OSHA 1910.27.

B. All rungs shall penetrate the wall of the tube side rails and shall be connected to the rails with both epoxy and rivets to provide both a chemical and mechanical lock, respectively.

C. Ladders shall be fully shop assembled. Ladder cages shall be test assembled and drilled to ensure a proper fit in the field. Ladder cage brackets shall remain attached to the ladder for shipping, but ladder cage components shall be disassembled, packaged, and shipped separately to ensure the lowest freight costs and to prevent damage in transit. Cage components shall be bundled with each respective ladder.

D. The hoop brackets shall be shop attached to the ladder with bolts. The hoops shall be field attached to the hoop brackets.

E. All cut or machined edges, holes and notches shall be sealed to provide maximum corrosion resistance. All field fabricated cuts shall be coated similarly by the contractor in accordance with the manufacturer’s instructions.

PART 4 - EXECUTION

4.01 Installation

A. Install all FRP products specified herein in accordance with manufacturer’s assembly drawings. Fasten products securely in place with hold down fasteners as specified herein. Field cut and drill fiberglass reinforced plastic products with carbide or diamond tipped bits and blades. Seal cut or drilled surfaces in accordance with manufacturer's instructions. Follow manufacturer's instructions

when cutting or drilling fiberglass products or using resin products; provide adequate ventilation.

-END-

DIVISION 7 – THERMAL & MOISTURE PROTECTION

SECTION 07190 - VAPOR AND AIR RETARDERS

PART 1 - GENERAL

1.01 Related work specified elsewhere:

A. Earthwork - Section 02200.

PART 2 - PRODUCTS

2.01 Material

A. Under slab vapor barrier: Polyethylene film, .010" (10 mil.) thick.

PART 3 - EXECUTION

3.01 Inspection

A. Inspect fill compaction, level surfaces and depressions for thickened slabs.

3.02 General

A. Damp-proof all interior concrete slabs on grade with polyethylene film.

B. Install vapor barrier above granular fill before concrete slab is placed.

3.03 Installation

A. Lap ends and edges minimum 6 inches. Make laps in directions of concrete pour. Cut carefully around pipes and conduit. Seal cut openings with tape. Repair all punctures before placing top 4 inches of compacted fill.

-END-

SECTION 07210 - BUILDING INSULATION

PART 1 - GENERAL

1.01 Scope

The Contractor shall provide all labor, materials, tools and equipment to install roll or batt insulation in the ceiling areas and perimeter rigid insulation around foundations of the building as shown on the Drawings.

1.02 Related work specified elsewhere:

A. Earthwork - Section 02200

B. Trenching, Backfilling, and Compaction – Section 02220

1.03 Reference Standards

A. Federal Specifications (FSS)

PART 2 - PRODUCTS

2.01 Material

A. Perimeter and under-slab insulation – shall be rigid thermal insulation 2" thick by 24" wide such as Styrofoam SM brand insulation as manufactured by the DOW Chemical Co. or equal. Insulation shall have a minimum compressive strength of 20 psi and maximum water absorption of 0.1% by volume. Adhesive shall be as recommended by manufacturer.

PART 3 - EXECUTION

3.01 Installation

A. Insulation

1. Installed in spaces indicated, with vapor barrier toward heated space in accordance with manufacturer's printed instructions.
2. Fitted snugly between framing members, pipes, conduits, and other obstructions.
3. Installed between pipes and sheathing.
4. Snugly end match.
5. Installed to maintain clearance to lights, fans and other heat generating equipment.

-END-

SECTION 07530 - FLEXIBLE SHEET ROOFING SYSTEM (FULLY ADHERED)

PART 1 - GENERAL

1.01 Summary

A. Extent of flexible sheet roofing (FSR) is indicated on drawings and is hereby defined to include non-traffic-bearing sheet membrane system intended for weather exposure as primary roofing.

B. Type of roofing systems specified in this section utilizing flexible sheet roofing membranes includes fully adhered systems. Flexible sheet roofing membranes include ethylene propylene diene monomer (EPDM).

C. Similar membranes concealed by a wearing surface are excluded by definition and, if required, are specified elsewhere in Division 7 as waterproofing.

1.02 Submittals

A. Product Data: Submit specifications, installation instructions and general recommendations from manufacturers of flexible sheet roofing system materials, for types of roofing required. Include data substantiating that materials comply with requirements.

B. Samples: Submit 12-inch square samples of finished roofing sheets, including “T-shaped” side/endlap seam if seaming is required.

C. Warranty: Submit sample copy of standard roofing system manufacturer’s warranty specified in section 1.06 below.

1.03 Quality Assurance

A. Installer Qualifications: Engage an experienced installer to perform work of this Section who has specialized in installing roofing similar to that required for this Project and who is approved, authorized, or licensed by the roofing system manufacturer to install manufacturer’s products. Provide certificate signed by roofing system manufacturer certifying that Installer is approved, authorized, or licensed by manufacturer to install specified roofing system. Provide list of recently completed projects with project names, names and telephone numbers of Owners and Architects, and type of roofing system installed.

B. Obtain primary flexible sheet roofing from a single manufacturer. Provide secondary materials and accessories as recommended by manufacturer of primary materials.

1.04 Project Conditions

Proceed with roofing work when existing and forecasted weather conditions permit work to be performed in accordance with manufacturers' recommendations and warranty requirements.

1.05 Warranty

A. General Warranty: The warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and shall be in addition to, and run concurrent with, other warranties made by the Contractor under requirements of the Contract Documents.

B. Standard Roofing Manufacturer's Warranty: Submit a written warranty, without monetary limitation, signed by roofing system manufacturer agreeing to promptly repair leaks resulting from defects in materials or workmanship for the following warranty period:

1. Warranty Period: 15 years.

PART 2 - PRODUCTS

2.01 General

Provide products which are recommended by manufacturers to be fully compatible with indicated substrates.

2.02 EPDM Membrane

A. Ethylene propylene diene monomers formed into uniform, flexible sheets, complying with ANSI/RMA 1PR-l:

1. Thickness: 60 mils, nominal; nonreinforced.
2. Exposed Face Color: Black.

B. Fully Adhered EPDM Membrane: Subject to compliance with requirements, provide products of one of the following: Firestone Building Products Co.; Carlisle Syntec Systems; or equal.

2.03 Auxiliary Materials for FSR

A. Sheet Seaming System: Manufacturer's standard materials for sealing lapped joints, including edge sealer to cover exposed spliced edges as recommended by manufacturer of FSR system.

B. Cant Strips, Tapered Edge Strips and Flashing Accessories: Types recommended by manufacturer of FSR material, provided at locations indicated and at locations recommended by manufacturer, including adhesive tapes, flashing cements, and sealants.

C. Flashing Material: Manufacturer's standard system compatible with flexible sheet membrane.

D. Mechanical Fasteners: Metal plates, caps, battens, accessory components, fastening devices, and adhesives to suit substrate and as recommended by FSR membrane manufacturer.

E. Membrane Adhesive: As recommended by FSR membrane manufacturer for particular substrate and project conditions, formulated to withstand a minimum of 60 psf uplift force.

PART 3 - EXECUTION

3.01 Preparation of Substrate

A. Comply with manufacturers' instructions for preparation of substrate to receive FSR system.

B. Clean substrate of dust, debris, and other substances detrimental to FSR system work. Remove sharp projections and other items which may damage roofing system.

3.02 Installation

General: Comply with manufacturers' instructions, except where more stringent requirements are indicated.

3.03 Adhered Membrane Installation

A. Install membrane by unrolling over prepared substrate, allowing to relax for 30 minutes, fastening at perimeter and at roofing penetrations. Lap adjoining sheets and bond, covering top edges of each sheet at seams with uniform fillet of sealant as recommended by manufacturer. Install flashings and counter flashings as shown and as recommended by manufacturer.

B. Install EPDM sheet over area to receive roofing according to roofing system manufacturer's written instructions. Unroll sheet and allow to relax for a minimum of 30 minutes.

C. Accurately align sheets and maintain uniform side and end laps of minimum dimensions required by manufacturer. Stagger end laps.

D. Apply bonding adhesive to substrate and underside of sheet at rate required by manufacturer and allow to partially dry. Do not apply bonding adhesive to splice area of sheet.

3.04 Flashing

A. Detail all flashings and roof turn-up at curbs, cants and parapets in strict accordance with the manufacturer's standard illustrated details.

B. Fasten or adhere all flashing at the top, under or through appropriate counterflashing. Use fasteners or adhesive as recommended by the roofing manufacturer.

C. Apply bonding adhesive to both the underside of flashing and to the surface to which it is to be bonded.

-END-

SECTION 07600 - FLASHING AND SHEET METAL

PART 1 - GENERAL

1.01 Scope

A. Gutters, downspouts, flashing and related work.

1.02 Related work specified elsewhere

A. Section 04000 – Masonry

B. Section 05520 – Miscellaneous Metal Work

C. Section 07900 – Joint Sealants

D. Section 15710 – Power Ventilators and Louvers

1.03 Job Conditions

A. Surfaces to receive sheet metal and flashing shall be even, smooth, sound dry, clean and free from all defects that would adversely affect the installation.

B. Materials furnished under this section, but to be built-in by other trades, shall be delivered in time to avoid delays in the work.

C. Where sheet metal or flashing abuts or fastens to dissimilar materials the juncture shall be executed in a manner to prevent electrolysis between the two materials.

D. Provide accessories and other items essential to the proper installation of sheet metal work.

1.04 Reference Standards

A. AAMA 611 - Voluntary Specification for Anodized Architectural Aluminum; American Architectural Manufacturers Association; 1998.

B. AAMA 2603 - Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels; 2002.

C. ASTM A 653/A 653M - Standard Specification for Steel Sheet, Zinc-Coated (Galvanized) or Zinc-Iron Alloy-Coated (Galvannealed) by the Hot-Dip Process; 2007.

D. ASTM A 666 - Standard Specification for Annealed or Cold-Worked Austenitic Stainless Steel Sheet, Strip, Plate, and Flat Bar; 2003.

E. ASTM B 209 - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate; 2007.

F. ASTM B 209M - Standard Specification for Aluminum and Aluminum-Alloy Sheet and Plate [Metric]; 2007.

G. ASTM D 4586 - Standard Specification for Asphalt Roof Cement, Asbestos-Free; 2007.

H. SMACNA (ASMM) - Architectural Sheet Metal Manual; Sheet Metal and Air Conditioning Contractors' National Association; 2003.

1.05 Domestic Product Requirements

All steel and foundry products provided for in this project, including ferrous and non-ferrous metals, piping, fittings, and piping-related products, shall be manufactured in the United States.

1.06 Submittals

A. See Section 01300 - Submittals, for submittal procedures.

B. Shop Drawings: Indicate material profile, jointing pattern, jointing details, fastening methods, flashings, terminations, and installation details.

1.07 Quality Assurance

A. Perform work in accordance with SMACNA Architectural Sheet Metal Manual requirements and standard details, except as otherwise indicated.

PART 2 - PRODUCTS

2.01 Materials

A. Flashing for window sills; roof penetrations; equipment support flashing; exposed trim, gravel stops and fascia; gable flashing; eave flashing; sill flashing; jamb flashing; wall/siding penetrations; fiber cement siding, trim; outside 90° flashing; and escutcheon plates:

1. Aluminum
   a. ASTM B209, Alloy 3003, Temper H14, Kynar 500 Finish (1.0 mil DFT)
   b. 0.050-inch thick, minimum
   c. Color: Medium Bronze

B. Flashing for gutters, downspouts, conductor heads, and scuppers:

1. Aluminum
   a. ASTM B209, Alloy 3003, Temper H14, Kynar 500 finish (1.0 mil DFT)
   b. 0.032-inch thick, minimum
   c. Color: Medium Bronze

C. Flashing for base flashing; counter flashing; and flashing receivers:

1. Stainless steel
   a. ASTM A167, Type 304, soft-annealed, with No. 2D finish
   b. 0.0187-inch thick, minimum

D. Solder

1. ASTM B32.
2. 5050 Block tin and pig lead.

E. Flux: F.S. O-F-506 B, Type 1.

F. Fasteners: Nails, screws, rivets, brackets, etc., shall be stainless steel unless indicated otherwise on the drawings.

G. Sheet Lead

1. Hard Type
2. Weight: 4 lbs. per sq. ft., minimum.
3. Conform to Fed. Specs. QQ-L-201a.

H. All accessories or other items essential to the completeness of the sheet metal installation, though not specifically shown or specified, shall be provided.

PART 3 - EXECUTION

3.01 Condition of Surfaces

A. Verify that surfaces to receive sheet metal are smooth and clean.

B. Do not start sheet metal work until conditions are satisfactory.

3.02 Installation

A. General

1. Install watertight, without waves, warps, buckles, fastening stresses or distortion, allowing for expansion and contraction.
2. Install prefabricated sheet metal in accordance with manufacturer's instructions.

B. Flashing

1. Concealed flashing shall be installed as shown on the drawings as the carpentry work proceeds.
2. Provide metal flashings and make proper connections to all piping through roofs. Flashing around piping shall be watertight and shall consist of 30" x 30" sheet of sheet lead properly installed around pipes.

C. Gutters and Downspouts

1. Gutters: 6" molded Ogee or "K" type (4 3/4" x 6") as indicated on the drawings.
2. Downspouts: 5" square, flat-sided. Provide as indicated on drawings.
3. Gutters to be evenly pitched to downspouts.
4. Workmanship and methods employed for forming, anchoring, cleating, expansion and contraction and construction of gutters and downspouts shall conform to applicable details and descriptions as indicated in current edition of Architectural Sheet Metal Manual as published by the Sheet Metal and Air Conditioning Contractors National Association, Inc.

-END-

SECTION 07900 - JOINT SEALANTS

PART 1 - GENERAL

1.01 Summary

A. Extent of each form and type of joint sealant is indicated on Drawings and schedules.

B. This Section includes joint sealants for the following locations:

1. Exterior joints in vertical surfaces and non-traffic horizontal surface.
2. Exterior joints in horizontal traffic surfaces.
3. Interior joints in vertical surfaces and horizontal non-traffic surfaces.
4. Interior joints in horizontal traffic surfaces
5. Joints in water immersion
6. Joints in pavement

1.02 System Performances

Provide joint sealants that have been produced to establish and maintain watertight and airtight continuous seals.

1.03 Submittals

A. Product Data from manufacturers for each joint sealant product required, including instructions for joint preparation and joint sealant application

B. Samples for Initial Selection Purposes. Manufacturer's standard bead samples consisting of strips of actual products showing full range of colors available, for each product exposed to view.

C. Samples for verification purposes of each type and color of joint sealant required. Install joint sealant samples in 1/2-inch wide joints formed between two 6-inch long strips of material matching the appearance of exposed surfaces adjacent to joint sealants.

D. Certificates from manufacturers of joint sealants attesting that their products comply with specification requirements and are suitable for the use indicated.

1.04 Quality Assurance

A. Installer Qualifications: Engage an Installer who has successfully completed within the last 3 years at least 3 joint sealant applications similar in type and size to that of this Project.

B. Single Source Responsibility for Joint Sealant Materials: Obtain joint sealant materials from a single manufacturer for each different product required.

C. Field-Constructed Mock-Ups: Prior to installation of joint sealants, apply elastomeric sealants to the following selected building joints as indicated below for further verification of colors selected from sample submittals and to represent completed work for qualities of appearance, materials, and application.

1. Joints in field-constructed mock-ups of assemblies specified in other sections which are indicated to receive elastomeric joint sealants specified in this section.
2. Retain mock-ups during construction as standard for judging completed construction.

1.05 Delivery, Storage, and Handling

A. Deliver materials to Project site in original unopened containers or bundles with labels informing about manufacturer, product name and designation, color, expiration period for use, pot life, curing time, and mixing instructions for multi-component materials.

B. Store and handle materials in compliance with manufacturers' recommendations to prevent their deterioration or damage due to moisture, high or tow temperatures, contaminants, or other causes.

1.06 Project Conditions

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

1. When ambient and substrate temperature conditions are outside the limits permitted by joint sealant manufacturers.
2. When joint substrates are wet due to rain, frost, condensation, or other causes.

B. Joint Width Conditions: Do not proceed with installation of joint sealants where joint widths are less than allowed by joint sealant manufacturer for application indicated.

C. Joint Substrate Conditions: Do not proceed with installation of joint sealants until contaminants capable of interfering with their adhesion are removed from joint substrates.

PART 2 - PRODUCTS

2.01 Materials, General

A. Compatibility: Provide joint sealants, joint fillers and other related materials that are compatible with one another and with joint substrates under conditions of service and application, as demonstrated by sealant manufacturer based on testing and field experience.

B. Provide color of exposed joint sealants as selected by Engineer from manufacturer's standard colors.

2.02 Elastomeric Joint Sealants

A. Elastomeric Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealant of base polymer indicated which complies with ASTM C 920 requirements, including those referenced for Type, Grade, Class, and Uses.

B. Type 1 - Two-Part Non-Sag Polysulfide Sealant: Type M; Grade NS; Class 12-1/2; Uses NT, M, G, A, and, as applicable to joint substrates indicated, O.

   1. Products:
      a. "CM-60"; W.R. Meadows, Inc.
      b. "GC-5 Synthacalk GC-5"; Pecora Corp.

C. Type 2 - Two-Part Pourable Polysulfide Sealant: Type M; Grade P; Class 12-1/2; Uses T, M, G, A, and, as applicable to joint substrates indicated, O.

   1. Products: "Chem-Calk 250"; Bostik Construction Products Div.

D. Type 3 - Two-Part Water Immersion Polysulfide Sealant: Type M; Grade NS; Class 12-1/2; Uses T, M, G, A, and, as applicable to joint substrates indicated, O; with a history of successful test results, per ASTM C 719, and field experience in the sealing of joints immersed intermittently or continuously in water of the same composition as that to which sealant will be exposed after installation.

   1. Products:
      a. "GC2+ Synthacalk"; Pecora Corp.

E. Type 4 - Multi-Part Non-Acid-Curing Silicone Sealant: Type M; Grade NS; Class 25; Uses T, NT, M, G, A, and, as applicable to joint substrates indicated, O; and complying with the following requirements for additional joint movement capability:

   1. Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the following percentage changes in joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920 for Uses indicated:
      a. 50 percent movement in both extension and compression for a total of 100 percent movement.
   2. Products: "Dow Corning 695"; Dow Corning Corp.

F. Type 5 - One-Part Non-Acid-Curing Silicone Sealant: Type S, Grade NS, Class 25, and complying with the following requirements for Uses and additional joint movement capability:

   1. Uses NT, M, G, A, and, as applicable to joint substrates indicated, O.
   2. Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the following percentage changes in joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920 for Uses indicated:
      a. 40 percent movement in both extension and compression for a total of 80 percent movement.

3. Products:
    a. “Chem-Calk N-Cure 2000”; Bostik Construction Products Div.
    b. “Dow Coming 790”; Dow Corning Corp.
    c. “Silglaze N SCS 2501”; General Electric Co.
    d. “Silpruf SCS 2000”; General Electric Co.
    e. “864”; Pecora Corp.
    f. “Dow Coming 795”; Dow Coming Corp.
    g. “Omniseal”; Sonneborn Products Div., BASF
    h. “Chem-Calk 1000”; Bostik Construction Products Div.
    i. “Gesil N SCS 2600”; General Electric Co.

G. Type 6 - One-Part High-Modulus Non-Acid-Curing Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, M, G, A, and, as applicable to joint substrates indicated, O.

1. Products
    a. “Dow Corning 784”; Dow Coming Corp.
    b. “Dow Coming 799”; Dow Coming Corp.
    c. “Ultraglaze SSG 4000”; General Electric Co.

H. Type 7 - One-Part Mildew-Resistant Silicone Sealant: Type S; Grade NS; Class 25; Uses NT, G, A, and, as applicable to non-porous joint substrates indicated, O; formulated with fungicide; intended for sealing interior joints with non-porous substrates and subject to in-service exposure to conditions of high humidity and temperature extremes.

1. Products
    a. “Dow Coming 786”; Dow Coming Corp.
    b. “SCS 1702 Sanitary”; General Electric Co.
    c. “863 #345 White”; Pecora Corp.
    d. “OmniPlus”; Sonneborn Products Div., BASF

I. Type 8 - Multi-Part Non-Sag Urethane Sealant: Type M, Grade NS, Class 25, and complying with the following requirements for Uses:

1. Uses NT, M, G, A, I, and, as applicable to joint substrates indicated, O.
2. Products:
    a. “Dynatrol II”; Pecora Corp.
    b. “Sikaflex-2c NS”; Sika Corp.
    c. “Sonolastic NP 2”; Sonneborn Products Div., BASF

J. Type 9 - Multi-Part Pourable Urethane Sealant: Type M, Grade P, Class 25, and complying with the following requirements for Uses:

1. Uses T, M, and, as applicable to joint substrates indicated, O.
2. Products:
    a. “Chem-Calk 550”; Bostik Construction Products Div.
    b. “Pourthane”; W.R. Meadows, Inc.
    c. “NR-200 Urexpan”; Pecora Corp.
    d. “PRC 280”; Products Research & Chemical Corp.
    e. “Sikaflex 2c SL”; Sika Corp.

f. “Sonolastic Paving Joint Sealant”; Sonneborn Products Div., BASF

K. Type 10 - One-Part Non-Sag Urethane Sealant: Type S; Grade NS; Class 25; Uses NT, M, A, and, as applicable to joint substrates indicated, O.

1. Products:
   a. “Chem-Calk 900”; Bostik Construction Products Div.
   b. “Chem-Calk 2639”; Bostik Construction Products Div.
   c. “Dynatrol I”; Pecora Corp.
   d. “Permapol RC-1”; Products Research & Chemical Corp.
   e. “Sikaflex-la”; Sika Corp.
   f. “Sikaflex-15LM”; Sika Corp.
   g. “Sonolastic NP 1”; Sonneborn Products Div., BASF

L. Type 11 - One-Part Pourable Urethane Sealant: Type S, Grade P, Class 25, and complying with the following requirements for Uses:

1. Uses T, M and, as applicable to joint substrates indicated, O.
2. Products:
   a. “Chem-Calk 950”; Bostik Construction Products Div.
   b. “NR-201 Urexpan”; Pecora Corp.
   c. “Sonolastic SL-1 “; Sonneborn Products Div., BASF

2.03 Solvent-Release-Curing Joint Sealants

A. Type 12 - Acrylic Sealant: Manufacturer’s standard one-part, non-sag, solvent-release curing, acrylic terpolymer sealant complying with ASTM C 920 for Type S; Grade NS; Uses NT, M, G, A, and, as applicable to joint substrates indicated, O; except for selected test properties which are revised as follows:

1. Heat-Aged Hardness: 40-50
2. Weight Loss: 5%
3. Max. Cyclic Movement Capability: Plus or Minus 12-1/2%
4. Products:
   a. “60+ Unicrylic”; Pecora Corp.
   b. “PTI 738”; Protective Treatments Inc.
   c. “PTI 767”; Protective Treatments Inc.

2.04 Latex Joint Sealants

A. Type 13 - Acrylic-Emulsion Sealant: Manufacturer’s standard, one part, non-sag, mildew-resistant, acrylic-emulsion sealant complying with ASTM C 834, formulated to be paintable and recommended for exposed applications on interior and on protected exterior locations involving joint movement of not more than plus or minus 5 percent.

1. Products:
   a. “Chem-Calk 600”; Bostik Construction Products Div.
   b. “AC-20”; Pecora Corp.
   c. “Sonolac”; Sonneborn Products Div.; BASF

B. Type 14 - Silicone Emulsion Sealant: Manufacturer's standard one part, non-sag, mildew-resistant, silicone-emulsion sealant complying with ASTM C 834 and ASTM C 920, formulated to be paintable and recommended for exposed applications on interior and on protected exterior locations involving joint movement of not more than plus or minus 12-1/2 percent.

1. Products
   a. "Performance Plus Silicone Sealant"; Dow Corning Corp.

2.05 Joint Sealants for Paving

A. Type 15 - Two-Part Jet-Fuel-Resistant Cold-Applied Sealant: Manufacturer's standard, pourable, chemically curing, elastomeric sealant complying with FS SS-S-200 and of the following formulation for base polymer.

1. Urethane formulation complying with FS TT-S-00227, with maximum movement capability of plus or minus 12-1/2 percent.
2. Coal-tar modified polymer formulation complying with ASTM C 920 for Type M, Grade P, Class 25, Uses T and O as applicable to joint substrates indicated.
3. Bitumen-modified urethane formulation.
4. Products:
   a. "Gardox"; W.R. Meadows, Inc.
   b. "Urexpan NR-300"; Pecora Corp.
   c. "Sonomeric CT 2"; Sonneborn Products Div., BASF

B. Type 16 - One-Part Jet-Fuel-Resistant Cold-Applied Urethane Sealant: Manufacturer's standard, pourable, coal-tar modified urethane formulation complying with performance requirements of FS SS-S-200, Type H.

1. Products:
   a. "Sonomeric CT 1"; Sonneborn Products Div., BASF

C. Type 17 - One-Part Jet-Fuel-Resistant Silicone Sealant: Manufacturer's standard, pumpable, low-modulus non-acid-curing silicone sealant complying with ASTM C 920 for Type S; Grade NS; Class 25; Uses T, M and, as applicable to joint substrates of concrete highways and concrete runways of airports subject to jet fuel exposure, O; and complying with the following requirements:

1. Additional capability, when tested for adhesion and cohesion under maximum cyclic movement per ASTM C 719, to withstand the following percentage changes in joint width as measured at time of application and remain in compliance with other requirements of ASTM C 920 for Uses indicated:
   a. 50 percent movement in extension of 50 percent movement in compression for a total of 100 percent movement.
2. Accepted for use in concrete highway and airport runway joints per FAA Engineering Brief No. 36, May 21, 1986.
3. Products: "Dow Corning 888"; Dow Corning Corp.

2.06 Butyl Joint Sealants

A. Type 18 - Exterior Metal Lap Joint Sealant: Butyl or polyisobutylene, non-drying, non-skinning, non-curing.

1. Applications: Use for:
   a. Concealed sealant bead in sheet metal work.
   b. Concealed sealant bead in siding overlaps.
2. Bostik Inc: www.bostik-us.com.
3. Pecora Corporation: www.pecora.com.

2.07 Joint Sealant Backing

A. General: Provide sealant backings of material and type which are non-staining; are compatible with joint substrates, sealants, primers and other joint fillers; and are approved for applications indicated by sealant manufacturer based on field experience and laboratory testing.

B. Plastic Foam Joint Fillers: Performed, compressible, resilient, non-waxing, non-extruding strips of flexible, non-gassing plastic foam of material indicated below; non-absorbent to water and gas; and of size, shape and density to control sealant depth and otherwise contribute to producing optimum sealant performance.

1. Either open-cell polyurethane foam or closed-cell polyethylene foam, unless otherwise indicated, subject to approval of sealant manufacturer, for cold-applied sealants only.

C. Bond-Breaker Tape: Polyethylene tape or other plastic tape as recommended by sealant manufacturer for preventing sealant from adhering to rigid, inflexible joint filter materials or joint surfaces at back of joint where such adhesion would result in sealant failure. Provide self-adhesive tape where applicable.

2.08 Miscellaneous Materials

A. Primer: Provide type recommended by joint sealer manufacturer where required for adhesion of sealant to joint substrates indicated, as determined from preconstruction joint sealant-substrate tests and field tests.

B. Cleaners for Non-Porous Surfaces: Provide non-staining, chemical cleaners of type which are acceptable to manufacturers of sealants and sealant backing materials, which are not harmful to substrates and adjacent non-porous materials, and which do not leave oily residues or otherwise have a detrimental effect on sealant adhesion or in-service performance.

C. Masking Tape: Provide non-staining, non-absorbent type compatible with joint sealants and to surfaces adjacent to joints.

2.09 Joint Fillers for Concrete Paving

Provide joint fillers of thickness and widths indicated which are compatible with sealant system used.

PART 3 - EXECUTION

3.01 Examination

Examine joints indicated to receive joint sealants, with Installer present, for compliance with requirements for compliance with requirements for joint configuration, installation tolerances and other conditions affecting joint sealant performance. Do not proceed with installation of joint sealants until unsatisfactory conditions have been corrected.

3.02 Preparation

A. Surface Cleaning of Joints: Clean out joints immediately before installing joint sealants to comply with recommendations of joint sealant manufacturers and the following requirements.

1. Remove all foreign material from joint substrates which could interfere with adhesion of joint sealant, including dust; paints, except for permanent, protective coatings tested and approved for sealant adhesion and compatibility by sealant manufacturer; old joint sealants; oil; grease; waterproofing; water repellents; water; surface dirt and frost.
2. Clean concrete, masonry, unglazed surfaces of ceramic tile and similar porous joint substrate surfaces, by brushing, grinding, blast cleaning, mechanical abrading, or a combination of these methods to produce a clean, sound substrate capable of developing optimum bond with joint sealants. Remove loose particles remaining from above cleaning operations by vacuuming or blowing out joints with oil-free compressed air.
3. Remove laitance and form release agents from concrete.
4. Clean metal, glass, porcelain enamel, glazed surfaces of ceramic tile; and other non-porous surfaces by chemical cleaners or other means which are not harmful to substrates or leave residues capable of interfering with adhesion of joint sealants.

B. Prime joint substrates where indicated or where recommended by joint sealant manufacturer based on pre-construction joint sealant-substrate tests or prior experience. Apply primer to comply with joint sealant manufacturer's recommendations. Confine primers to areas of joint sealant bond, do not allow spillage or migration onto adjoining surfaces.

1. Prime all concrete, masonry, stone, and similar porous surfaces.

C. Use masking tape where required to prevent contact of sealant with adjoining surfaces which otherwise would be permanently stained or damaged by such contact or by cleaning methods required to remove sealant smears. Remove tape immediately after tooling without disturbing joint seal.

3.03 Installation of Joint Sealants

A. General: Comply with joint sealant manufacturers' printed installation instructions applicable to products and applications indicated, except where more stringent requirements apply.

B. Elastomeric Sealant Installation Standard: Comply with recommendations of ASTM C 962 for use of joint sealants as applicable to materials, applications and conditions indicated.

C. Solvent-Release-Curing Sealant Installation Standard: Comply with requirements of ASTM C 804 for use of solvent-release-curing sealants.

D. Latex Sealant Installation Standard: Comply with requirements of ASTM C 790 for use of latex sealants.

E. Install sealant backings to comply with the following requirements:

1. Install joint fillers of type indicated to provide support of sealants during application and at position required to produce the cross-sectional shapes and depths of installed sealants relative to joint widths which allow optimum sealant movement capability.
   a. Do not leave gaps between ends of joint fillers.
   b. Do not stretch, twist, puncture, or tear joint filters.
   c. Remove absorbent joint fillers which have become wet prior to sealant application and replace with dry material.
2. Install bond breaker tape between sealants and joint fillers, compression seals, or back of joints where adhesion of sealant to surfaces at back of joints would result in sealant failure.

F. Install sealants by proven techniques that result in sealants directly contacting and fully wetting joint substrates, completely filling recesses provided for each joint configuration, and providing uniform, cross-sectional shapes and depths relative to joint widths which allow optimum sealant movement capability.

G. Tooling of Non-Sag Sealants: Immediately after sealant application and prior to time skinning or curing begins, tool sealants to form smooth, uniform beads of configuration indicated, to eliminate air pockets, and to ensure contact and adhesion of sealant with sides of joint. Remove excess sealants from surfaces adjacent to joint. Do not use tooling agents which discolor sealants or adjacent surfaces or are not approved by sealant manufacturer.

1. Provide concave joint configuration per Figure 6A in ASTM C 962, unless otherwise indicated.
2. Provide flush joint configuration per Figure 6B in ASTM C 962 at horizontal joints.

3.04 Cleaning

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

3.05 Protection

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

JOINT SEALANT SCHEDULE

A. Exterior Joints

1. Vertical and Non-Traffic Horizontal Surfaces
   a. Sealants: Type 4 (Silicone) or Type 8 (Polyurethane)
   b. Applications:
      i. Control & expansion joints in cast-in-place concrete
      ii. Control & expansion joints in unit masonry
      iii. Control & expansion joints in ceiling and overhead surfaces
      iv. Joints between different surfaces listed above
2. Horizontal Traffic Surfaces
   a. Sealants: Type 9 (Polyurethane)
   b. Applications:
      i. Control, expansion, and isolation joints in cast-in-place concrete slabs
3. Submerged Surfaces
   a. Sealants: Type 8 (Polyurethane)
   b. Applications:
      i. Control & expansion joints in new and existing cast-in-place concrete
4. Other Exterior Surfaces
   a. Sealants: Type 12 (Acrylic)
   b. Applications:
      i. Perimeter Joints Around Door, Window, and Louver Frames
      ii. Perimeter joints of exterior openings and other locations where indicated on the drawings not listed above
5. Sheet Metal and Siding
   a. Sealants: Type 18 (Butyl)
   b. Applications:
      i. Concealed sealant bead in sheet metal work.
      ii. Concealed sealant bead in siding overlaps.

B. Interior Joints

1. Vertical and Non-Traffic Horizontal Surfaces
   a. Sealants: Type 5 or 6 (Silicone), Type 10 (Polyurethane), or Type 13 (Acrylic-emulsion)
   b. Applications:
      i. Control and expansion joints on exposed interior surfaces of exterior walls
      ii. Joints between tops of non-load bearing unit masonry walls and underside of cast-in-place concrete slabs and beams
      iii. Vertical control joints on exposed surfaces of interior unit masonry and concrete walls and partitions
      iv. Joints on underside of precast concrete beams and panels
      v. Perimeter joints around interior side of window, door, and louver frames
      vi. Perimeter joints of exterior openings and other locations where indicated on the drawings not listed above
      vii. Joints where drywall meets other substrates and finish carpentry
2. Horizontal Traffic Surfaces
   a. Sealants: Type 11 (Polyurethane)
   b. Applications:

i. Control and expansion joints in cast-in-place concrete

3. Perimeter Joints of Restroom Fixtures
   a. Sealant: Type 7 (Silicone)

C. Water Immersion

1. Sealants: Type 3 (Polysulfide)
2. Applications:
   a. Control and construction joints, interior side of tanks walls and slabs
   b. Joints and gaps in weirs, baffles, and other submerged items

D. Paving, Petroleum, and Solvents

1. Sealants: Type 15 or 16 (Urethane) or Type 17 (Silicone)
2. Applications:
   a. Joints in concrete pavements
   b. Joints between concrete and bituminous pavements
   c. Joints between new and existing bituminous pavement
   d. Joints susceptible to contact with petroleum, fuels, and solvents.

- END –

DIVISION 8 – DOORS AND WINDOWS

SECTION 08120 – ALUMINUM DOORS AND FRAMES

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and install aluminum doors, frames, and appurtenances necessary to complete work indicated.

B. Codes, specifications, and standards referred to by title or number shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply.

C. Glass for doors as indicated is specified in Section 08800.

1.02 Domestic Product Requirements

A. All steel and foundry products provided for in this project, including ferrous and non-ferrous metals, piping, fittings, and piping-related products, shall be manufactured in the United States.

1.03 Submittals

A. Submittals shall be in accordance with Division 1 requirements.

B. Submit the following:

1. Shop Drawings showing fabrication and installation of aluminum doors and frames. Include details of each frame type, elevations of door design types, conditions at openings, details of construction, location and installation requirements of door and frame hardware and reinforcements, and details of joints and connections. Show anchorage and accessory items.
2. Door Schedule: Submit schedule of doors and frames using same reference numbers for details and openings as those on Contract Drawings. Indicate coordination of glazing frames and stops with glass and glazing requirements.

1.04 Product Delivery, Storage and Handling

A. Deliver doors and frames cardboard-wrapped or crated to provide protection during transit and job storage. Provide additional protection to prevent damage to finish of factory-finished doors and frames.

B. Inspect doors and frames on delivery for damage. Minor damages may be repaired provided refinished items match new work and are acceptable to Owner; otherwise, remove and replace damaged items as directed.

C. Store doors and frames at building site under cover. Place units on minimum 4inch-(100-mm-) high wood blocking. Nonvented plastic or canvas shelters that could

create a humidity chamber are not permitted. If cardboard wrappers on doors become wet, remove cartons immediately. Provide minimum 1/4-inch (6-mm) spaces between stacked doors to promote air circulations.

PART 2 - PRODUCTS

2.01 Flush Doors

A. Minimum door thickness shall be 1-3/4 inches. Door width and height shall be as shown on Drawings.

B. Extrusions shall be manufactured of commercial quality 6063-T5 aluminum alloy, free from defects, and with an ultimate tensile strength of 28,000 pounds per square inch. Perimeter trim units shall be beveled where required for operation.

C. Exterior doors shall be insulated.

D. Door construction shall be one of the following:

1. Doors shall have an internal grid of tubular extrusions covered with an aluminum face sheet. Internal member wall thickness shall not be less than 0.08 inch. Hinge rail edge thickness shall not be less than 0.19 inch. Lock rail edge thickness shall not be less than 0.125 inch. Face sheet thickness shall not be less than 0.09 inch. Reinforce tops and bottoms of doors with three stacked internal tubular extrusions. Reinforce perimeter of all door cut-outs with not less than one internal tubular extrusion. Door rim and grid sections shall be assembled in interlocking aluminum channel clips, screws, rivets, and 3/8-inch diameter plated steel tie bolts. Fill voids in doors with rigid, noncombustible insulation. The core shall meet the requirements of Federal Specification }IH-I-529. Bond the aluminum face sheet to the rim, grid sections, and insulation with epoxy adhesive.
2. Doors shall have an extruded aluminum tubular frame and honeycomb core covered with tempered hardboard and aluminum face sheet. Tubular frame extrusion wall thickness shall not be less than 0.125 inch. Core shall be honeycomb material not less than 80 pounds per 3,000 square foot ream and 20% phenolic resin. Core cell size shall not be more than 7/16 inch. Tempered hardboard thickness shall not be less than 0.125 inch. Aluminum face sheet shall be 3003-H14 stretcher leveled aluminum alloy. Face sheet thickness shall not be less than 0.04 inch.

E. Door facings shall be vertically fluted or ribbed. All joints in the door facings shall be flush and sealed watertight. Exposed overlaps in the door facings will not be allowed.

F. Glass cut-outs where indicated for half-glass doors shall be of manufacturer’s standard reinforced construction.

2.02 Glazing

Glazing for doors shall be insulated glass as specified in Section 08800.

2.03 Glazing Stops

A. Entrance doors and flush doors with windows shall have extruded aluminum glazing stops. The wall thickness of the glazing stops shall not be less than 0.05 inch.

B. Removable glazing stops shall be tamper-proof snap-in type with vinyl, polyvinyl chloride, or neoprene inserts and shall be located on the inside face of the door.

2.04 Frames

A. Door frames shall be fabricated from aluminum extrusions of commercial quality 6063-T5 aluminum alloy, with an ultimate tensile strength of 28,000 pounds per square inch. Frames shall be free from defects.

B. Frames shall be furnished by door manufacturer.

C. Frames to be mounted in masonry or concrete walls with a thickness greater than 5 inches shall be fabricated from 1-3/4-inch deep by 4-1/2-inch wide tubular extrusions with a minimum wall thickness of 0.125 inch. Door stops shall be extruded section with a minimum wall thickness of 0.09 inch.

D. Frames to be mounted in walls with a thickness of five inches or less shall be extrusions which will overlap the wall in which the frame is installed. The minimum wall thickness of the extrusions shall be 0.09 inch. Stops shall be formed by the frame extrusions. Frames shall have adjustable jamb anchors.

E. Door frames shall be cut square at corners and fastened together with stainless steel fasteners. Reinforce frame corners, as required, to maintain frames square and aligned during handling, storage, and installation.

F. Exterior door frames shall be insulated.

2.05 Weatherstripping

All exterior doors shall have weatherstripping mounted on door or frame, unless otherwise shown or specified. Provide astragals on all double doors unless otherwise noted. Provide gaskets between doors of frames as indicated on door schedule.

2.06 Finish

A. Doors and Frames shall receive one of the following (to be selected by Owner from manufacturer's samples):

1. Class I Color Anodized Finish: AAM12C22A42/A44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural (film thicker than 0.7 mil with integral color or electrostatically deposited color), complying with AAMA 606.1 or AAMA 608.1. Color: Medium or Dark Bronze

2.07 Thresholds

Thresholds shall be cast aluminum with fluted top. Thresholds shall be 5 inches wide, unless otherwise shown or specified. Thresholds shall provide proper clearance and an effective seal with door weatherstripping. Thresholds used with concealed vertical rod hardware or flush bolts shall be prepared to receive bottom lock bolt.

2.08 Signs

A. Coordinate signs for doors with Section 10400, Signs, Plaques, and Labeling.

B. Sign wording shall be designated by the Engineer and as listed in Section 10400.

2.09 Cleaning and Packing

A. Thoroughly clean all doors, frames, and appurtenances of all water, sand, grit, weld splatter, grease, oil, and other foreign materials before preparation for shipment. Protect doors, frames, and appurtenances against physical damage and exposure to the elements during shipment, handling, storage, and installation.

B. Pack doors, frames, and appurtenances to provide ample protection from damage during shipment, handling, and storage.

2.10 Door Manufacturers

A. Doors and frames shall be the heavy duty series by one of the following manufacturers':

1. Curries Manufacturing Inc., Mason City, Iowa.
2. Cline Aluminum Doors, Inc., Bradenton, Florida (Series 100 BE).
3. Cross Aluminum Products, Dowagiac, Michigan (extra heavy duty).
4. EFCO Corporation, Monett, Missouri (D-500/FC-200)
5. Or Equal

PART 3 - EXECUTION

3.01 Installation of Frames

A. Set frames in position, plumb, align, and brace securely until permanent anchors are set. Anchor bottom of frames to floors with expansion bolts, or with power fasteners.

B. Anchor each frame to jamb in at least three places on each side of frame. Anchors shall be spaced to evenly distribute door and frame load.

C. In masonry and concrete construction, anchor doors with stainless steel expansion bolts. Caulk between frame and masonry or concrete.

D. Where frames require ceiling struts or other overhead bracing, frames shall be anchored securely to ceilings, or structural framing above, as indicated or as required by job conditions.

E. Wherever aluminum frames will be in contact with dissimilar metals, provide suitable insulation between contact surfaces. Aluminum surfaces which will be in contact with concrete or mortar shall be separated therefrom by application of a coat of zinc chromate primer, the vehicle of which shall be a synthetic of the phenolic resin or alkyd resin type.

3.02 Installation of Doors and Hardware

A. All hardware shall be installed in strict accordance with the templates and printed instructions supplied by the manufacturers and in accordance with "Recommended Locations for Builder Hardware" published by the National Builders Hardware Association.

B. Fastenings of proper type, size, and finish shall be installed with each article of hardware and thresholds, as applicable. Machine screws and expansion shields shall be used for attaching hardware and thresholds to concrete or masonry. Use stainless steel fasteners.

C. Interior door identification signs shall be mechanically attached to doors with stainless steel fasteners. Vertical centerline of signs shall be centered on doors. Horizontal centerline of signs shall be 5 feet 8 inches above bottom of doors.

D. All hardware shall be properly adjusted. All hinges, bolts, holders, closers, and all other items as required shall be lubricated for smooth operation. -

E. All errors in cutting and fitting and all damages in adjoining work shall be corrected, repaired, and finished.

3.03 Cleaning

A. After erection, the doors shall be cleaned using a mild soap and water followed by a clear water rinse.

B. The Contractor shall clean off all blemish marks, repair all damage to surfaces on prime coating, or replace damaged materials. Clean all portions of the doors after the painting and finishing of the building are complete.

3.04 Protection

Protect installed doors and frames against damage during subsequent construction activities.

-END-

SECTION 08520 - ALUMINUM WINDOWS

PART 1 – GENERAL

1.01 Section Includes

A. Material: aluminum windows as on the drawings and specified in this section.

B. Installation: labor, tools, and material needed to install aluminum windows.

1.02 Related Sections

A. Section 07900 – Sealants

B. Section 08800 - Glazing

1.03 References

A. AAMA - American Architectural Manufacturers Association

1. AAMA/NWWDA 101/I.S.2-97 “Voluntary Specifications for Aluminum, Vinyl (PVC) and Wood Windows and Glass Doors”
2. AAMA 502-90 "Voluntary Specification for Field Testing of Windows and Sliding Glass Doors"
3. AAMA 611-98 "Voluntary Specification for Anodized Architectural Aluminum"
4. AAMA 701-92 "Voluntary Specification for Pile Weatherstripping"
5. AAMA 800-92 "Voluntary Specifications and Test Methods for Sealants"
6. AAMA 902-98 “Voluntary Specification for Sash Balances”
7. AAMA 1503-98 "Voluntary Test Method for Thermal Transmittance and Condensation Resistance of Windows, Doors, and Glazed Wall Sections"
8. AAMA 2603-98 “Voluntary Specification, Performance Requirements and Test Procedures for Pigmented Organic Coatings on Aluminum Extrusions and Panels”
9. AAMA 2604-98 “Voluntary Specification, Performance Requirements and Test Procedures for High Performance Organic Coatings on Aluminum Extrusions and Panels”
10. AAMA 2605-98 “Voluntary Specification, Performance Requirements and Test Procedures for Superior Performing Organic Coatings on Aluminum Extrusions and Panels”
11. AAMA CW-10-97 "Care and Handling of Architectural Aluminum from Shop to Site"

B. ASCA - Architectural Spray Coaters Association - ASCA 96 “Voluntary Specification for Superior Performance of Organic Coatings on Architectural Aluminum Curtainwall, Extrusions and Miscellaneous Aluminum Components”

C. ASTM - American Society for Testing and Materials

1. ASTM E 90-90 "Standard Test Method for Laboratory Measurement of Airborne Sound Transmission Loss of Building Partitions"

2. ASTM E 283-91 "Standard Test Method for Rate of Air Leakage Through Exterior Windows, Curtain Walls, and Doors"
3. ASTM E 330-96 "Standard Test Method for Structural Performance of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference"
4. ASTM E 331-96 "Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Uniform Static Air Pressure Difference"
5. ASTM E 547-96 "Standard Test Method for Water Penetration of Exterior Windows, Curtain Walls, and Doors by Cyclic Static Air Pressure Differential"
6. ASTM E 774-92 "Specification for Sealed Insulating Glass Units"

1.04 System Description

A. AAMA Designation: H-C45.

B. Windows: 3 1/4" frame depth; extruded aluminum with integral structural polyurethane thermal break in frame and sash members; equal-leg frame; finish factory-applied; frames and sash factory-assembled.

C. Configuration: double hung; top and bottom sash tilt in for glass cleaning.

D. Glazing: Refer to Sectio 08800

1.05 Performance Requirements

A. Conformance to H-C45 specifications in AAMA/NWWDA 101/I.S.2-97 when tests are performed on the prescribed 4'6" x 7'6" minimum test size with the following test results:

1. Air Infiltration: maximum .15 cfm/square foot when tested per ASTM E 283-91 at a static air pressure difference of 1.57 psf.
2. Water Penetration: no uncontrolled water leakage when tested per ASTM E 547-96 and ASTM E 331-96 at a static air pressure difference of 7.5 psf.
3. Uniform Structural: window to be operable, and maximum .4% permanent deformation per member when tested per ASTM E 330-96 at a static air pressure difference of 67.5 psf.

B. Thermal testing per AAMA 1503.1-88, at the prescribed 4'0" x 6'0" test size glazed with 3/4” insulating glass made with 1/8” clear and 1/8” Low E lites, with the following test results:

1. Condensation Resistance Factor: minimum 47 frame and 57 glass CRF.
2. Thermal Transmittance: maximum .47 BTU/HR/SQ.FT/F U value.

1.06 Submittals

A. Shop drawings: window location chart; typical window elevations; details of assemblies, hardware, and glazing details for factory-glazed units.

B. Product data: manufacturer's specifications and test reports from an AAMA-accredited laboratory.

C. Samples: each specified finish for aluminum; other samples as requested.

1.07 Quality Assurance

A. Manufacturer's warranties:

1. Windows: warrant for one year against defects in material or workmanship under normal use.
2. Insulating glass units: warrant seal for five years against visual obstruction from film formation or moisture collection between internal glass surfaces, excluding that caused by glass breakage or abuse.

1.08 Delivery, Storage, and Handling

A. Handle and protect windows and accessories in accordance with AAMA CW-10-97 until project completion.

PART 2 - PRODUCTS

2.01 Manufacturers

A. TRACO TR-5000 Double Hung Tilt Thermal Aluminum Window

B. Other equal by the following:

1. Kawneer
2. Acorn
3. Rebco
4. Or equal

2.02 Materials

A. Aluminum extrusions: produced from commercial quality 6063-T5 alloy; free from defects impairing strength and durability.

B. Hardware: zinc meeting rail lock and keeper - one per window under 48", two on wider windows; plated steel pivot bars, one spring-loaded for sash removal without tools; slot tilt latches, spring-loaded for automatic jamb engagement when sash is in vertical position.

C. Weatherstrip: secured in extruded ports; double rows on sash perimeters: one pile conforming to AAMA 701-92 in meeting rail, one flexible thermoplastic rubber bulb/flap seal in bottom sash lift rail in contact with frame sill, and pile conforming to AAMA 701-92 with polypropylene center fin in remaining locations.

D. Balances: spiral conforming to AAMA 902-98 with capacity to hold sash stationary and permit it to operate freely; nylon balance shoes which lock when tilted to prevent sash travel.

E. Insect screens: half ; held in exterior tracks with stainless steel leaf springs; 5/16" x 1 1/2" x .045" extruded tubular aluminum frame with same finish as window; corners mitered, gusset reinforced, and crimped; 18 x 16 dark fiberglass mesh; PVC spline.

2.03 Fabrication

A. Frame: head and sill coped and fastened to jambs with two stainless steel screws per corner; corners factory-sealed with sealant conforming to AAMA 800-92.

B. Sash: tubular horizontal sash rails coped and fastened to vertical sash stiles with a telescope-design joint secured with one stainless steel screw per corner; corners factory-sealed with sealant conforming to AAMA 800-92.

C. Sash design: continuous extruded pull-down rail on top sash interior and lift rail on bottom sash interior; mechanical meeting rail interlock; weep holes for drainage.

2.04 Glass Units – refer to Section 08800

2.05 Finish On Aluminum Extrusions

A. Window frames shall receive one of the following (to be selected by Owner from manufacturer’s samples):

1. Class I Color Anodized Finish: AAM12C22A42/A44 (Mechanical Finish: as fabricated, nonspecular; Chemical Finish: etched, medium matte; Anodic Coating: Class I Architectural (film thicker than 0.7 mil with integral color or electrostatically deposited color), complying with AAMA 606.1 or AAMA 608.1. Color: Medium or Dark Bronze

PART 3 - EXECUTION

3.01 Preparation

A. Prepare openings to be in tolerance, plumb, level, provide for secure anchoring, and in accordance with approved shop drawings.

3.02 Installation

A. Install windows in accordance with manufacturer's recommendations and approved shop drawings with skilled craftspeople who have demonstrated a successful history of installing windows for 10 years.

B. Provide required support and securely fasten and set windows plumb, square, and level without twist or bow.

C. Apply sealant per sealant manufacturer's recommendations at joints, wipe off excess, and leave exposed sealant surfaces clean and smooth.

3.04 Adjusting and Cleaning

A. Adjust windows as necessary for smooth and weathertight operation, and leave windows clean and free of construction debris.

-END-

SECTION 08710 - FINISH HARDWARE

PART 1 - GENERAL

1.01 Description

A. Hardware Requirements

1. Provide hardware, locks, and other devices called for in the Door Schedule.
2. The schedule is not intended to be entirely inclusive but is furnished to assist Contractor in determining the extent and quality of hardware required.
3. Hardware items not specifically mentioned shall be supplied in equal quality and type indicated in the schedule.

B. Related Work Specified Elsewhere

1. Aluminum Doors and Frames - Section 08120

1.02 Submittals

A. Submit complete schedule showing factory numbers and sized for approval.

B. Furnish catalog cuts, drawings and other descriptive hardware data as required.

1.03 Quality Assurance

A. Applicable Federal Specifications

1. Hardware types list shall meet the requirements of the applicable provisions of the following Federal Specifications:

a. Hinges	FF-H-116c
b. Locks and Door Trim	FF-H-106A Series 161 & FF-H-106B Series 86
c. Door closers	FF-H-121c
d. Door stops and bumpers	FF-H-11a

B. Trade names and catalog numbers of a particular manufacturer are given as a means of describing type, materials, strength, design, quality, weight, mechanical construction and operation of hardware items and requirements to which such hardware shall conform.

1.04 Product Delivery, Storage, Handling

A. Deliver hardware individually packed and labeled with item number corresponding to approved schedule

1.05 Job Conditions

A. Furnish correct hardware to fit the door and frame conditions, with special attention to threshold heights.

1.06 Guarantee

A. Guarantee in writing that hardware furnished is free from defects in material and workmanship for a period of one year from date of final acceptance of this work.

B. Agree to repair or replace defective hardware during the guarantee period at no additional cost to Owner.

PART 2 - PRODUCTS

2.01 Fabrication

A. General

1. All hardware shall be of best manufacture in quality, finish and design free from defects.
2. Finish for hardware: U.S. 32D (satin stainless steel) unless otherwise indicated.

B. Prepare doors and frames for hinges, locks, closers, and door stops. Provide backup plates as required.

C. Door hardware shall be furnished by the door manufacturer. Furnish door hardware as follows:

1. Hinges per door leaf

Door Height	Hinges
6'8" thru 7'4"	1-1/2 pair
7'6" thru 9'0"	2 pair
9'2" thru 12'-0"	2-1/2 pair

2. One lockset, lever, panic device, or push/pull plate per door as indicated on Schedule.
3. Closer on all exterior door leaves and interior doors indicated on Schedule.
4. Floor or wall-mounted bumper for each leaf as indicated.
5. Panic device on all exterior door leaves and interior doors indicated on Schedule.
6. Kick plate on inside of all doors.

D. Hinges shall be stainless steel, ball bearing, 4-1/2 inch by 4-1/2 inch, full mortise template type with non-removable pins. Hinges shall meet the requirements of Federal Specification FF-H-116 and shall be Type T2112. Hinge finish shall be US 32D. Screws for hinges shall be stainless steel.

E. Locksets shall be mortised type and shall meet the requirements of ANSI Series 1000-21, Sargent Series 7800/8200 or equal. Locks shall be keyed, master-keyed and submaster-keyed and integrated into existing system as directed by

the Owner. Furnish four keys per each different key. Provide strikes for all doors. Finish shall be US 32D. Lockset type shall be as follows:

ANSI Series Designation	1000-2L	Description
Doors with panic devices	F17	Mortise Exit Device
	F05	Entrance by lever. Key locks or unlocks lever outside. Inside trim always operable.
Doors without panic Devices	F05	Entrance and exit by lever. Key locks or unlocks lever outside. Inside lever always operable.
	F15	Latchbolt retracted by either trim, no locks

F. Closers shall be one piece cast iron construction with adjustable backcheck and delayed action. Closers to have separate regulating valves for door speed and latching speed. Provide non-handed hold open arms for 90° and 180° as required. Closer to be non-handed and non-sized with adjustable spring power. Provide high impact non-corrosive cover. Closers shall be Sargent 250 Series, Yale 400 ADA Complying Series, or equal.

G. Operating levers to be Sargent 8200 Series, Rose: LN, Lever: J, Finish US32D or equal.

H. Panic devices shall be UL listed for fire. Devices on single leaf doors and active leaf of double doors shall be mortise type. Devices on inactive leaf of double doors shall be concealed vertical rod type. Covers, arms, and crossbars shall be aluminum. Trim on mortise devices shall be aluminum, wide full escutcheon, pull, and cylinder. Panic devices shall be Sargent 90 Series, Yale 1500 Series, or equal.

I. Kick plates shall be 18-8 stainless steel, 0.050 inch thick with US32D finish. Width of plate shall be 2 inches less than the door width and height shall be 8 inches.

J. Where noted on the Schedule or as shown on Drawings, doors shall be equipped with switches for remote monitoring and/or control of other equipment, i.e., fans, lights, etc. Coordinate with the electrical contractor for installation of switches into door header, or other locations as required.

K. Thresholds shall be cast aluminum with fluted top. Thresholds shall be 5 inches wide, otherwise shown or specified. Thresholds shall provide proper clearance and an effective seal with door weatherstripping. Thresholds used with concealed vertical rod panic hardware or double doors with concealed flush bolts shall be prepared to receive bottom lock bolt.

L. Provide astragal on all double doors. Color and material to match door.

M. Flush bolts on inactive leaf of double doors shall have US32D finish. Ives FB458 with DP2 strike, or equal.

N. Wall bumpers to have US32D finish.

O. Kick-down foot door holders to be aluminum. Ives FS455 or equal.

PART 3 - EXECUTION

3.01 Inspection

A. Examine the drawings, projections of trim and rebates to permit door to swing 180 degrees or to the closest adjacent wall.

B. Check thickness of doors and verify sizes of all hardware, for proper fit and performance.

3.02 Preparation

A. Cylinders, keying and keys

1. Key all locks and cylinders to Owner's existing keying system if Owner desires.
2. Consult Engineer for instructions relative to keying.

3.03 Installation

A. All hardware shall be installed by mechanics skilled in the application of institutional grade hardware.

B. All instruction sheets and installation details, which are packed with the hardware, shall be read and understood before an attempt is made to install the hardware.

C. Install finishing hardware without marring adjacent work. After fitting, remove until painting is completed, then re-install.

D. Thresholds

1. Bedded in synthetic rubber sealant
2. Fasten with lead machine screw anchors
3. Shall not be predrilled

E. After installation, all templates, instruction sheets, and installation details, shall be placed in a file folder to be turned over to Owner when building is accepted.

3.04 Adjustment

A. Examine hardware at work completion.

B. Test, oil, grease, ease, and adjust hardware for proper operation.

-END-

SECTION 08800 - GLAZING

PART 1 - GENERAL

1.01 Summary

A. This Section includes glazing for the following products, including those specified in other Sections where glazing requirements are specified by reference to this Section:

1. Insulated window units.
2. Interior and exterior doors and windows.

B. Related Sections: The following sections contain requirements that relate to this Section.

1. Section 08120 - Aluminum Doors and Frames
2. Section 08520 – Aluminum Windows

1.02 Related Documents

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

B. Codes, specifications, and standards referred to by title or number shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply

1.03 Definitions

A. Manufacturer is used in this Section to refer to a firm that produces primary glass or fabricated glass as defined in the referenced glazing standard.

B. Deterioration of Coated Glass Defects developed from normal use that are attributed to the manufacturing process and not to causes other than glass breakage and practices for maintaining and cleaning coated glass contrary to manufacturer's directions. Defects include peeling, cracking, and other indications of deterioration in metallic coating

C. Deterioration of Insulating Glass: Failure of the hermetic seal under normal use due to causes other than glass breakage and improper practices for maintaining, and cleaning insulating glass Evidence of failure is the obstruction of vision by dust, moisture, or film on the interior surfaces of glass. Improper practices for maintaining and cleaning glass do not comply with the manufacturer's directions.

1.04 System Performance Requirements

A. General: Provide glazing systems that are produced, fabricated, and installed to withstand normal thermal movement, wind loading, and impact loading (where

applicable), without failure including loss or glass breakage attributable to the following: defective manufacture, fabrication, and installation; failure of sealants or gaskets to remain watertight and airtight; deterioration of glazing materials; and other defects in construction.

B. Normal thermal movement results from the following maximum change (range) in ambient and surface temperatures acting on glass-framing members and glazing components. Base engineering calculation on materials' actual surface temperatures due to both solar heat gain and nighttime sky heat loss.

1. Temperature Change (Range): 120 deg F (67 deg C), ambient; 180 deg F (100 deg C), material surfaces.

1.05 Submittals

A. General: Submit the following according to Conditions of Contract and Division 1 Specification Sections.

B. Product data for each glass product and glazing material indicated.

C. Samples for verification purposes of 12-inch-square samples of each type of glass indicated except for clear monolithic glass products, and 12-inch-long samples of each color required (except black) for each type of sealant or gasket exposed to view. Install sealant or gasket sample between two strips of material representative in color of the adjoining framing system.

D. Product certificates signed by glazing materials manufacturers certifying that their products comply with specified requirements.

1. Separate certifications are not required for glazing materials bearing manufacturer's permanent labels designating type and thickness of glass, provided labels represent a quality control program of a recognized certification agency or independent testing agency acceptable to authorities having jurisdiction.

1.06 Quality Assurance

A. Glazing Publications: Comply with published recommendations of glass product manufacturers and organizations below, except where more stringent requirements are indicated. Refer to these publications for glazing terms not otherwise defined in this Section or in referenced standards

1. FGMA Publications: "FGMA Glazing Manual."

B. Safety Glass: Products complying with ANSI Z97.1 and testing requirements of 16 CFR Part 1201 for Category II materials.

C. Insulating Glass Certification Program: Provide insulating glass units permanently marked either on spacers or at least one component life of units with appropriate certification label of inspecting and testing agency indicated below:

1. Insulating Glass Certification Council (IGCC)

D. Glazier Qualifications: Engage an experienced glazier who has completed glazing similar in material, design, and extent to that indicated for Project with a record of successful in-service performance.

E. Single-Source Responsibility for Glass: Obtain glass from one source for each product indicated below:

1. Primary glass of each (ASTM C 1036) type and class indicated.
2. Heat-treated glass of each (ASTM C 1048) condition indicated.
3. Insulating glass of each construction indicated.

F. Single-Source Responsibility for Glazing Accessories: Obtain glazing accessories from one source for each product and installation method indicated.

1.07 Delivery, Storage, and Handling

Protect glazing materials to comply with manufacturer's directions and as needed to prevent damage to glass and glazing materials from condensation, temperature changes, direct exposure to sun, or other causes.

1.08 Project Conditions

A. Environmental Conditions: Do not proceed with glazing when ambient and substrate temperature conditions are outside the limits permitted by glazing materials manufacturer or when glazing channel substrates are wet from rain, frost, condensation, or other causes.

1. Install liquid sealants at ambient and substrate temperatures above 40 deg F (4.4 deg C).

1.09 Warranty

A. General: Warranties specified in this Article shall not deprive the Owner of other rights the Owner may have under other provisions of the Contract Documents and will be in addition to and run concurrent with other warranties made by the Contractor under requirements of the Contract Documents.

B. Manufacturer's Warranty on Insulating Glass~ Submit written warranty signed by manufacturer of insulating glass agreeing to furnish replacements for insulating glass units that deteriorate as defined in "Definitions" article, Lob. point of manufacture, freight allowed Project site, within specified warranty period indicated below. Warranty covers only deterioration due to normal conditions of use and not to handling, installing, protecting, and maintaining practices contrary to glass manufacturer's published instructions.

1. Warranty Period Manufacturer's standard but not less than 10 years after date of Substantial Completion

PART 2 - PRODUCTS

2.01 General Requirements

Glass Product Data Sheets: Subject to compliance with all requirements of this section, required glass and glazing products are described in general in the Glass Schedule at the end of this Section.

2.02 Primary Float Glass Products

A. Float Glass: ASTM C 1036, Type I (transparent glass, flat), Class as indicated below, and Quality q3 (glazing select).

   1. Class 1 (clear) unless otherwise indicated.

B. Refer to Primary Clear Float Glass Product Data Sheet for Class 1 uncoated tinted glass for monolithic glazing

C. Refer to coated glass product requirements for tint color and performance characteristics of coated tinted glass for monolithic glazing relative to visible light transmittance, U-values, shading coefficient, and visible reflectance.

D. Refer to requirements for sealed insulating glass units for performance characteristics of assembled units composed of tinted glass, coated or uncoated, relative to visible light transmittance, U-values, shading coefficient, and visible reflectance.

2.03 Heat-Treated Float Glass Products, General

Fabrication Process: By vertical (tong-held) or horizontal (roller-hearth) process, at manufacturer's option, except provide horizontal process where indicated as tongless or free of tong marks.

2.04 Heat-Treated Float Glass

A. Uncoated, Clear, Heat-Treated Float Glass: ASTM C 1048, Condition A (uncoated surfaces), Type I (transparent glass, flat), Class 1 (clear), Quality q3 (glazing select), kind as indicated below.

   1. Kind HS (heat strengthened) where indicated.
   2. Kind FT (fully tempered) where indicated.

B. Available Manufacturers: Subject to compliance with requirements, manufacturers offering heat-treated glass products that may be incorporated in the Work include, but are not limited to, the following companies.

   1. AFG Industries, Inc.
   2. Artistic Glass Products Co.
   3. Cardinal 1G.
   4. Saint-Gobain.
   5. Falconer Glass Industries.

6. Glasstemp, Inc.
7. Guardian Industries Corp.
8. HGP Industries.
9. PPG Industries, Inc.
10. Spectrum Glass Products, Inc.
11. Tempglass.
12. Viracon, Inc.

2.05 Insulating Glass Products

A. Sealed Insulating Glass Units: Preassembled units consisting of organically sealed lites of glass separated by dehydrated air spaces complying with ASTM E 774 and with other requirements indicated, including those in Insulating Glass Product Data Sheet at the end of this Section

1. For properties of individual glass lites making up units, refer to requirements specified elsewhere in this Section applicable to types, classes, kinds, and conditions of glass products comprising lites of insulating glass units
2. Provide heat-treated, coated float glass of kind indicated or, if not otherwise indicated, Kind HS (heat strengthened) where recommended by manufacturer to comply with system performance requirements specified and Kind FT (fully tempered) where safety glass is designated or required.
3. Low-Emissivity (Low-E) coating: sputtered or pyrolytic on second or third surface, per manufacturer.

2.06 Elastomeric Glazing Sealants

A. General: Provide products of type indicated, complying with the following requirements:

1. Compatibility: Select glazing sealants and tapes of proven compatibility with other materials they will contact, including glass products, seals of insulating glass units, and glazing channel substrates, under conditions of installation and service, as demonstrated by testing and field experience.
2. Suitability: Comply with sealant and glass manufacturer's recommendations for selecting glazing sealants and tapes that are suitable for applications indicated and conditions existing at time of installation.
3. Colors: Provide color of exposed joint sealants to comply with the following:
   a. Provide selections made by Architect from manufacturer's full range of standard colors for products of type indicated.

B. Elastomeric Glazing Sealant Standard: Provide manufacturer's standard chemically curing, elastomeric sealants of base polymer indicated that comply with ASTM C 920 requirements indicated on each Elastomeric Glazing Sealant Product Data Sheet at the end of this Section, including those referencing ASTM classifications for Type, Grade, Class and Uses.

2.07 Glazing Tapes

A. Back-Bedding Mastic Glazing Tape: Preformed, butyl-based elastomeric tape with a solids content of 100 percent, nonstaining and nonmigrating in contact with

nonporous surfaces, with or without spacer rod as recommended by tape and glass manufacturers for application indicated, packaged on rolls with a release paper backing, and complying with AAMA 800 for products indicated below:

1. AAMA 806.1

B. Expanded Cellular Glazing Tape: Closed-cell, polyvinyl chloride foam tape, factory coated with adhesive on both surfaces, packaged on rolls with release liner protecting adhesive, and complying with AAMA 800 for product 810.5.

C. Available Products: Subject to compliance with requirements, glazing tape that may be incorporated in the Work include, but is not limited to, the following:

1. Back-Bedding Mastic Glazing Tape Without Spacer Rod:
   a. Dyna-Seal, Pecora Corp.
   b. PTI 626 Architectural Sealant Tape, Protective Treatments, Inc.
   c. S-M 5710 H.P Poly-Glaze Tape Sealant, Schnee-Morehead, Inc.
   d. SST-800 Tape, Tremco, Inc.

2.08 Glazing Gaskets

A. Dense Compression Gaskets: Molded or extruded gaskets of material indicated below, complying with standards referenced with name of elastomer indicated below, and of profile and hardness required to maintain watertight seal:

1. Neoprene, ASTM C 864
2. EPDM, ASTM C 864.
3. Silicone, ASTM C 1115.
4. Thermoplastic polyolefin rubber, ASTM C 1115.
5. Any material indicated above.

B. Soft Compression Gaskets: Extruded or molded closed-cell, integral-skinned gaskets of material indicated below, complying with ASTM C 509, Type II, black, and of profile and hardness required to maintain watertight seal:

1. Neoprene.
2. EPDM.
3. Silicone.
4. Thermoplastic polyolefin rubber
5. Any material indicated above

C. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated in the work include, but are not limited to, the following companies

1. Preformed Gaskets:
   a. Advanced Elastomer Systems, L.P
   b. Schnee-Morehead, Inc.
   c. Tremco, Inc.

2.09 Miscellaneous Glazing Materials

A. General: Provide products of material, size, and shape complying with referenced glazing standard, requirements of manufacturers of glass and other glazing materials involved for glazing application indicated, and with a proven record of compatibility with surfaces contacted in installation.

B. Cleaners, Primers and Sealers: Type recommended by sealant or gasket manufacturer.

C. Setting Blocks: Elastomeric material with a Shore A durometer hardness of 85 plus or minus 5.

D. Spacers: Elastomeric blocks or continuous extrusions with a Shore A durometer hardness required by glass manufacturer to maintain glass lites in place for installation indicated.

E. Edge Blocks: Elastomeric material of hardness needed to limit glass lateral movement (side-walking).

F. Plastic Foam Joint Fillers: Preformed, compressible, resilient, nonstaiing, nonextruding, nonoutgassing, strips of closed-cell plastic foam of density, size, and shape to control sealant depth and otherwise contribute to produce optimum sealant performance.

2.10 Fabrication of Glass and Other Glazing Products

Fabricate glass and other glazing products in sizes required to glaze openings indicated for Project, with edge and face clearances, edge and surface conditions, and bite complying with recommendations of product manufacturer and referenced glazing standard as required to comply with system performance requirements.

PART 3 - EXECUTION

3.01 Examination

A. Examine glass framing, with glazier present, for compliance with the following:

1. Manufacturing and installation tolerances, including those for size, squareness, offsets at corners.
2. Presence and functioning of weep system.
3. Minimum required face or edge clearances.
4. Effective sealing between joints of glass-framing members.

B. Correct unsatisfactory conditions ahead of installation.

3.02 Preparation

Clean glazing channels and other framing members receiving glass immediately before glazing. Remove coatings that are not firmly bonded to substrates

3.03 Glazing, General

A. Comply with combined recommendations of manufacturers of glass, sealants, gaskets, and other glazing materials, except where more stringent requirements are indicated, including those in referenced glazing publications.

B. Glazing channel dimensions as indicated on Drawings provide necessary bite on glass, minimum edge and face clearances, and adequate sealant thicknesses, with reasonable tolerances. Adjust as required by Project conditions during installation.

C. Protect glass from edge damage during handling and installation as follows:

1. Use a rolling block in rotating glass units to prevent damage to glass corners. Do not impact glass with metal framing. Use suction cups to shift glass units within openings; do not raise or drift glass with a pry bar. Rotate glass lites with flares or bevels on bottom horizontal edges so edges are located at top of opening, unless otherwise indicated by manufacturer's label.
2. Remove damaged glass from Project site and legally dispose of off site. Damaged glass is glass with edge damage or other imperfections that, when installed, weaken glass and impair performance and appearance.

D. Apply primers to joint surfaces where required for adhesion of sealants, as determined by preconstruction sealant-substrate testing

E. Install elastomeric setting blocks in sill rabbets, sized and located to comply with referenced glazing standard, unless otherwise required by glass manufacturer. Set blocks in thin course of compatible sealant suitable for heel bead

F. Do not exceed edge pressures stipulated by glass manufacturers for installing glass lites.

G. Provide spacers for glass sizes larger than 50 united inches (length plus height) as follows:

1. Locate spacers inside, outside, and directly opposite each other. Install correct size and spacing to preserve required face clearances, except where gaskets and glazing tapes are used that have demonstrated ability to maintain required face clearances and comply with system performance requirements.
2. Provide 1/8-inch minimum bite of spacers on glass and use thickness equal to sealant width. With glazing tape, use thickness slightly less than final compressed thickness of tape.

H. Provide edge blocking to comply with requirements of referenced glazing publications, unless otherwise required by glass manufacturer.

I. Set glass lites in each series with uniform pattern, draw, bow, and similar characteristics.

J. Where wedge-shaped gaskets are driven into one side of channel to pressurize sealant or gasket on opposite side, provide adequate anchorage so gasket cannot walk out when installation is subjected to movement.

K. Square cut wedge-shaped gaskets at corners and install gaskets in manner recommended by gasket manufacturer to prevent corners from pulling away; seal corner joints and butt joints with sealant recommended by gasket manufacturer.

3.04 Tape Glazing

A. Position tapes on fixed stops so that when compressed by glass their exposed edges are flush with or protrude slightly above sightline of stops.

B. Install tapes continuously but not in one continuous length. Do not stretch tapes to make them fit opening.

C. Where framing joints are vertical, cover these joints by applying tapes to heads and sills first and then to jambs. Where framing joints are horizontal, cover these joints by applying tapes to jambs and then to heads and sills.

D. Place joints in tapes at corners of opening with adjoining lengths butted together, not lapped. Seal joints in tapes with compatible sealant approved by tape manufacturer.

E. Do not remove release paper from tape until just before each lite is installed.

F. Apply heel bead of elastomeric sealant.

G. Center glass lites in openings on setting blocks and press firmly against tape by inserting dense compression gaskets formed and installed to lock in place against faces of removable stops. Start gasket applications at corners and work toward centers of openings.

H. Apply cap bead of elastomeric sealant over exposed edge of tape.

3.05 Gasket Glazing (Dry)

A. Fabricate compression gaskets in lengths recommended by gasket manufacturer to fit openings exactly, with stretch allowance during installation.

B. Secure compression gaskets in place with joints located at corners to compress gaskets producing a weathertight seal without developing bending stresses in glass. Seal gasket joints with sealant recommended by gasket manufacturer.

C. Install gaskets so they protrude past face of glazing stops.

3.06 Sealant Glazing (Wet)

A. Install continuous spacers between glass lites and glazing stops to maintain glass face clearances and to prevent sealant from extruding into glass channel weep systems until sealants cure. Secure spacers in place and in position to control depth of installed sealant relative to edge clearance for optimum sealant performance.

B. Force sealants into glazing channels to eliminate voids and to ensure complete wetting or bond of sealant to glass and channel surfaces.

C. Tool exposed surfaces of sealants to provide a substantial wash away from glass. Install pressurized gaskets to protrude slightly out of channel to eliminate dirt and moisture pockets

3.07 Lock-Strip Gasket Glazing

Comply with ASTM C 716 and gasket manufacturer's printed recommendations. Provide supplementary wet seal and weep system unless otherwise indicated.

3.08 Protection and Cleaning

A. Protect exterior glass from breakage immediately after installation by attaching crossed streamers to framing held away from glass. Do not apply markers to glass surface. Remove nonpermanent labels, and clean surfaces

B. Protect glass from contact with contaminating substances resulting from construction operations including weld splatter. If, despite such protection, contaminating substances do come into contact with glass, remove them immediately as recommended by glass manufacturer.

C. Examine glass surfaces adjacent to or below exterior concrete and other masonry surfaces at frequent intervals during construction, but not less than once a month, for build-up of dirt, scum, alkali deposits, or stains, and remove as recommended by glass manufacturer

D. Remove and replace glass that is broken, chipped, cracked, abraded, or damaged in any way, including natural causes, accidents and vandalism, during construction period.

E. Wash glass on both faces in each area of Project not more than 4 days prior to date scheduled for inspections that establish date of Substantial Completion. Wash glass as recommended by glass manufacturer.

GLASS SCHEDULE

A. INSULATING GLASS PRODUCT

1. Insulating Clear Glass Units:
   a. Classification of Units: Class CBA. per ASTM E 774.
   b. Air Space Width: Nominal 1/2 inch measured perpendicularly from surfaces of glass lites at unit's edge.
   c. Sealing System: Dual seal, primary and secondary sealants: manufacturer's standard sealants.
   d. Spacer Specifications: Manufacturer's standard metal.
      (1) Dessicant: Either molecular sieve or silica gel or blend of both.
      (2) Corner Construction: Manufacturer's standard corner construction.
      (3) Color of Spacer Color as selected by Engineer from manufacturer's standard colors.
   e. Glass Specifications: Comply with the following requirements:
      (1) Thickness of Each Lite: 6.0 mm (0.23 inch).
      (2) Indoor and Outdoor Lites: Heat-treated Kind FT (fully tempered) for safety glass, Low-E coating, Class 1 (clear) float glass
   f. Locations:
      (1) All doors requiring glazing and all exterior windows

B. ELASTOMERIC GLAZING SEALANT PRODUCT

1. Elastomeric Glazing Sealant
   a. Base Polymer: Neutral-curing silicone.
   b. Type: S single component.
   c. Grade: NS (nonsag).
   d. Class: 25.
   e. Additional Movement Capability: 40 percent movement in extension and 40 percent in compression for a total of 80 percent movement.
   f. Use(s) Related to Exposure: NT (nontraffic).
   g. Uses Related to Glazing Substrates: G, A, and, as applicable to glazing substrates indicated, 0.
   h. Use 0 Glazing Substrates: Coated glass, steel and aluminum coated with a high-performance coating, elastomeric glazing gaskets and glazing accessories.

-END-

SECTION 09900 – PROTECTIVE COATINGS

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and apply coatings and do related work necessary to complete work shown or specified.

B. Work Specified Elsewhere: Pipe identification markers for piping are specified in Division 10 and 15.

C. Codes, Specifications, and Standards: Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise shown or specified.

D. Definitions

1. Abbreviations
   a. ASTM - American Standard Testing Materials
   b. OSHA - Occupational Safety & Health Administration
   c. SSPC - Steel Structures Painting Council
   d. SW - The Sherwin Williams Paint Company
   e. DFT - Dry film thickness
   f. DMT - Dry mill thickness
   g. NFPA - National Fire Protection Association
   h. NACE - National Association of Corrosion Engineers
2. Coating: The term coating includes emulsions, enamels, paints, stains, varnishes, sealers, emulsion filler, and other coating materials whether used as prime, intermediate, or finish coats.
3. Spatter: Drops and droplets of coating and spilled or splashed coatings on surfaces not specified to be coated or surfaces previously finish coated.

1.02 Quality Assurance

A. All coating and surface preparation shall be completed by a qualified painting contractor who shall have a minimum of five (5) years experience in applying protective coatings to industrial and municipal water and wastewater treatment facilities.

B. All coating shall be done strictly in accordance with the most recent manufacturer’s printed instructions and shall be performed in a manner satisfactory to the Engineer.

C. Minimum requirements for materials are included in this Section. These requirements are intended to establish standards of quality. Products of manufacturers which meet all minimum requirements as herein established shall be acceptable. Written acceptance of the materials to be used shall be obtained prior to surface preparation or application.

D. No request for substitution will be considered which decreases the film thickness designated, or which offers a change from the generic type of coating specified. Requests for substitution shall contain the full name of each product, descriptive literature, directions for use, generic type, nonvolatile content by volume.

E. All materials shall be brought to the job site in the original sealed and labeled containers of the manufacturer and shall be subject to inspection by the resident representative of the job.

F. All materials shall be the product of or recommended by the coating manufacturer.

G. All materials shall be compatible with the service intended. No products shall be used that may have ingredients which might react detrimentally with adjacent fluids or gases.

1.03 Submittals

A. Submittals shall be as specified in the General Conditions.

B. Submit the following:

1. Technical product data sheets for all products used.
2. Color charts and samples.
3. Samples of slip-resistant adhesive tape, if used.
4. List of surfaces indicating coating system and colors.
5. Manufacturer's application instructions.

1.04 Product Delivery, Storage, and Handling

A. Be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged or deteriorated products from the job site, including products which have exceeded their shelf life. Replace damaged products with undamaged and undeteriorated products.

C. All coating materials stored on the job site shall be stored in a location consistent to the manufacturer's storage requirements. Take all safety precautions accordance with NFPA Bulletin No. 101.

1.05 Job Conditions

A. Environmental Requirements

1. Perform coating work in strict conformance with manufacturer's printed recommendations as to environmental conditions under which coating and coating systems can be applied.
2. Do not apply finish in areas where dust is being generated.

3. During the course of the coating work, adequately ventilate the coated spaces to ensure there will be no concentration of noxious odors, hazardous fumes, or flammable vapors.
4. Unless otherwise noted, do not apply coatings in damp weather or when the temperature is below 50°F or above 95°F.
5. Provide heating and enclosure when necessary to maintain specified temperature during application and curing of coatings.
6. Provide forced air circulation in enclosed areas during the application and curing period.
7. All costs associated with providing and/or maintaining the required environmental conditions shall be borne by the contractor or coating subcontractor.

B. Protection

1. Protect all finish work of other trades and surfaces not being coated. Furnish suitable coverings as required. Remove coating spatter from all finished surfaces, and restore finishes of affected items to their original conditions at no additional cost to the Owner.
2. Post “Wet Paint” notices, as required, to protect newly coated surfaces.
3. Keep oily rags and waste in Underwriters’ Laboratories labeled metal containers. Do not allow oily rags and waste to accumulate in buildings.
4. Protection of Adjacent Surfaces – Cover or otherwise protect all finished work or other trades and surfaces not being painted. Remove finish hardware, accessories, light fixtures and cover plates, factory finished work, and similar items. Replace upon completion of coating.

C. Job Site Conference: The Contractor shall arrange and conduct a job site conference between the coating manufacturer’s representative, the Owner’s representative, and the personnel assigned this work prior to any field surface preparation or coating application.

PART 2 - PRODUCTS

2.01 Manufacturers

A. Except as otherwise specified, materials shall be the products of the following manufacturers, or equal:

1. The Sherwin Williams Company (SW)

B. Equivalent materials of other manufacturers may be substituted on written approval of the Engineer. Requests for substitution shall include manufacturer’s literature for each product giving the name, generic type, and descriptive information. Submittals shall include the following performance data as certified by a qualified testing laboratory:

1. ASTM D 4541 Adhesion
2. ASTM B 117 Salt Spray
3. ASTM D 1653 Permeability

4. ASTM D 4060 Abrasion
5. ASTMD4585 Humidity
6. Galvanic Protection Conductivity

C. Materials selected for coating systems for each type surface shall be the product of a single manufacturer, unless otherwise acceptable to the Owner.

2.02 Materials

A. All field applied primers and undercoats shall be provided to ensure compatibility of total coating systems and of the same manufacturer as the finish coats for each system as specified hereafter. Provide barrier coats over incompatible primers or remove and reprime as required. No thinner or solvents other than those approved by the Coating Manufacturer shall be used.

B. All materials shall herein be assigned a designation number for ease of reference. The minimum material requirements shall be as listed.

2.03 Coating Systems

All surfaces to be coated shall be cleaned of all dirt, oil, grease, salts, mill scale and other foreign matter prior to the surface preparation and coating applications described below.

A. <u>SYSTEM 1</u> - Non-Submerged Interior or Exterior Metals, Piping, & Machinery

1. Surface preparation: Commercial blast, per SSPC-SP6, achieve 1.0-2.0 mil profile
2. Prime Coat (shop coated or field coated): Organic Zinc-Rich Urethane, 1 coat, 2.5-3.5 mils DFT
   a. SW: Corothane I, B65 Series
3. Finish Coat: Aliphatic Acrylic Polyurethane, 2 coats, 2.0-5.0 mils DFT
   a. SW: Acrolon 218 HS, B65 W600 Series
4. Minimum of 3 coats and a minimum total finished DMT of 6.5

B. <u>SYSTEM 2</u> - Submerged Metals, Piping, & Machinery (Note 2)

1. Surface preparation: Near-white metal blast, per SSPC-SP-10, achieve 1.0-2.0 mil profile
2. Prime Coat (Shop Coated or Field Coated):
   a. Non-Potable, Wastewater, and Sludge Service: Organic Zinc Rich Urethane, 1 coat, 2.5-3.5 mils DFT
      (1) SW: Corothane I, B65 Series
3. Finish Coat: Modified Epoxy, 2 coats, 6.0-8.0 mils DFT per coat
   a. Non-Potable, Wastewater, and Sludge Service:
      (1) SW: Dura-Plate 235, B67V235 Series
4. Minimum of 3 coats and a minimum total finished DMT of 14.5

C. SYSTEM 3 - Interior or Exterior fiberglass (FRP) and PVC piping and surfaces

1. Surface Preparation: Cleaner/detergent per SSPC-SP1, lightly abrade with sandpaper - surface to resemble medium-grit sandpaper
2. Prime Coat: Epoxy, 1 coat, 2.5-4.0 mils DFT
   a. SW: Tile Clad HS, B62 Series
3. Finish Coat (Interior): Polyainide Epoxy, 1 coat, 2.5-4.0 mils DFT
   a. SW: Tile Clad HS, B62 Series
4. Finish Coat (Exterior): Aliphatic Acrylic Polyurethane, 1 coat, 2.5-4.0 mils DFT
   a. SW: Corothane II, B65 Series
5. Minimum of 2 coats and a minimum total finished DMT of 5.0

E. SYSTEM 5 - Manhole Frames and Covers and Valve Box Covers

1. Surface preparation: Commercial blast, SSPC-SP6, achieve 1.0-2.0 mils profile
2. Prime Coat: Organic Zinc-Rich Urethane,1 coat, 2.5-3.5 mils DFT
   a. SW: Corothane I, B65 Series
3. Finish Coat: Aliphatic Acrylic Polyurethane, 2 coats, 2.0-5.0 mils DFT per coat
   a. SW: Acrolon 218 HS, B65 W600 Series
4. Minimum of 3 coats and a minimum total finished DMT of 6.5

H. SYSTEM 8 - Concrete Floors and Equipment Pads - New or Existing (finish as noted on Coating List)

1. Surface preparation: Prepare per ASTM D4259, achieve profile of 80 grit sandpaper, or per manufacturer's instructions.
2. SYSTEM 8A – Clear or Colored Sealer (gloss orange peel finish, skid-resistant)
   a. Prime Coat: Epoxy, 1 coat
      1) SW: ArmorSeal 1000 HS, B67-2000 Series, 10.0-12.0 mils DFT
3. SYSTEM 8B – Clear or Colored Sealer (satin orange peel finish, skid-resistant)
   a. Prime Coat: Epoxy, 2 coats, 4.0-6.0 mils DFT per coat
      1) SW: Macropoxy HS, B58T404/B58V400
   b. Minimum of 2 coats and a minimum total finished DMT of 8.0
4. SYSTEM 8C - Color Finish (orange peel finish or skid resistant)
   a. Prime Coat: Epoxy, 2 coats, 4.0-6.0 mils DFT per coat
      1) SW: Armor Seal 3300 LV, B58 VQ3300 Series
   b. Finish Coat: Polyamine Epoxy, 2 coats, 6.0-8.0 mils DFT per coat
      1) SW: ArmorSeal 650 SL/RC, B58Q Series
   c. Minimum of 4 coats and a minimum total finished DMT of 20.0
5. SYSTEM 8E - Corrosive Areas
   a. Prime Coat: Epoxy, 1 coat
      1) SW: CoroBond 100, B58 WQ5100 Series, 10.0-12.0 mils DFT
   b. Fiber Coat: Novolac Epoxy, 1 coat
      1) SW: CoroBond 6700 Novolac, B58 Q6700 Series, 11.0-14.0 mils DFT
   c. Finish Coat: Novolac Epoxy, 1 coat, 8.0-10.0 mils DFT

1) SW: CoroBond 6700 Novolac, B58 Q6700 Series, 11.0-14.0 mils DFT

d. Minimum of 3 coats and a minimum total finished DMT of or 26.0

7. SYSTEM 8F - Secondary Containment Areas (Interior and Exterior)
   Option 1
   a Prime Coat: 1 coat
      1) SW: Magnalox 304, 921-W-304 Series, 14.0-16.0 mils DFT
   b. Fiber Coat: 1 coat
      1) SW: None required
   c. Finish Coat: 1 coat
      1) SW: Magnalox 304, 921-W-304 Series, 14.0-16.0 mils DFT
   d. Minimum of 2 coats and a minimum total finished DFT of 28.0
   Option 2:
   e. Prime Coat: Epoxy, 1 coat
      1) SW: CoroBond HS Primer, 3.0-4.0 mils DFT
   f. Fiber Coat: Novolac Epoxy, 1 coat
      1) SW: Control Tech Cor-Cote HCR FF, 10.0-15.0 mils DFT
   g. Finish Coat: Novolac Epoxy, 1 coat, 8.0-10.0 mils DFT
      1) SW: Control Tech Cor-Cote HCR, 10.0-15.0 mils DFT
   h. Minimum of 3 coats and a minimum total finished DFT of 26.0

I. SYSTEM 9 - Interior Masonry (Prime coat for CMU only - not required for smooth masonry)

1. Prime Coat: Cementitious Acrylic, 1 coat, 13.0-25.0 mils DFT
   a. SW: Cement Plex 875, B42 W2001B42 V201
2. Finish Coat: Polyamine Epoxy, 2 coats, 8.0-10.0 mils DFT per coat
   a. SW: Sher-Tile HS, B67 W200 Series
3. Minimum of 3 coats and a minimum total finished DMT of 29.0

M. SYSTEM 13 - Existing Non-submerged Interior or Exterior Metals, Machinery, and Piping with Coating

1. Surface preparation: Scrub with ADD H2O Hyper Concentrate to remove oil, grease, and other surface contaminants. Commercial blast per SSPC-SP6. If piping is in service, recoat condensating pipes with Aquatapoxy.
2. Spot Coat: Modified Epoxy, 6.0-8.0 mils DFT
   a. SW: MacroPoxy, B58 Series
3. Finish Coat: Modified Epoxy, 1 coat, 6.0-8.0 mils DFT
   a. SW: MacroPoxy, B58 Series
4. Minimum of 2 coats and a minimum total finished DMT of 12.0

N. Notes:

1. The total finish dry mil thickness shall be in accordance with the manufacturer's coating system's requirements.
2. The term submerged applies to water and wastewater. Special consideration shall be given to applications where acids or other highly corrosive materials will be present.
3. Minimum total dry film thickness excludes the primer.

2.04 Colors

A. Comply with OSHA requirements concerning color coding and safety marking.

B. Color code exposed piping. Color code equipment associated with piping, unless otherwise shown or specified. Whenever banding is listed for color coding, bands shall be 6-inches wide spaced along the pipe at 5-foot intervals.

C. Color coding shall be generally as follows. Specific colors for each type of service will be selected by the Owner after submittal of color charts:

Application	Color
Dangerous Machine Parts & Energized Equipment	Safety Orange
Traffic Operations and Housekeeping Marking	White
Fire Protection Equipment & Flammable Materials	Safety Red
Radiation Hazards	Safety Yellow w/ Black Legend
Water Lines - Finished or Potable	Dark Blue
Wastewater Lines	Light Gray
Various Sludge Lines	Various shades of Brown
Sewer (Sanitary or Other)	Dark Gray
Chemical Lines	To Be Determined In Field
Non-Potable Water Lines	Dark Blue w/ red band
Reclaimed Water Lines	Violet or Purple
Walls, Ceilings and Floors	To Be Determined in Field
Gas Lines	
Compressed Air	Safety Green
Natural Gas	Safety Yellow
Other Items	To Be Determined in Field

2.05 Mixing and Tinting

A. Coatings, except two part epoxies, shall be delivered to the job site premixed.

B. Job tinting will not be acceptable, except as approved by the Engineer.

C. All mixing shall be done in mixing pails placed in suitably sized non-ferrous or oxide resistant metal pans.

PART 3 - EXECUTION

3.01 Inspection

A. Inspect all surfaces on which paint is to be applied, and notify the Owner of any defects considered detrimental to the application of materials specified.

B. If dirty, rusty, scaly, greasy, damp, scuffed surfaces, or conditions otherwise detrimental to the formation of a durable paint film are painted over, remove paint and repaint the affected area without additional cost to the Owner.

C. Provide all scaffolding, staging, and other temporary facilities required for the proper execution of the work. Place scaffolding so as not to interfere with the work of others. Should it be necessary for the progress of the Work in general, if so directed and without extra cost to the Owner, move, relocate, or arrange scaffolds, ladders, or coverings to permit the Owner or other crafts to proceed with their work without delay.

D. Furnish the following for the Engineer's use during the project for both metal and concrete substrates, as applicable:

1. A low voltage wet sponge instrument for checking film continuity.
2. A dry mil thickness gauge for checking film thickness.

3.02 Surface Preparation

A. General

1. All surfaces to be coated shall be prepared in a workman-like manner with the objective of obtaining a clean and dry surface. No coating shall be applied before the prepared surfaces are approved by the Engineer.
2. All preparation and cleaning procedures shall be in strict accordance with the coating manufacturer's printed instructions and as specified in this Section for each particular substrate condition.
3. Remove or otherwise protect hardware, hardware accessories, machined surfaces, plates, lighting fixtures, and similar items in place and not to be painted prior to surface preparation and painting operations. Remove items, if necessary, for the complete painting of the items and adjacent surfaces. Following completion of painting of each space, reinstall removed items. Such removal and reinstalling shall be done by workmen skilled in the trades involved.
4. Clean surfaces to be coated before applying coating or surface treatments. Remove oil and grease with clean cloths and cleaning solvents in accordance with SSPC SP-1 prior to mechanical cleaning. Clean surfaces of galvanized metals, fiberglass and PVC with water soluble detergents prior to etching.

Cleaning solvents shall be low toxicity and shall have a flash point in excess of 115°F. Program cleaning and painting so dust and other contaminants from the cleaning process do not fall in wet, newly coated surfaces.

B. Metals

1. All ferrous metal to be primed in the shop shall have all rust, dust, and scale, as well as all other foreign substances, removed by sandblasting in accordance with SSPC SP-6 or SP-10 and achieve a profile ranging from 1.0 to 3.0 mils DFT as recommended by manufacturer. Immersion (submerged metals) exposure shall receive surface preparation SSPC SP10 near-white blast. Non-immersion (non-submerged metals) exposure shall receive surface preparation SSPC SP-6 commercial blast. Cleaned metal shall be primed or pretreated immediately after cleaning to prevent new rusting. Abraded or corroded spots on shop coated surfaces shall be wire brushed and touched up with primer specified in this Section. Remove all surface imperfections that will induce premature coating system failure. Chip or scrape off weld splatter and weld slag. Grind down sharp and rough edges of weld seams to create a smooth transition. Surface cleanliness shall be verified in accordance with SSPC-VIS1.
2. Store shop coated ferrous surfaces out of contact with the ground in such manner and location as will minimize the formation of water-holding pockets, soiling, contamination, and deterioration of the coating film.
3. All ferrous metals not primed in the shop shall be sand-blasted in the field prior to application of the primer pretreatment in accordance with criteria specified above.
4. All non-ferrous metals and galvanized surfaces, whether to be shop or field primed, shall be solvent cleaned per SSPC SP-1 prior to the application of a vinyl-phosphoric wash and/or primer.
5. Piping scheduled for a coating which is supplied with a bituminous coating shall receive two coats of titanium pigmented alcohol-soluble resin before applying primer and colored finished coat.
6. All new exterior and interior metal electrical conduits will be coated per specification.
7. All existing coated metals and previously shop coated metals shall be free of all foreign substances and cleaned according to manufacturer's recommendations prior to application of primer and finish coats.
8. All non-submerged existing pipe, pipe supports, metal structural members, and miscellaneous metal items to remain which are to be recoated shall have SSPC SP-6 (commercial blast cleaning) surface preparation. All submerged existing metal items to remain and to be recoated shall have SSPC SP-10 (near white blast cleaning) or SP-11 (near white power tool cleaning) surface preparation to remove existing coating to bare metal. All rust, dust scale, and other foreign substances shall be removed. Bare metal exposed after cleaning shall be immediately primed to prevent new rusting. Prior to applying new coating, clean existing metals and piping with water-soluble degreasers or solvent per SSPC SP-1.

C. Concrete and Masonry

1. All new concrete surfaces shall be allowed to cure a minimum of 28 days before coatings may be applied.
2. All new or existing uncoated concrete surfaces to be coated shall receive a brush-off blast per ASTM D4259 to achieve a profile equal to 80-grit sandpaper as recommended by the manufacturer to remove laitance, efflorescence, chalk, dust, dirt, grease, oil, asphalt, tar, excessive mortar and mortar droppings: Surface deposits of free iron shall be removed prior to painting. At no time shall the underlying aggregate be exposed. Fill holes and imperfections in finish surfaces with surface/fill as recommended by manufacturer. Do not coat over surfaces where the moisture content exceeds that permitted in the coating manufacturer's written instructions.
3. Masonry surfaces to be coated shall be free of laitance, efflorescence, dust, dirt, grease, oil, excessive mortar and mortar droppings. Fill holes and imperfections in finish surfaces with surface/filler as recommended by manufacturer.
4. Walls, ceilings, and floors to be coated shall have all specified coats applied prior to the installation of equipment or items such as panels which will result in a portion of the wall, ceilings, or floor being inaccessible and preventing them from receiving the specified number of coats.

D. Wood: New wood surfaces to be coated shall be cleaned of all dirt, oil, and other foreign substances with water-soluble cleaners/detergents per SSPC SP-1. Existing coated wood surfaces shall have all loose and peeling paint removed with scrapers and sandpaper as required, then cleaned as described above for new wood surfaces. Finished surfaces exposed to view shall be made smooth by sandpapering and free of dust. Scrape and clean small, dry, seasoned knots and these shall be given a thin coat of knot sealer before application of priming coat. Fill holes and imperfections in finish surfaces with putty or plastic wood filler, colored to match the finish coat, if natural finish is required, allow to dry and sandpaper smooth. Coating shall proceed only when the moisture content of the wood does not exceed 12%.

E. Fiberglass (FRP) and Polyvinyl Chloride (PVC) Pipe and Fittings: Fiberglass and Polyvinyl chloride pipe and fittings to be coated shall be cleaned of all dirt, oil, excess glue, and other foreign substances with water-soluble cleaners/detergents per SSPC SP-1, scrapers, and sandpaper as required. Surfaces to receive coating shall be lightly abraded with sandpaper to resemble medium grit sandpaper and made free of dust prior to applying coating.

3.03 Application

A. Coating Thickness

1. Each coat of material shall be applied at the rate specified by the manufacturer to achieve the minimum dry mil thickness specified. Dry film thickness shall be verified in accordance with SSPC-PA2. If material has thickened or must be diluted for application by spray gun, the coating shall be built up to the same film thickness achieved with undiluted material. One gallon of unthinned material as originally furnished by the manufacturer must

not cover a greater square foot area when applied by spray gun than when applied unthinned by brush. Coatings in submersible applications shall be pinhole-free.

2. Deficiencies or excesses in film thickness shall be corrected by the application or removal of an additional coat(s) of material.

B. Application to Masonry

1. Application rates will vary on masonry according to surface texture; however, in no case shall the manufacturer's stated coverage rate be exceeded.
2. It shall be the Contractor's responsibility to achieve a protective and decorative finish on porous surfaces either by decreasing the coverage rate or by applying additional coats of material.

C. Application to Concrete Floors: After floor is clear and dry, prepare surface in accordance with ASTM D4259 brush-off blast or etch with 5% solution (by weight) of muratic acid to achieve a profile equal to 80-grit sandpaper. Remove all dust and apply one coat of sealer using lambswool applicator. Let dry overnight, then burnish first coat and sweep surface thoroughly before applying second coat. Repeat if third coat is specified. Apply coat and let dry overnight before opening to traffic.

D. Application to Concrete Stairs and specified Skid-Resistant Areas: Follow same procedures as concrete floors, with one of the following additions:

1. Apply third coat containing an adequate amount of silica sand or manufacturer's standard skid-resistant coating on the top surface of all steps and landings or in areas specified to be skid resistant to provide a skid-resistant surface; or
2. For stairs only, provide skid resistant adhesive tape on the surface of all steps and the edges of landings in sufficient amount to cover the outer 6-inches of each step or landing.
3. Other areas to receive skid-resistant coating such as around pumps and other water-prone areas will be specifically noted on the Coating List if skid-resistant coating is desired.

E. Drying Time: Drying time shall be construed to mean "under normal conditions." Where conditions are other than normal because of the weather or because coating must be done in confined spaces, longer drying times will be necessary. Additional coats of material shall not be applied, nor shall units be returned to service until coatings are thoroughly dry.

3.04 Protective Coating of Non-Ferrous and Galvanized Metals

A. Where non-ferrous metals such as aluminum, copper, and galvanized metal comes in contact with concrete or dissimilar metals, a protective coating must be applied. In the case of galvanize, obtain recommendation from coating supplier.

B. A vinyl gasket may be used in lieu of the protective coating.

C. The bottom of aluminum railing posts and aluminum clip angles shall be coated with an aluminum impregnated caulking compound (Alumilastic, or equal) prior to erection.

D. After erection and alignment, openings between non-ferrous metal surfaces and the concrete shall be sealed in a watertight manner with the proper caulking compound, relative to and in accordance with the opening width demand.

3.05 Cleaning

A. Touch-up coatings and restore finish where damaged or defaced by construction activities.

B. Remove coating spatter from all finished surfaces and restore affected finishes.

C. Remove excess materials, scaffolding, staging, drop cloths, equipment, and rubbish from the job site.

3.06 Coating List

A. Areas and items to receive coatings may be indicated on the Drawings and/or on the Coating List. Colors are to be selected by the Owner and Engineer after submittal of the color chart. Color schemes and coding are to match existing facilities on the project site unless otherwise indicated by the Engineer.

B. The coating list is not a guaranteed complete listing of all items requiring coating. Any new items of the Work requiring coating for corrosion protection, aesthetics, or for color coding that are not listed shall be coated based upon the specific application of that item.

COATING LIST

(miscellaneous steel surfaces do not include stainless steel)

A. For All New Work

1. Exposed metal piping, fittings, valves, supports and appurtenances
2. Miscellaneous steel surfaces
3. Steel or cast iron components of equipment

B. General Yard/Site

1. New yard hydrants
2. New bollards (safety yellow)
3. New valve box covers
4. Vertical faces and 4-inches on top edge of all new concrete stoops and sidewalk steps [safety yellow]
5. New Valve operating levers [safety yellow]

C. New Chemical Feed Building

1. Interior precast concrete ceiling
2. Interior CMU walls
3. Floor (System 8B - clear)
4. Chemical Storage Tank Sump floor and walls (System 8F)
5. New steel lintels for new doors, windows, louvers, etc.
6. Roof hatch covers

-END-

DIVISION 10 – SPECIALTIES

SECTION 10400 - SIGNS, PLAQUES, AND LABELING

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and install signs, plaques, labels, and appurtenances necessary to complete work shown or specified.

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply in all cases.

C. Refer to Division 15 for HVAC and Division 16 for Electrical Identification and labeling requirements.

1.02 Submittals

A. Submittals shall be as specified in Section 01300-Submittals.

B. Submit the following:

1. Shop drawings with physical characteristics of signs, plaques and labels.
2. Installation data describing appurtenant items, installation requirements, and installation information.
3. One sample each of the following:
   a. Floor loading plaque
   b. Valve identification disc
   c. Room and building identification signs
   d. Equipment identification labels
   e. “Exit” and “Not an Exit” signs
   f. Pipe markers
   g. Chemical labels

1.03 Product Delivery, Storage and Handling

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 - PRODUCTS

2.01 Signs

A. Exit Signs: Non-illuminated signs shall be 10-inch by 14-inch size and shall comply with OSHA requirements.

1. Each sign shall be fabricated from 1/16-inch thick Fiber-Shield fiberglass, 0.040 gauge aluminum, or semi-rigid butyrate material. The signs shall have phosphorescent or luminous feature that absorbs sun, fluorescent and incandescent light source, and glows in the dark when light source is removed.
2. Provide Illuminated signs as indicated on Drawings. Signs shall be 118 volt, aluminum extrusion with a transparent bronze acrylic plastic lens and red acrylic plastic diffuser and comply with OSHA requirements.
3. Sign wording shall identify character of passageway. Wording shall be as follows:

Character	Sign Wording
Exit	EXIT
Non-Exit	NOT AN EXIT

4. Signs designating the direction to an exit shall have an arrow.
5. Mounting shall be as recommended by sign manufacturer or as indicated on the drawings.

B. Non-Potable Water Signs: Signs shall be 10 inch by 14 inch. Each sign shall be fabricated from 1/16-inch thick Fiber-Shield fiberglass, 0.040 gauge aluminum, or semi-rigid butyrate material.

1. Sign wording shall be "DANGER – Do Not Drink", red lettering on black and white background.
2. Fasteners shall be stainless steel and sized per sign manufacturer's recommendations.

C. Miscellaneous Signs: Provide the following signs of size, wording, quantity, and colors indicated at locations designated by the Engineer. Indoor signs shall be 1/6-inch fiberglass, 0.040 gauge aluminum, or semi-rigid butyrate. Outdoor signs shall be aluminum 0.040 gauge aluminum.

1. "CAUTION – This Equipment Starts and Stops Automatically" (15" x 7"), black on yellow background, quantity: 1
2. "Sampling Location →" (12" x 6"), black lettering on white background.
3. See Section 10523 for signs for fire extinguishers.
4. Sign for sump valve outside
5. Signs at Chemical Fill Station

D. Valve identification discs shall be 1-1/2 inch diameter 19 gauge brass discs with 1/2 inch black-filled engraved numbers and mounting rings. Numbering system shall correspond to numbers as listed elsewhere in these specifications or as otherwise directed by the Engineer. Valve discs shall be by Seton Identification Products, or equal.

1. Brass discs shall have a 3/16 inch hole to accommodate mounting hardware.
   a. Discs for exposed valves shall be mechanically attached to the valve bodies or attached to the valves by a brass jack chain and S-hooks.
   b. Discs for buried valves shall be attached to the valve box concrete collars.
2. Fasteners for valve identification discs shall be brass. Fastener size shall be as recommended by the disc manufacturer.

E. Pipe Markers: Provide on all new piping and existing piping which is recoated. Pipe labels shall be self-adhesive or snap-around labels by Seton, or equal. Flow direction arrows and banding shall be self-adhesive. Labels shall be weather proof suitable for moist areas or outdoor environments and compatible with the surface applied.

1. Pipe label colors shall be as directed by the Engineer. A minimum of five (5) different colors shall be used.
2. The sizing for band and markers shall have minimum sizing as follows:

Outside Diameter of Pipe or Covering	Length of Label	Size of Label Letters
3/4" to 1 1/4"	8"	1/2"
1 1/2" to 2"	8"	3/4"
2 1/2" to 6"	12"	1-1/4"
8" to 14"	24"	2"
16" and over		3"

F. Equipment, Structure, Building and Room Labeling: Refer to Articles 3.6 and 3.7 of this Section.

G. Sign Manufacturers: Exit signs, valve identification discs, and pipe markers shall be products of Brady Facilities Identification Products, Milwaukee, Wis.; Seton Name Plate Corp., New Haven, Conn.; Safety Sign Co., Cleveland, Oh.; or equal.

2.02 Plaques

A. Provide on all floors of new structures. Floor loading plaques shall be 1/16-inch thick Fiber-Shield fiberglass, 0.040 gauge aluminum or semi-rigid butyrate material, 8 inches high and 16 inches wide, with 5/8-inch letter to read as follows:

THE MAXIMUM SAFE LOAD
THAT MAY BE APPLIED TO
THE FLOOR IN THIS ROOM IS
_____POUNDS/SQUARE FOOT

1. The applicable live loads to be stated on the plaques are as follows:
   175 lbs./sq.ft. for all rooms
2. Plaques shall be wall mounted and shall have holes of sufficient diameter to accommodate mounting hardware. Each plaque shall be secured by not less than six fasteners.
3. Fasteners for plaques shall be stainless steel. Fastener size shall be as recommended by the plaque manufacturer.

B. Project Identification Plaque: Furnish one bronze plaque for the purpose of identifying the parties responsible for the project.

1. The plaque shall be a minimum of 36 inches wide by 30 inches high and shall be wall mounted. Furnish concealed type mounting.
2. Exact wording for the tablet shall be furnished by the Engineer.
3. Letters shall be Helvetica block style. Plaque shall have a border. Height and thickness of letters shall be proportional to the wording and space available. Ratio of lower case letters to capital letters shall be 2/3.

PART 3 - EXECUTION

3.01 General

Install signs and plaques in accordance with manufacturer's recommendations and as specified in this Section.

3.02 Exit and Not-An-Exit Signs

A. Each exit from the new Chemical Feed Building shall be clearly designated by a sign located directly over the exit or in another conspicuous place as directed by the Engineer.

B. Any existing passageway from which an exit is not visible shall be marked with exit signs as directed by the Engineer. If the direction of travel to the exit may not be apparent, an exit sign with directional arrow shall also be mounted.

C. Any existing or new door, passage, or stairway which is neither an exit nor a way of exit access, and which is so located or arranged that it may likely be mistaken for an exit, shall be identified by a sign reading "Not an Exit", or shall be identified by a sign indicating its actual character.

D. Installation of signs shall conform to OSHA requirements.

E. Signs shall be level and plumb.

F. Signs shall be mounted according to manufacturer requirements.

3.03 Non-Potable Water Signs

A. Each new yard hydrant, hose bib, sillcock, spigot, and sample cock connected to a non-potable water source shall be identified by a Non-potable Water Sign.

B. Mount signs on posts for yard hydrants or on wall for wall hydrants. Provide treated wooden 4 x 4 mounting posts and stainless steel hardware for yard hydrants. Signs shall be level and plumb.

3.04 Valve Identification Discs

A. All new valves shall be identified by a numbered valve disc. Operating stands and valve boxes shall be similarly labeled as the valves served.

B. The brass valve tags shall be fastened either by drilling and using a brass screw or by attachment using a brass jack chain. Drilling and tapping methods shall be such that the valve body is not structurally weakened or the pressure rating reduced.

C. Valve identification discs to be mounted on valve box concrete collars shall be mechanically attached in such a manner that the discs will not be loosened by freezing and thawing. Discs shall be imbedded in the concrete collars so that the disc faces are flush with the concrete finish surface. Each disc shall be oriented so that the top of the lettering is toward its respective valve box.

3.05 Pipe Markers

After the final finishing coating of pipe work has been completed, label each line with identification labeling showing the service, direction of flow, destination of flow, and/or other identification of the pipe line as directed by the Engineer. Such identification labeling shall appear every 15-20 feet and after changes in direction, or as necessary in the judgment of the Engineer, but generally not less than two places. A complete detail listing of pipe markers indicating wording and locations will be provided in the field by the Engineer during construction. A typical example of pipe marking is as follows:

"SodAl to Aeration Influent →"

3.06 Equipment Labeling

After the finish coat is applied to equipment items listed on the Schedule, label each item with the title and number (if applicable) of the equipment, in addition to labeling required for electrical identification. Example: "Chemical Feed Pump No. 1". The location of the label for each piece of equipment will be determined in the field by the Engineer. Associated electrical, controls and instrumentation equipment shall also be labeled corresponding to the title of the equipment. Example: disconnect switch, control panel, manual motor starter, or VFD for "Chemical Feed Pump No. 1." shall also be labeled as such. Electrical labeling is described in Division 16. Labels shall be as described for structures, buildings, and rooms with 1 inch lettering standard for equipment. Painted, stencil lettering may be allowed on a case-by-case basis.

3.07 Building Labeling

After the finish coat is applied or exterior finish completed (as applicable) for the new buildings, it shall be labeled with the title indicated. Exterior Labels for buildings shall be 0.040 gauge aluminum. Labels shall have 2-inch lettering for buildings, tan on brown background. Labels shall be mounted at eye level, mechanically fastened to the wall, structure, or door with stainless steel bolts at a location determined by the Engineer in the field.

3.08 Floor Loading Plaques

A. Install a plaque on each wall around the new platform in the Chemical Room on which the design live load for the particular floor shall be recorded.

B. Each plaque shall be wall mounted in a conspicuous place near a frequently used exit from the room where shown on the plans or as directed by the Engineer.

C. Installation of floor loading plaques shall conform to OSHA requirements.

D. Plaques shall be level and plumb.

3.09 Project Identification Plaque

A. Install project identification plaque in the location shown on the drawings or designated by the Engineer.

B. Plaque shall be installed level and plumb.

C. Plaque shall be mechanically secured to the mounting wall.

3.09 Cleaning

Clean grease, oil, dirt, paint, or any other contaminants from the exterior surfaces of signs, plaques, fasteners, and parts after installation.

SIGNS, PLAQUES, AND LABELING SCHEDULE

This schedule is to be used only as a guide and is not meant to represent a complete listing of labeling requirements. If the electrical label numbers do not correspond with those listed in Specification Divisions 13000 and 16000 or on the Drawings, verify correct number with the Engineer.

1. Equipment Labeling
    a. Chemical Feed Pump No. 1
    b. Chemical Feed Pump No. 2
    c. Chemical Feed Pump No. 3
    d. Unit Heater No. 1
    e. Unit Heater No. 2
    f. Storage Tank No. 1
    g. Storage Tank No. 2

2. Structure/Building Labeling
    a. Chemical Feed Building

3. Chemical Fill Station Labeling
    a. Sodium Hypochlorite
    b. Sodium Bisulfite
    c. Sodium Aluminate

4. Miscellaneous Labelling
    a. “Beware of Off-Gassing During Delivery”
    b. 12”x12” OSHA/DOT diamond chemical hazard labels for each chemical
        1. At Chemical Fill Station
        2. On each Storage Tank
    c. Chemical detail sticker for each chemical

-END-

SECTION 10523 - FIRE EXTINGUISHERS

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and install fire extinguishers and appurtenances necessary to complete work shown or specified.

1. Each fire extinguisher shall be complete with pressure gauge, mounting device, and appurtenances. All components of the fire extinguishers shall be furnished by one manufacturer.

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply, unless otherwise specified.

C. Abbreviations

1. OSHA - Occupational Safety & Health Administration.
2. NFPA - National Fire Prevention Association.
3. TJL - Underwriters' Laboratory.

1.02 Submittals

A. Submittals shall be as specified in the General Conditions.

B. Submit the following:

1. Certified copies of test reports of factory tests required by the applicable standards.
2. Shop drawings with physical characteristics of fire extinguishers and application for specified use.

1.03 Product Delivery, Storage, and Handling

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 - PRODUCTS

2.01 General

Furnish fire extinguishers and mounting devices as specified in this Section and as shown on the drawings.

2.02 Fire Extinguishers

A. The fire extinguishers shall be of the dry chemical type suitable for use on Class A, B, and C fires, and shall have a chemical capacity of 10 pounds, a range of 5 feet, and a UL rating of 4A, 4OBC.

B. Dry chemical must remain inert with concentrated FeCl solution.

C. Fire extinguishers shall be provided full and ready for use.

D. The fire extinguishers shall meet or exceed all requirements established by OSHA and NFPA.

E. Each extinguisher shall be furnished with a pressure gauge.

2.03 Mountings

A. Wall mounted fire extinguishers shall be provided with wall mounting brackets which support extinguisher at top and bottom. Extinguishers shall be wall-mounted unless otherwise shown.

B. Cabinet mounted fire extinguishers shall be provided with cabinets. Cabinets shall be 18-gauge steel, baked enamel finish, semi-recessed with interior dimensions of 32 inches high x 16 inches wide x 8 inches deep. The door shall be 5/8-inch thick steel and shall be with clearly identifiable lettering.

2.04 Signs

Provide glow-in-the-dark sign above each fire extinguisher provided. Sign shall be mounted with stainless steel hardware.

PART 3 - EXECUTION

3.01 Installation

Install fire extinguishers in accordance with manufacturer's written instructions. Tops of extinguishers shall not be more than 5 feet above the floor. The fire extinguishers shall be mounted in locations as indicated on the Drawings.

FIRE EXTINGUISHER DATA SHEET

A. LOCATIONS:

1. New Chemical Feed Building

B. QUANTITY: Two (2)

C. MOUNTING DEVICE: All locations to be wall-mounted.

D. MANUFACTURERS:

1. Allen Mgf. Company, Broadview, Illinois; Elkhart Brass Mfg. Company, Elkhart, Indiana; or equal.

-END-

DIVISION 11 – EQUIPMENT

SECTION 11740 – CHEMICAL FEED PUMPS

PART 1 – GENERAL

1.01 Description

A. Scope: Furnish and install chemical feed pumps and and accessories as specified and shown on the drawings. The chemical feed pumps and accessories specified in this section shall be provided by the same supplier providing the equipment specified in Section 13700 – Chemical Storage Tanks. In addition, the Contractor shall be responsible for ensuring a complete and operable chemical feed system and shall establish the exact limits of work between the Contractor and the equipment supplier.

B. The configuration of the chemical feed pumps and accessories is shown as a schematic on the Drawings. The manufacturer's shop drawings shall show the actual location and orientation of the chemical feed pumps and accessories within the New Chemical Feed Building. All stands, supports, brackets, etc. required for the accessories shall be provided by the manufactuer and shall be non-metallic, chemically resistant.

C. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply unless otherwise shown or specified.

D. Pumps shall be positive displacement peristaltic type complete with spring-loaded or retractable roller pumphead, self-contained variable speed drive, and flexible extruded tube as specified.

E. Peristaltic pumping action is created by the compression of the flexible tube between the pumphead rollers and track, induced forward fluid displacement within the tube by the rotation of the pump rotor, and subsequent vacuum-creating restitution of the tube.

F. Pumps shall be dry self-priming, capable of being run dry without damaging effects to pump or tube, and shall have a maximum suction lift capability of up to 30' vertical water column. Maximum pressure rating: 30 psi.

G. Pump shall not use check valves or diaphragms and shall not require dynamic seals in contact with the pumped fluid. Process fluid shall be contained within pump tubing and shall not directly contact any rotary or metallic components.

H. Flow shall be in the direction of the rotor rotation, which can be reversed, and shall be proportional to rotor speed.

1.02 Quality Assurance

A. To maximize pump efficiency and minimize tube fatigue that will impact life, performance, and accuracy, pumps must be designed not to exceed the specified P/10 ratio (Theoretical maximum number of occlusions per 10 gallons pumped). Pumps exceeding the specified P/10 ratio, will not be considered suitable for the duty condition. The following criteria is set to maintain the P/10 of ratio for the tube size specified for this application:

1. Maximum two compressing rollers for two compressions per revolution.
2. Tube wall thickness of 2.4 mm or 3.2mm and material specified
3. Large diameter spring-loaded roller set for 2.4mm or 3.2mm wall thickness tubing
4. Max base drive speed of 220 RPM for 2.4mm wall thickness tubing, 265 RPM for 3.2mm wall thickness tubing.
5. Track geometry of no less than 180 degrees and rotor geometry with roller 180 degrees apart.

B. P/10 ratio shall not exceed the following per tube size:

Tube Size	P/10 Ratio	Tube Size	P/10 Ratio
1.6mm x 2.4mm	181,820	6.4mm x 3.2mm	5,848
3.2mm x 2.4mm	45,460	9.6mm x 3.2mm	3,022
4.8mm x 2.4mm	20,840	12.7mm x 3.2mm	1,892
6.4mm x 2.4 mm	11,570	15.9mm x 3.2mm	1,580
8.0mm x 2.4mm	7,170		
9.6mm x 2.4mm	4,960		

C. For quality assurance, all pump tubing must be manufactured by the pump manufacturer in accordance with their specifications. Tubing not manufactured by the pump manufacturer will not be acceptable.

D. Drive and pumpheads shall be 24-hr continuous duty rated and have a five-year manufacturer's warranty from date of shipment.

E. Pumps to be manufacturer's standard product. Manufacturer of tubing pumps must have at least 20 operating installations in domestic water or wastewater treatment plants located in the United States over a period of at least seven years in the same service and size as specified.

F. Pumps must be manufactured under ISO 9001-2000.

G. Pumps shall be meet all applicable CE and C ETL US standards per L610101A.

1.03 Submittals

A. Submittals shall include information and materials specified in this Section, the General Conditions, and Section 01300, Submittals.

B. Submit the following for the Engineer's review and approval:

1. Manufacturer's Certificate of Compliance with the referenced specifications and applicable standards.
2. Certified copies of factory tests and reports, if specified in this Section or required by the referenced standards.
3. Descriptive information including catalogue cuts and manufacturer's specifications for all components.
4. Copy of manufacturer's standard warranty for each type of equipment provided.
5. Shop drawings with performance data, descriptive literature, weights and dimensions, and other physical characteristics verifying compliance with this section including certified pump curves, motor starting and full-load amps, and motor horsepower and data, and other specific pump information. When numerous options and sizes are shown, the shop drawings shall be marked to clearly indicate the size and types specific to this Section and project.
6. Electrical:
   a. Submit all electrical requirements for each piece of equipment including voltage, phase, and load data.
   b. Provide wiring diagrams for each piece of equipment. For example, submitting one diagram for all blowers is not acceptable.
   c. "Typical" diagrams are not acceptable. Manufacturer's standard diagrams may be submitted if they are made specific for this project by:
      1) Showing all included options, special items, etc.
      2) Unused options or features shall be crossed out or deleted.
      3) Identify the drawing with project name, equipment name, and tag number, e.g., "West Lafayette WWTP, Chemical Feed Pump No. 1, Tag No. xx-xx."
7. Complete electrical control schematic.
8. Control philosophy provided in both written and schematic format.
9. A material list indicating items to be furnished by the equipment manufacturer.
10. List of which components and materials shall be shipped preassembled and parts list for the other components and materials. Weights and physical dimensions shall be indicated for each part, assembly, and/or package to be shipped.
11. Manufacturer's installation instructions and recommended testing procedures.
12. Manufacturer's operation and maintenance (O & M) manuals and materials. When numerous types and sizes are shown, the manuals shall be marked to clearly indicate the sizes and type specific to this project. Provide four (4) bound hard copy sets and two (2) CD's with complete electronic copy in pdf format – see Section 01300. O&M manuals must be received and reviewed by the Engineer prior to the equipment being put into permanent operation.
13. Provide start-up certification report specified in this Section.
14. P/10 ratio calculation.

1.04 Product Delivery, Storage, and Handling

A. Ship pump and drive assembled complete. Ship tubing separately packed in a continuous length. Required length for installation shall be cut by the Contractor, with the remaining tubing stored for spare replacement.

B. Pack all additional spare parts in containers bearing labels clearly designating contents and pieces of equipment for which intended.

C. Deliver spare parts at the same time as pertaining equipment.

D. The Contractor shall be responsible for the delivery, storage, and handling of products. Store products in accordance with manufacturer's recommended procedures.

E. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 – PRODUCTS

2.01 Pump Construction

A. Pumphead – 2.4mm Tubing

1. Pumphead shall consist of a fixed track, a hinged guard door, two spring-loaded tube clamp mechanisms, and spring-loaded roller rotor assembly. Pump tubing shall be in contact with the inside diameter of the track through an angle of 180 degrees and be held in place on the suction and discharge by a spring loaded self-adjusting clamp mechanism. At all times, one roller shall be fully engaged with the tubing providing complete compression and preventing back flow or siphoning. Tube occlusion and spring tension shall be factory set to accommodate 2.4mm wall thickness tubing and shall not require adjustment for accommodating tubing of 1.6mm to 9.6mm ID.
2. Pumphead guard shall be transparent for purpose of viewing direction of rotation. For operator and environmental safety, pumps in which the direction of rotation cannot be visually verified are not acceptable.
3. Pumphead Assembly
   a. Pump Track Geometry must have a minimum 96.6mm swept diameter through a minimum track angle of 180 degrees
   b. Provide high corrosion/impact materials as specified
      i. Track Construction: polyphenylene sulfide (PPS)
      ii. Guard Construction: hinged impact-resistant polycarbonate breakaway guard, tool un-lockable for operator safety.
      iii. Rotor Construction: polyphenylene sulfide (PPS)
4. Tube Retainer Mechanism: Provide two spring–loaded adjustable tube retainer mechanism to secure the tubing at the entry and exit points of the pumphead.
5. Rotor Assembly
   i. Provide rotor assembly that ensures gradual tube occlusion and compensates for tube tolerance.
   ii. Twin spring-loaded roller arms located 180 degrees apart, each fitted with stainless steel helical springs and compressing roller for occlusion of the tube twice per rotor revolution
   iii. Compressing Rollers: 316SS with low friction stainless steel bearings and PTFE seals, minimum diameter of 18mm
   iv. Provide non-compressing guide rollers constructed of corrosion

resistant Nylatron

v. Clutch: Equip rotor with a central handgrip hub and manually activated clutch to disengage the rotor from the drive for manual rotor rotation during tube loading. Clutch shall automatically reengage rotor to gearbox upon one complete revolution.

vi. Mounting: To prevent slip, the rotor assembly shall be axially secured to the dogged output shaft of the gearmotor via a slotted collet and central retaining screw.

vii. Pumpheads requiring disassembly or special tools for tube changing are not acceptable.

B. Pumphead – 3.2mm Tubing

1. Pumphead shall consist of a fixed track with tool lockable-hinged guard door and magnetic safety interlock, which shall render the drive inoperable when the pump door is open. For operator safety, pumps without lockable guard, safety interlock, and/or flip-top design pump heads are not acceptable.
2. Pumphead door shall have two clear windows for viewing of rotation direction. When closed, pump door shall seal against the pump track for leak containment and controlled waste through the pumphead waste port in the event of a tube failure. For operator and environmental safety, pumps without clear viewing windows and/or waste port are not acceptable.
3. Rotor assembly shall be equipped with two compression rollers, which shall be retractable for tube loading, SIP, or CIP flushing cycles. Compression rollers shall be located 180 degrees apart for compression of the tube against the track twice per rotor revolution. One roller shall at all times be fully engaged with the tubing providing complete compression to prevent backflow or siphoning. Occlusion gap shall come factory set to accommodate 3.2 mm wall thickness tube. To maximize pump efficiency, pumps without retractable rollers and/or more then 2 compressing rollers are not acceptable.
4. The rotor assembly shall be close coupled to the output shaft of the drive gear motor by a 19 mm keyed shaft and shall be axially secured to the shaft by a through center retaining screw. Pumphead track shall be secured to the drive via two slotted screws and shall be self-locating.
5. Material of Construction:
   a. Track: Aluminium, trimite polyester powder coat, electrostatically applied and baked.
   b. Door:
      i. Inner Shell: Grilamid TR55
      ii. Outer Shell: Shock resistant polyurethane
      iii. Door Seal: Silicone
      iv. Drain Port Adapter: Acetyl
   c. Rotor:
      i. Hub & Roller Arms: Forton 1140L4 (PPS)
      ii. Hub Cover: Dupont Hytrel G5544
      iii. Main Rollers: 304SS
      iv. Main Roller Bearings: Carbon Steel (sealed)
      v. Guide Rollers: Nylatron
      vi. Hardware & Leaf Springs: 304SS

C. Tubing

1. Pump tubing shall be in contact with the inside diameter of the track (housing) through an angle of 180 degrees and be held in place on the suction and discharge by tube retainer clamps. The tubing shall be replaceable without the use of tools and with no disassembly of the pumphead. To achieve maximum flow per revolution, pump heads with a track angle of less then 180 degrees are not acceptable.
2. Pump tubing shall be constructed of Marprene II, a thermoplastic elastomer with a 64 Shore A durometer and 2.4mm or 3.2mm wall thickness. Pump manufacturer must manufacture Marprene tubing in-house. Pump manufacturers who purchase third party tubing are not acceptable.
3. Pump shall readily accept the following tubing ID's without pump adjustment or replacement:
   a. 2.4mm Wall Thickness: 1.6mm, 3.2mm, 4.8mm, 6.4mm, 8.0mm, 9.6mm
   b. 3.2mm Wall Thickness: 6.4mm, 9.6mm, 12.7mm, 15.9mm
   c. Tubing with a wall thickness less then 2.4mm is not acceptable.
4. Supply 15-meter spare roll of specified tubing for each size provided.

D. Drive

1. Rating: Continuous 24-hour operation, 40ºC ambient
2. Supply: 110-120V 50/60 Hz and 220-240V 50/60 Hz, 1-Phase field switchable. Supply nine-foot length main power cords with standard 115V three-prong plug.
3. Max drive power consumption: 135VA (2.4mm tube), 250VA (3.2mm tube)
4. Enclosure: NEMA 4X Washdown
5. Housing: Pressure cast aluminum with Alocrom pre-treatment and exterior grade corrosion resistant polyester powder coat. By nature of the environmental conditions, unpainted housings, including 316SS, are not acceptable.
6. Pumps shall meet the following minimum requirements for operator interface functionality. Pumps not meeting this minimum functionality will not be accepted.
   a. Backlit graphical LCD capable of up to four lines of text with up to 16 characters per line to display pump speed, running status, flow rate, and programming instructions
   b. Keypad for start, stop, speed increment, speed decrement, forward/reverse direction, rapid prime, and programming.
   c. Menu driven on screen programming of manual or auto control, flow and remote signal calibration, and general programming.
   d. Programmable "Auto Restart" feature to resume pump status in the event of power outage interruption.
   e. Programmable "Keypad Lock" to allow operator lockout of all keys except emergency start/stop.
   f. Programmable "Maximum Speed" to allow operator to set the maximum speed of the pump within 0.1-220 rpm (2.4mm tube) 0.1-265 rpm (3.2mm tube).

7. Supply auto control features to meet the following minimum functionality requirements. Pumps not meeting this minimum functionality will not be accepted.
    a. Remote Control Inputs
        i. Speed Control:
            1) Primary Primary Analog 4-20mA or 0-10VDC speed input, with input signal trimmable and speed scaleable over any part of the drive speed range.
            2) Secondary Analog 4-20mA or 0-10VDC scaling input, with input signal trimmable and programmable scaling factor.
            3) Provisions for alternative remote accessory potentiometer (if supplied by others) for primary speed control or secondary speed scaling.
        ii. Start/Stop Control: via 5V TTL, 24V industrial logic or dry contact-Configurable command sense allowing open to equal run or open to equal stopped.
        iii. Forward/Reverse Control: via 5V TTL, 24V industrial logic or dry contact
        iv. Auto/Man Mode Control: via 5V TTL, 24V industrial logic or dry contact
        v. Leak Detector Run/Stop Control: via 5V TTL, 24V industrial logic, or dry contact
    b. Status Outputs
        i. Four relay contacts rated for a 30 VDC with a maximum load of 30W, NO or NC software configurable to indicate the following:
            1) Running/Stopped status
            2) Forward/Reverse status
            3) Auto/Manual status
            4) General Alarm status
            5) Leak Detected status
        ii. Speed output – Analog 4-20mA or 0-10 VDC
    c. Accepts RS 485 data protocol
    d. Termination: Supply screw down terminals suitable for 18AWB field wire and accessible through four glanded cable entry points on the pump.
8. Drive motor-brushless DC motor with integral gearbox and tachometer feedback.
    a. Speed Control Range of 2200:1 from 0.1 to 220 rpm +/- 0.1 rpm through the range for 2.4 mm tube, 2650:1 from 0.1 to 265 rpm +/- 0.1 rpm through the range for 3.2mm tube.
    b. Closed loop microprocessor controlled drive with pulse width modulation at speeds above 35 rpm and synchronous mode with magnetic field rotation control below 35 rpm.
    c. Circuitry complete with temperature and load compensation and protection.
9. Mounting: Drive shall be self-supporting and shall not require anchoring.
10. Pump Skid & Table
    a. Manufacturer shall provide the set of three Phosphorus Chemical Feed Pumps on a non-metallic, chemically resistant pump skid.
    b. Pump skid shall include PVC calibration column with isolation valve, three (3) pressure relief valve(s) with PVC body and viton diaphragm, three (3) discharge pressure gauges with isolater, chemical resistant pump panel constructed from polypropylene, all necessary ball valves, piping (sch 80 PVC), and fittings necessary for a complete system.

c. The skid shall be fastened to a manufacturer-supplied non-metallic, chemically reistant table of sufficient size and design for the associated pump skid.
d. All components of the pump skid and table including stands, supports, brackets, etc. shall be provided by the manufactuer and shall be non-metallic, chemically resistant.

11. Leak Detection: Pump manufacturer shall supply float-type leak sensor mounted below the pump head for leak detection and pump shut down in the event of a tubing failure.
12. Spare Parts: Provide one (1) spare 2.4mm tube pump head assembly and two (2) spare 3.2mm tube pump head assemblies.
13. Provide removable clear hard pastic safety covers over each individual pump.

PART 3 - EXECUTION

3.01 Installation

A. All equipment shall be installed in accordance with the drawings, manufacturer's written instructions, and in accordance with all state and local codes, ordinances and regulations.

B. Lubricate all moving parts as recommended by the manufacturer’s written instructions.

C. Make sure that all equipment is securely anchored. Also, make certain that all connections are tight.

D. Install units level and plumb to ensure the units are uniformly supported.

E. Contractor shall supply hose barb-to-process line adapters for connection of pump tubing to process lines. Hose barbs shall be secured to the pump tubing via a hose clamp tightened around the OD of the tubing.

F. Contractor shall supply shielded signal wiring for wiring of the remote nput and output to the connectors.

3.02 Cleaning Up

Upon completion of work, the Contractor shall remove all construction equipment and temporary materials, and he shall also dispose of all rubbish and other unsightly debris caused by operations and shall leave the premises in as good or better condition than found.

3.03 Manufacturer's Service and Start-Up Certification Report

A. The Contractor shall provide the services of a qualified representative of the manufacturer for a minimum of one (1) day to perform the following tasks:

1. Inspect the installation of the equipment.
2. Place the equipment in operation and make any necessary adjustments.

3. Perform tests specified in this Section and recommended by the equipment manufacturer.
4. Instruct Owner's personnel in the proper operation and maintenance (O & M) of the equipment (training).

B. If equipment is not completed for proper start-up and training procedures, the representative shall reschedule another visit at no additional cost to the Owner. Training will not be permitted without prior start-up and proper operation of the equipment. Training shall be performed separate and distinct from start-up and testing tasks. An abstract or outline of the start-up, testing and training procedures shall be provided to the Engineer at least five days prior to the scheduled visit. Manufacturer’s operation and maintenance manuals and materials shall be incorporated in the training procedures, with emphasis on items or materials or greatest importance.

C. A typed, bound report covering the manufacturer's representative's findings shall be submitted to the Engineer for review and approval. The report shall:

1. Describe the start-up procedures taken;
2. Include any inspections performed;
3. Outline in detail any deficiencies observed along with the corrective measures taken; and
4. Include the results of all field tests, including necessary graphs, charts, tables, etc., specified in this Section or required by the referenced standards. The report shall certify that the equipment is properly installed and functioning for the purpose intended. The report must be received and reviewed by the Engineer prior to the equipment being put into permanent operation.

D. The Contractor shall bear all expenses associated with the start-up, testing, and training procedures and report described above, including labor, transportation, lodging, and material costs.

3.05 Warranty

The Contractor shall guarantee the equipment to be free from defective material and workmanship for a period of one year from the date of acceptance of the equipment by the Owner. The Contractor shall replace any defective materials, components, or workmanship during this time, including but not limited to all materials, labor, shipping, and transportation, at no additional cost to the Owner. Any repair work performed during this one year period shall also be guaranteed to be free from defective material or workmanship for a period of one year from the date the work is complete and shall be addressed in the same manner at no additional cost to the Owner.

3.06 Acceptance of Equipment

Refer to Section 01650, Starting of Systems, for acceptance of equipment by Owner.

DATA SHEET

CHEMICAL FEED PUMPS

1. TITLE:	Phosphorus Chem Feed Pumps	Plant Effluent– Sodium Hypochlorite	Plant Effluent– Sodium Bisulfite
2. LOCATION:	New Chemical Feed Building	Existing Chlorine Building	Existing Chlorine Building
3. QUANTITY:	Three (3) (Pump Nos. 1, 2, & 3)	Two (2)	Two (2)
4. FLUID:	Sodium Aluminate, 38%	Sodium Hypochlorite, 15%	Sodium Bisulfite, 40%
5. CAPACITY RANGE:	0 – 4.8 gpm	0 – 4.8 gpm	0 – 52 gph
6. MAX RPM:	265	265	220
7. TUBING WALL:	3.2 mm	3.2 mm	2.4 mm
8. TUBING ID:	15.9 mm	15.9 mm	8.0 mm
9. DISPLACEMENT/REV:	0.01267 gal	0.01267 gal	0.0028 gal
10. P/10 RATIO	1,580	1,580	7,170
11. MIN FLOW RATE:	0.0013 gpm	0.0013 gph	0.0167 gph
12. MAX FLOW RATE:	4.8 gpm	4.8 gpm	52 gph
13. MAX DISCHARGE PRESSURE:	30 psi	30psi	30psi
14. SUCTION HEAD:	< 30’ water	< 30’ water	< 30’ water
15. POWER:	115 VAC, 60Hz, 1 Phase	115 VAC, 60 Hz, 1 Phase	115 VAC, 60 Hz, 1 Phase
16. MOUNTING:	Prefabricated Triplex Skid	Provide Loose	Provide Loose
17. MODEL NO.	620	620	520
18. MANUFACTURER:	Watson-Marlow, Inc.; Base Bid		

-END-

DIVISION 13 – SPECIAL CONSTRUCTION

SECTION 13600 - INSTRUMENTATION AND CONTROLS

PART 1 - GENERAL

1.01 Description

A. This specification covers the technical requirements for the fabrication, installation, engineering, wiring, adjustment, testing, start-up, commissioning, and training for the instrumentation and control (I&C) systems required for the project.

B. The instrumentation and control systems shall include all work and materials necessary to perform the control functions as illustrated on the electrical drawings as specified in the Division 13 Specifications.

C. The Systems Integrator shall be responsible for work of this division.

D. PROVIDE HARDWARE ONLY FOR THIS PROJECT, ALL PROGRAMMING WILL BE DONE BY THE OWNER UNDER SPERATE CONTRACT. Hardware included under this project are specified here and shown on the Contract Drawings are as follows:

1. PLC-CB
2. Chemical Fill Station Control Panel (Tanks level indication and alarms)

1.02 Quality Assurance

A. All work and materials specified herein shall be furnished by a single Systems Integrator (SI). The SI shall be an experienced and reputable firm, which has been engaged in the business of providing instrumentation and control systems for water and wastewater treatment facilities for at least five years.

B. Drawings and specifications shown are intended to convey information required for a complete functioning system for the purposes specified. The Systems Integrator shall be responsible for all details which may be necessary to properly install, adjust, and place in operation a complete and working system, including all final wiring diagrams, connections, and the final layout, sizes and quantities of conduit and wiring communicated to the Electrical Contractor.

C. In order to achieve standardization in appearance, operation, maintenance, and spare parts, similar equipment provided under this contract shall be the end products of a single manufacturer.

D. The Systems Integrator shall provide all materials and work necessary for a complete and functioning I&C system and shall have full coordination responsibility for the electrical, mechanical, and structural work associated with the I&C system, as specified herein and as shown on the drawings, including conveying all conduit and wiring information to the Electrical Contractor.

E. Codes, specifications, and standards referred to by number of title shall form a part of this specification to the extent required by the references thereto.

1.03 Pre-Construction Submittals

A. Submittals shall be as specified in the General Conditions and Section 01300, Submittals.

B. Submit the following:

1. Project schedule, which shall represent the Contractor's and System Integrator's best projections of when activities listed below will occur. Project schedules shall be updated at the Engineer's request, when major changes in the schedule occur. The activities shall include, but not be limited to, the following:
   a. Coordination and loop review meetings
   b. Shop drawing submittals for each group of equipment
   c. Shop drawing approvals for each group of equipment
   d. Equipment manufacturing/panel fabrication
   e. Equipment delivery
   f. Equipment installation
   g. System testing and calibration
   h. Operational testing and demonstration.
   i. As-built submittals
   j. Operation and Maintenance Manual submittals
   k. Operator training
   l. Follow-up Operator training at six months after substantial completion.
2. Manufacturer's certification of compliance with the referenced specifications and standards.
3. Certified copies of reports of factory tests specified herein and required by the referenced standards.
4. Shop drawings, indicating performance and physical data of the equipment specified herein.
5. Manufacturer's installation instructions.
6. Provide mounting details for field mounted equipment.
7. Manufacturer's operation and maintenance instructions.
8. If available, video-audio cassette tapes, DVD and CD ROM media produced by the equipment manufacturer, which contain demonstrations of operation and maintenance procedures for the equipment specified herein.

C. Physical requirements of submittals shall be as follows:

1. Submittals shall be submitted in three-ring binders.
2. Submittals shall be organized and divided into logical division by means of tagged manila dividers. Each type of equipment shall be given a separate division.
3. Provide index sheets for the submittals.
4. Drawings shall be 8-1/2 by 11 inches minimum. Drawings larger than 11 by 17 shall be folded and put into a three-hole plastic pocket.

5. All text material shall at minimum be typewritten. Handwritten material is not acceptable.
6. Telecopied (FAX) documents or photocopies of faxed documents shall not be included in submittals. Submittals containing telecopied documents will be rejected and returned immediately.

D. Shop drawings shall include, but not be limited to, the following:

1. Instrument index, which shall include instrument tag numbers, instrument description and instrument calibrated ranges.
2. Typewritten specification sheets, which shall include manufacturer's names and complete catalog numbers.
3. Detailed calculations as applicable, which shall include, but not be limited to, the following:
   a. Power supply sizing calculations
   b. Thermal loading (heat dissipation) calculations
4. Cut sheets and catalog information, which shall contain equipment specifications, dimensions, wiring and piping drawings, and installation and mounting details.
5. Loop drawings, which shall contain, but not be limited to, the following information:
   a. Loop numbers and instrument tag numbers
   b. Individual loop component locations
   c. Actual equipment wiring terminal designations, point to point wiring, and cable shield terminations
   d. Wire type, size and identification number
   e. Signal types (e.g., 120 Volt AC, 4-20 Ma DC, pulse frequency, 3-15 psig, etc.)
   f. Contact orientations (e.g., normally open, normally closed, etc.)
   g. Equipment grounding requirements
   h. Sources of loop power, or power supply identifications
   i. Signal boosters, interposing relays and shunt resistors
   j. For each loop, present a tabular summary of the following:
      1) Load impedance capability of each transmitting instrument output
      2) Input impedance of each receiving instrument
      3) Calculated loop wiring impedance, based on wire sizes and lengths
      4) Total loop impedance
      5) Reserve output capacity
6. Instrument panel layout drawings, which shall include, but not be limited to, the following:
   a. Bill of materials
   b. Front panel layout drawings
   c. Internal panel layout drawings
   d. Internal wiring diagrams, including wire type, size and identification number
   e. Terminal block layout drawings
   f. Nameplate lists
   g. Color schedules and samples
7. Elementary control diagrams.
8. Other descriptive information that will assist the Engineer with approval.

1.04 Record Drawings (As-Built) Submittals

A. Record drawings (as-built) submittals shall be as specified in the General Conditions and Section 01720, Project Record Documents.

B. The record drawings submittals shall consist of, but not be limited to, the following:

1. Submit to the Engineer one set of corrected contract documents. The original contract documents shall be marked to reflect 'as-built' conditions. Corrections shall be made in red.
2. Submit to the Engineer one set of corrected loop description. The original loop description shall be marked to reflect 'as-built' conditions. Corrections shall be made in red.
3. Submit one set to the Engineer and one set to the Owner printer outputs of the final configuration or programs of all programmable controller based equipment.
4. Where applicable, submit to the Owner standard magnetic storage devices, such as CD/DVD disks, of all programmable controller based equipment and all software and programs.
5. Submit original licensed copies and original documentation for all software. All software licenses shall be in Owner's name.
6. Where applicable, submit to the Owner two sets of pre-configured Read-only Memory Modules, such as EEPROMS or UVPROMS, of all programmable microprocessor based equipment. Each memory module shall be submitted in an anti-static zippered poly-bag, which shall be clearly labeled and identified.

1.05 Operation and Maintenance Manuals

A. The Systems Integrator shall prepare and furnish Operation and Maintenance Manuals of the system, which shall be submitted to the Engineer prior to operator training described below. Provide four (4) bound hard copy sets and one (1) CD with complete electronic copy in pdf format – see Section 01300.

B. The Operation and Maintenance Manuals shall include, but not be limited to, the following:

1. Approved shop drawings amended by approved change orders and as-built conditions.
2. Manufacturer supplied operating and installation manuals.
3. Detailed procedures and instructions on the operation, removal, installation, adjustment, calibration, and maintenance of each component provided under this contract.
4. As-built control panel and enclosure drawings, including termination drawings, PLC input/output (I/O) wiring diagrams, and panel bill of materials.
5. List of recommended spare parts, which shall include complete catalog numbers
6. List of local or the nearest manufacturer approved repair and service centers.

1.06 Operator Training

A. The System Integrator shall provide operation and maintenance training of the Owner's personnel. This training shall include, but not be limited to, the following:

1. The review of the Operation and Maintenance Manuals prepared and furnished by the System Integrator.
2. The review of 'as-built' panel layout drawings and wiring diagrams.
3. Hands-on training in the operation of each instrument and each loop.
4. Hands-on training in the maintenance, removal, and reinstallation of each instrument and each loop.
5. Hands-on training in the programming or configuration of all programmable microprocessor based instruments. This does not include the PLC system. Training for this equipment is covered under Section 13610.

B. For bidding purposes, the System Integrator shall include a minimum training period of three days, at eight hours per day, for up to five persons, and at approximately six months after substantial completion, include follow-up Operator training for one day, for five persons.

C. The System Integrator shall bear all expenses associated with the operator training activities, including labor, transportation and material costs.

PART 2 - PROCESS DESCRIPTION

2.01 General

A. Definitions

1. "Local" shall reference a location at the respective equipment MCC or VFD.
2. "Remote" shall reference a location at or near the physical equipment location on the WWTP site.

B. All Remote Control Panel (RCP) enclosures shall be NEMA 4X stainless steel.

C. Where indicated, outputs should be displayed through SCADA.

D. Where indicated three phase starters in the Motor Control Centers (MCC) shall have the following pilot and control devices:

1. HAND-OFF-AUTO
   a. In HAND the equipment shall run (if RCP is provided, the RCP shall control and "HAND" shall be replaced with "REMOTE").
   b. In OFF the equipment shall remain off.
   c. In AUTO, the equipment shall be controlled by the PLC.
2. Green LED ON light.
3. Amber LED FAIL or ALARM light.
4. Elapsed time meter (ETM)

PART 3 - EXECUTION

3.01 General

A. The System Integrator shall provide all materials and work necessary for a complete and functioning I&C system and shall have full coordination responsibility of the electrical, mechanical, and structural work as specified herein and as shown on the drawings. The System Integrator shall ensure that the instrumentation and control systems work is properly interfaced with equipment and other work furnished under other divisions of the contract documents.

B. The System Integrator shall install, make final connections to, adjust, test, and start-up the complete instrumentation and control system utilizing the technical service and advice of the systems superior.

3.02 Coordination Meetings

A. Coordination and control loop review meetings shall be attended by representatives of the Contractor and the Systems Integrator. The meetings shall be held at the Engineer's office periodically during the course of the project. The purpose of these meetings shall be to document the compatibility of the mechanical and electrical work as described in Article 3.01, paragraph A. above.

B. For bidding purposes, the Contractor and the Systems Integrator shall include cost for participation in no less than three (3) coordination and control loop review meetings. Each meeting shall require at least one working day.

3.03 Produce Delivery, Storage and Handling

A. Materials and equipment shall be delivered to the job site at a maximum of ten days prior to installation and not before.

B. All instruments containing electronics components shall be stored off the ground in weathertight enclosures. They shall be kept dry at all times. All plug-in equipment which can be removed from panels without the necessity of disconnecting any wire terminations shall be removed from its panel before shipping. They shall be shipped in separate shipping containers.

C. All equipment covered by this specification shall be shipped in a thoroughly clean condition, free from sand, oil, grit or grease (except when required for lubrication), weld splatter, or other foreign materials. All panel openings shall be capped.

3.04 Installation

A. General

1. Installation shall be in strict compliance with individual equipment manufacturer's instructions. The Contractor and the Systems Integrator shall assume full responsibility for additional costs which may result from unauthorized deviation from the equipment manufacturer's instructions.
2. All gages and indicators shall be mounted in the upright position.

3. Provide sufficient space around the equipment for maintenance and removal.
4. Cover front panels, gages and indicators, during construction for protection from weld and paint splatter.
5. Unless otherwise impractical, support instruments independent of process piping.

B. Installation Hardware

1. All nuts and bolts shall be stainless steel.
2. Support channels shall be stainless steel unistrut channels with stainless steel hardware.
3. Do not mount equipment directly to masonry or concrete walls. Provide unistrut channels on wall.
4. All equipment mounting plates shall be of 0.25-inch thick minimum stainless steel.
5. All contact surfaces between dissimilar metals shall be gasketed to prevent galvanic reaction.

C. Instrument Disconnect and Surge Protection

1. 120 volt AC power to each field-mounted instrument shall be provided with a disconnect switch and a surge protector, which shall be enclosed in a NEMA 4X box and labeled.
   a. Disconnect switch – Hubbell HBLDS3 or equal
   b. TVSS – APT TE series (include NEMA 4X enclosure), Liebert LTAC series.
2. All analog signal wiring shall be provided with surge protection at both the transmitting end and at the receiving end.
   a. At the instrument - TP48 by Telematic, Liebert FLW series.
   b. At PLC – SD Series by MTL Surge Technolgies or equal.

D. Weather Protection

1. Unless noted otherwise or impractical, all externally located instruments shall be installed to face north.
2. All externally located instruments, indicators, totalizers, control panels and control stations shall be mounted on a panel or mounting plate, which shall be provided with an aluminum or stainless steel weathershield to protect the instruments from direct exposure to the sun and weather. This weathershield shall be 3” wider at each end and have a 6” overhang in front of the instrument. All edges shall be smooth and rounded.

3.05 Equipment Identification and Tag Numbers

A. All apparatus, control equipment, and instruments, both panel and field mounted, shall be plainly identified, using the following methods:

1. Pipe-mounted instruments shall be provided with embossed stainless steel tags, which shall be attached to the instruments by means of stainless steel wire or tie wrap.

2. Wall, plate, or panel mounted instruments shall be provided with engraved laminated plastic tags, which shall be mounted above, or below instruments. The plastic tags shall be mounted at eye level, and shall be visible from a minimum distance of 20 feet. Lettering shall be black on white background.

B. Tag numbers and engraved or embossed text shall be as shown on the drawings, or as approved by the Engineer during shop drawing approval.

C. Tag numbers shall conform to the current Instrument Society of America (ISA) Standards, which shall consist of a multi-character prefix, followed by a loop number. Tag numbers shall be as indicated on the drawings.

3.06 Testing and Calibration

A. Test all analog loop zeroes and spans by disconnecting wiring at each transmitter and substituting an approved 4-20madc generator. Adjust the indicators and receiving instruments to indicate the correct value, correlated to the simulated current signal.

B. Test all annunciator points by placing jumpers across normally open contact inputs, or by disconnecting wiring on normally closed contact inputs.

C. Submit testing and calibration reports for all instruments to the Engineer.

3.07 Commissioning

A. This activity shall consist of two sequential performance tests and Operator training. Each test shall be witnessed by representatives of the Contractor, Systems Integrator, Owner, and Engineer.

1. Loop Operation Test: The objective is to demonstrate that the instrumentation and control system individual instruments are ready to be placed into permanent operation. Each loop shall be tested and demonstrated.
2. Control Function Test: The objective of this test is to demonstrate that all local and remote control panels, control stations, MCC, and Operator interface functions are ready to placed into permanent operation.
3. The Contractor shall prepare an agenda for the commissioning and submit to Engineer as part of the shop drawing submittal package.
4. The Contractor shall conduct training as specified.
5. Substantial completion of the system shall not be approved until satisfactory completion of the above commissioning tasks.

3.08 Warranty

A. The Contractor shall guarantee the Instrumentation and Control System to be free from defective material and workmanship for a period of one year from the date of acceptance of the equipment by the Owner. The Contractor shall replace any defective materials, components, or workmanship during this time, including but not limited to all materials, labor, shipping, and transportation, at no additional cost to the Owner. Any repair work performed during this one year period shall also be

guaranteed to be free from defective material or workmanship for a period of one year from the date the work is complete and shall be addressed in the same manner at no additional cost to the Owner.

B. During the warranty period adjust, recalibrate, repair, replace and otherwise place back into service any instrument and any item(s) that may require service, including software, at no additional cost to the Owner for any reason.

C. During the warranty service, provide unlimited on-site software and operation support, at no additional cost to the Owner for any reason.

D. Respond to a call for service within 24 hours.

E. At approximately six months completion of the warranty period, visit the plant and perform routine diagnostics and tests to determine on-going operation and performance of the I & C system within the project requirements. Make any and all repairs and adjustments necessary at no additional cost to the Owner for any reason. Conduct additional “follow-up training” to assist the Owner in operation of the plant and to address any operational concerns that may have become known after six months of operation.

- END -

SECTION 13610 – PROGRAMMABLE LOGIC CONTROLLERS

PART 1 - GENERAL

1.01 Scope of Work

A. Work under this section is subject to the requirements of the contract documents.

B. This section includes the technical requirements for the fabrication, installation, engineering, wiring, adjustment, programming, testing, start-up, calibration, and commissioning, training, and record documentation of the programmable controller systems, and accessories; all together comprising the Programmable Logic Controllers (PLC) in this project.

C. The Chemical Feed Building PLC (PLC-CB) shall be provided complete, including all hardware, cabling, and accessories, power supplies, input/output modules, interposing relays, enclosure, and provisions for a future touch screen HMI graphics display. PROGRAMMING OF THE PLC WILL BE BY THE OWNER UNDER SEPARATE CONTRACT.

D. Enclosures shall be furnished and installed in accordance with Section 13640, and as indicated on the drawings.

E. The system shall include future graphical user interface –human machine interface screens on a panel-mounted touch-screen computer. Graphical images shall be limited to a simple alarm and acknowledge style format. These screens shall be located on the front of the PLC enclosures.

F. The systems shall be described herein and as indicated on the drawings, and shall include, but not be limited to, the following:

1. PLC Hardware
2. SCADA communication via Ethernet.

G. Future Operator Interface:

1. Provide provisions for a future touch-screen Operator Interface Human Machine Interface (HMI) shall be provided in the front door of all PLC enclosures for operator input, control, and programming. The HMI shall be a flat panel touch screen display. The HMI shall allow access to all functions of the PLC's covered in this section.

1.02 Manufacturer

A. Manufacturer of PLC Components:

1. Allen Bradley SLC 5/05 to match existing PLC’s within the WWTP. All PLC's shall be by one manufacturer, and have the same hardware and software.

B. Manufacturer of Enclosure:

1. Hoffman or approved equal.

C. Manufacturer of UPS Power Supply:

1. MGE or approved equal.

1.03 Quality Assurance

A. Installer: Qualified with at least five (5) years of successful installation experience on projects with PLC and HMI instrumentation and control work similar to that required for this project.

1. It is intended that an experienced electronic systems integrator/ instrumentation and control systems subcontractor shall be in responsible charge of all PLC work.
2. The Systems Integrator Subcontractor shall be responsible for all design and installation details of the complete PLC system to install, adjust, and place into operation the PLC system.
3. Working together, the Systems Integrator Subcontractor and the project Contractor shall be responsible for all coordination between the PLC systems, field mounted instruments, the motor control system, and other equipment.
   a. It is intended that a qualified Electrical Subcontractor be responsible for all conduit and box installations, and all field wiring between items of equipment.
   b. All field wiring shall be in accordance with point-to-point drawings provided by the SI.
   c. The SI shall be responsible for specifying the exact types and quantities of cables and conductors to be installed by the Electrical Subcontractor.
   d. The SI shall be responsible for final terminations and testing of cables.
   e. SI shall assist the Electrical Contractor in identifying the location of the fault.
4. All installations shall be made in accordance with manufacturer's instructions and requirements.

B. Codes & Standards

The control system and its components shall comply will all applicable requirements of the following:

1. NFPA 70, National Electrical Code
2. NEMA
3. IEEE
4. EIA
5. FCC
6. UL

1.04 Submittals

A. Submittals shall comply with the Contract Documents. Shop drawings and descriptive data shall be submitted complete, in a single submittal.

B. Shop Drawings shall include the following:

1. System hardware configuration block diagrams, equipment cut-sheets, and instruction bulletin for each type used.
2. Panel/enclosure shop drawings, which shall include front elevation, internal panel elevation, conduit hole penetrations, and panel bill of material. Each item of panel-mounted equipment shall be shown.
3. Panel wiring diagrams, which shall show input/output wiring and terminations, and panel power wiring and terminations.
4. Detailed calculations, including power supply sizing calculation.
5. Other descriptive information that will assist the Engineer with assessment of the shop drawings.
6. Submit the PLC system and the operator interface system technical manuals and instruction bulletins, which shall include, but not be limited to, the following items:
   a. Complete system overview.
   b. Programming instructions
   c. Installation and start-up instructions
   d. Trouble shooting instructions
   e. Specifications of the various I/O devices
   f. Specifications of the various programming devices

1.05 Equipment Identification and Tag Numbers

All NEW apparatus, control equipment and instruments, both panel and field mounted, shall be identified by engraved laminated labels. Description on the labels and methods of attachment shall be as approved by the Engineer during shop drawing approval. Tag numbers shall conform to the current Instrument Society of America (ISA) Standards, which shall consist of a multi-letter prefix and a loop number. Tag numbers shall be assigned in the instrument lists and as indicated on the instrumentation and control (IC) drawings. Labels shall be per section 16047 – Identification.

PART 2 - PRODUCTS

2.01 General

A. See Section 13600 for the Process Control Descriptions.

B. DIN rails shall accept any mixture of inputs, outputs, communication devices etc. as required.

C. Input and output circuits shall be electrically isolated from the PLC via dry contacts and interposing relays.

D. Provide removable terminal strips to allow replacement of modules without disturbing panel wiring. Provide isolating type terminal strips.

E. LED indicators shall show status of each I/O to aid in troubleshooting.

F. Provide power supplies as required to operate and protect all I/O modules, communication cards, processors, remote I/O adapters, etc. as required. Power supplies must have at least the capacity specified in the drawings and must be capable of carrying the full power requirements of two control cabinets.

G. Provide Uninterruptible Power Supplies to ride-through power interruptions and condition power for NEW PLC and HMI devices.

2.02 Overview

A. Provide an industrial grade Open Controller style product with CPU networked to Input/Output modules.

B. The equipment must operate within the temperature range of –0 to 60 degrees C. with humidity up to 95% non-condensing.

C. The controller shall execute user entered logic instructions from memory and perform output functions as required by the logic instructions to discrete, analog, parallel, and serial data outputs.

D. The central processor unit (CPU) shall not require the use of external storage devices (i.e., disk drives) to execute user programs.

E. The controller and I/O modules shall be chassis based in design, DIN rail mounted.

2.03 Processor

A. The CPU and associated memory shall be incorporated into the same modular unit.

B. Under normal operating conditions, the memory shall retain a program for no less than six months in the event of power failure.

C. The CPU must have a time date stamp that will remain accurate to within five seconds a day even through power outages.

D. The CPU must have a memory size of 64 K minimum, with word lengths of 32 bits running at 50 MHz or higher. This memory must retain data through power outages of up to 30 days.

E. The CPU shall be capable of handling up to 1000 RS485 and 10,000 Ethernet I/O channels.

F. The PLC must be capable of data-logging based on time or on an event.

2.04 Inputs and Outputs

A. The system shall have the capacity to accommodate no less than 500 inputs or outputs. Modules and their assemblies shall contain all circuitry for interfacing inputs and outputs to the controller.

B. Modules shall be field replaceable without shutting off power.

C. The MPCP cabinet shall contain the processor, power supply, UPS and I/O modules. The following standard I/O modules shall be utilized:

1. Analog Input/Output (AI/AO): Modules shall be the source of all loop power. Accuracy shall be 0.2% over -20°C to 70°C. The Al /AO module shall have surge protection conforming to IEEE 472-1974 and C37.90-1978. The analog signal shall be 4-20 mA.
2. Discrete Input isolation. The DI modules shall have 1500V common mode optical isolation. The DI modules shall provide the voltage to the contacts. Sixteen (16) inputs per card shall be provided.
3. Discrete Output (DO). Sixteen (16) open collector outputs per card shall be provided. Interposing relays shall be provided.
4. General: All I/O AI, AO, DI, DO, shall be wired to disconnecting or fused type terminal strips.
5. If a Set-Up Module is required in order to set IP addresses. This module shall be provided with the equipment for current and future use.

2.05 Ratings

A. Electrical

1. DC Input power supplied by power supply module. Power supply powered by 120V AC input.
2. 120V AC power to be supplied by single phase UPS within control cabinet.
3. PLC module, LAN controller and I/O Input Voltage requirements: +24 VDC

B. Environmental

1. Operation Temperature: -20° C to 70° (-4° F to 158° F)
2. Storage Temperature: -20° C to 70° (-4° F to 158° F)
3. Relative Humidity: 5 to 95% noncondensing
4. Vibration: Mil Std 810C, Method 5142
5. Noise Immunity: NEMA (ICS-304)

2.06 Standards and Regulatory Agency Approvals

A. The CPU and associated racks, power supplies and I/O modules shall have major approvals including:

1. UL Listing

2.07 Power Supply and Batteries

A. Input power shall be 120VAC. Produce DC voltages for internal operation of processor and auxiliary internal functions.

B. Provide 120VAC UPS.

1. Provide MGE Pulsar Evolution 1500 tower style, or approved equal.

C. Provide diagnostic indication (LED) and alarm for UPS backing up Power Supply.

2.08 Interposing Relays

A. Provide interposing relays for inputs and outputs.

B. All relays shall be ice-cube style with octal base, with hold-in clips, DIN rail mounted type with coils, contacts, and voltage ratings as required. All contacts shall be rated 10 amps at 120 volts minimum. Relays shall have screw type wire connections.

2.09 PLC Software

A. PLC Programming Software: All PLC programming shall be accomplished using a standard software package developed for this purpose. The latest and most advanced offerings for all software packages shall be installed on the hard disk of the portable PLC programming terminal and on the operator workstation. All flow rate and run status inputs shall be totalized within the PLC registers.

B. All programming, monitoring, searching, and editing shall be accomplished using this PLC programming software. It shall be usable both on-line (while connected to the PLC) and off-line. The software shall be able to monitor the status of all inputs, outputs, timers, counters, and coils. It shall have the capability to disable/force all inputs, outputs, and coils. It shall include a search capability to locate any address or element and its program location. PLC status information, such as error indication and amount of memory remaining shall be accessible.

C. The PLC programming software shall have the capability to generate a PLC program printout, which is fully documented. Fully documented program listings shall have appropriate code with comments to clarify to a reader what that segment of the program accomplishes. A fully documented listing shall also include a cross-reference report of program addresses.

D. System Level Software: System-level software shall include a complete and unmodified operating system furnished by the CONTRACTOR that provides system-level functions as specified herein. Operating system software shall function automatically without operator intervention, except as required to establish file names and similar information. System-level software shall include a real time operating system, a calendar/time program, a file management program and a system of diagnostic routines in addition to any compilers, editors, loaders, or assemblers required to support the PLC software.

1. Operating System Software: The real-time operating system software shall be the standard product of the PLC manufacturer and shall provide the following minimum functions:
   a. Respond to demands from a program request.
   b. Dynamic allocation of the resources available in the PLC shall include main memory usage, computation time, peripheral usage, and I/O channel usage.
   c. Allotment of system resources on the basis of task priority levels such that a logical allocation of resources and suitable response times are assured.
   d. Queuing of requests in order of priority if one or more requested resources are unavailable.
   e. Resolution of contending requests for the same resource in accordance with priority.
   f. Service requests for execution of one program by another.
   g. Transfer data between programs as requested.
   h. Management of all information transfers to and from peripheral devices.
   i. Control and recovery from all program fault conditions.
   j. Diagnose and report real-time hardware device errors.
2. Program Execution: Program execution shall be scheduled on a priority basis. A multilevel priority interrupt structure is required. A program interrupted by a higher priority program shall be entered into a list of pending programs. Its execution shall be resumed once it becomes the currently highest priority program. The system shall allow periodic programs to be scheduled. The allocation of resources to a time-scheduled program shall be based on its relative priority and the availability of resources. Initiation of programs shall, as a minimum, be activated in the following ways:
   a. In response to external interrupts.
   b. At a scheduled time of the day.
   c. On an elapsed time interval basis.
   d. On request by another program.
3. Start-up and Restart: Software shall be provided which initializes and brings a PLC or any microprocessor based hardware unit from an inactive condition to a state of operational readiness. Initialization shall include determination of system status prior to start-up of initializing operating system software and initializing application software. Initialization shall also include the loading of all memory resident software, initializing timers, counters, and queues, and initialization of all dynamic database values.
4. Shutdown: The software shall provide an orderly shutdown capability for shutdowns resulting from equipment failure, including PLC processor failure, primary power failure, or a manually entered shutdown command. When the loss of primary power is sensed, a high-priority hardware interrupt shall initiate software for an immediate, orderly shutdown. When a shutdown occurs in response to a command or malfunction, the software shall control the affected hardware quickly and automatically to a secure state. The failure of the PLC shall be detected at the operator workstation level.

E. Diagnostics: Diagnostic programs shall be furnished with the PLC software package to detect and isolate hardware problems and assist maintenance personnel in discovering the causes for system failures. The manufacturer s standard diagnostic routines shall be used as much as possible. Diagnostic

software and test programs shall be furnished for each significant component in the SCADA system. Diagnostic routines shall test for power supply, central processing unit, memory, communications and I/O bus failures as a minimum.

F. Calendar/Time Program: The calendar/time program shall update the second, minute, hour, day, month, and year in the operating system and transfer accurate time and date information to all system level and application software. Variations in the number of days in each month and in leap years shall be handled automatically by the program. A master node shall maintain system time, and issue periodic time syncs to the rest of the SCADA system. A PLC shall request a time sync from the master in case of a power failure, program download or time syncs error.

G. Algorithms: PLC software shall support the implementation of algorithms for the determinations of control actions and special calculations involving analog and discrete data. These algorithms shall be capable of outputting positional or incremental control outputs or providing the product of calculations. The algorithms shall include alarm checks where appropriate. As a minimum, the following types of algorithms shall be provided:

1. A calculator algorithm, which performs functions such as summing several variables, raising to a power, roots, dividing, multiplying, and subtracting.
2. A switch algorithm, which reads the current, value from its input address and stores it as the value of its output address. Two types of switches shall be accommodated, two outputs with one input and one output with two inputs.
3. A three-mode, Proportional-Integral-Derivative (PID) controller algorithm, with each of the 3 modes independently adjustable. The algorithm shall support both direct and reverse acting modes.
4. Algorithms for lead, lag, dead time, and ratio compensators.
5. Algorithms to perform integration and totalization of analog process variables.

H. Operator Control: All programming commands related to changing system configuration or controlling field devices shall be performed only through the SCADA system and shall require more than one keystroke to protect against inadvertent operations. SCADA system configuration editing shall be password protected. This shall apply to changes in the algorithm's control sequences, and similar configuration related actions, as well as file copy and file delete commands. If any sequence requiring operator conformation, the operator shall be able to cancel the operation at any point prior to executing the command.

I. The PLC software shall be Allen Bradley RSLogix in a Windows networking environment.

J. All software and firmware shall be upgraded to the latest revision at the time of Project acceptance.

PART 3 - EXECUTION

3.01 System Installation

A. The Contractor shall provide all material and work necessary for a complete and functioning PLC system and shall have full coordination responsibility of the electrical, instrumentation and control, mechanical, and structural work as indicated in these specifications and/or shown on the drawings.

B. The Contractor shall ensure that PLC system work is properly interfaced with equipment and other work not furnished by the system provider.

C. The Contractor shall install, make final connections to, adjust, test, and start-up the complete PLC system utilizing the technical services of the system provider.

3.02 Operator Training

A. The Contractor, using the technical expertise and assistance of the PLC System Integrator and Manufacturer, shall provide operation and maintenance training for five (5) plant personnel. This training shall include, but not be limited to, the following:

1. The review of two complete sets of loose-leaf Operation and Maintenance Manuals prepared and furnished by the PLC and PC system provided through the Contractor.
2. These manuals shall contain sufficient detail to facilitate the operation, removal, installation, adjustment, calibration, and maintenance of each component provider under this section.
3. A component part list identifying recommended spare and expendable components should also be furnished.
4. The review of one set of as-built panel layout and wiring diagram drawings on reproducible mylar prepared and furnished by the PLC system provided through the contractor; drawings shall also be provided on compact disc.
5. Job site training in the operations and maintenance of each component of the PLC system.
6. This initial training must be separate from system start-up activities. Do not combine commissioning activities and training activities.
7. Demonstrate and train how to acknowledge and reset alarms, how to change alarm parameters, how to select and change selection of equipment for load shed control, how to save changes made, etc.
8. At approximately six months after substantial completion, conduct follow-up training.

B. The maximum duration of the initial training class shall be sixteen (16) hours (two eight-hour days). Follow-up training after six months shall be eight (8) hours duration.

C. The Contractor shall be responsible for all costs related to the training program, which shall include, but not be limited to, the following:

1. Travel costs.

2. Job-site location.
3. All class materials.
4. All necessary equipment and any associated rental costs.

D. Operating and instruction manuals shall be provided for each participant.

3.03 Commissioning

A. This activity shall consist of two performance tests, incorporated into overall I & C system testing and demonstration:

1. Functional Test of individual instruments and devices connected to the PLC's.
2. Operational test of all PLC programs and features, including HMI screens and Operator input features.

B. The proposed format and documentation of these tests shall be submitted to the Engineer for review and comment prior to commencement of this activity.

C. Representatives of the PLC system provider, the Contractor, the Engineer and the Owner, shall witness each test.

3.04 Closeout and Acceptance

A. The Contractor shall deliver all diskettes, program documentation, etc. to the Owner (prior to final acceptance) and shall obtain a receipt for it and provide a copy to the Engineer.

B. The Contractor shall assist the Owner with licensing of all software. The Owner shall have all original copies of software, documentation, licenses, etc.

C. The Contractor shall back-up and restore all programs and data after system is successfully placed on-line. The Contractor shall train the Owner's representatives in the back-up and restoration functions.

- END –

SECTION 13640 – INSTRUMENT PANEL AND ENCLOSURE CONSTRUCTION

PART 1 - GENERAL

1.01 Description

A. This specification covers the technical requirements for the fabrication, engineering, wiring and installation for instrument panels and enclosures.

B. The instrument panels shall be as shown on the drawings. They shall include, but shall not be limited to the following:

1. All remote/local control panels.
2. PLC-CB
3. Chemical Fill Station Control Panel (Tanks level indication and alarms)

1.02 Submittals

A. Submittals shall be as specified in the following specifications sections:

1. Section 01300: Submittals.
2. Section 13600: Instrumentation and Controls.

PART 2 - PRODUCTS

2.01 General

A. The instrument panels and enclosures shall be as follows:

1. Located in environmentally controlled (heated and ventilated) rooms, shall be steel rated NEMA 12.
2. General instrumentation and control panels located outdoors or in non-air conditioned areas shall be stainless steel rated NEMA 4X.

B. NEMA 12 enclosures shall be painted electro-statically, prior to equipment installation:

C. The exterior surfaces of a NEMA 4X stainless steel enclosure shall not be painted. The finish shall be sandblasted, roughened or chemically etched to reduce gloss, reflections & glare.

D. Conduit knockouts on the enclosure shall be made prior to installation of any equipment within the enclosure. The size and the number of conduit knockouts shall be as required. Provide malleable iron water tight conduit hubs for all NEMA 4X enclosures.

E. All enclosures exposed to weather conditions shall be provided with sun shields to protect the enclosure from direct exposure from the sun and rain.

2.02 Panel Construction

A. General

1. Stiffening members shall be provided for strength and stiffness as required.
2. Seamless welded construction shall be used throughout. All exposed seams shall be continuously welded and ground smooth.
3. Lifting rings shall be provided for panels in excess of 100 pounds.
4. Subpanels shall be provided as required, with mounting designed for easy removal. The subpanels shall be finished with 2 coats if white enamel paint.
5. Print pockets shall be attached to the interior side of each door.
6. Hinges shall be stainless steel piano type.

B. NEMA 12 Enclosures

1. NEMA 12 enclosures shall be fabricated from 12 gauge cold rolled sheet steel or better.
2. Double doors shall be of the flush type construction with continuous hinge and gasket.
3. Doors shall be equipped with three-point latching mechanism and door locks.
4. Corrosion inhibitors shall be furnished for corrosion control inside the panel.

C. NEMA 4X Enclosures

1. Nema 4X enclosures shall be fabricated from 14 gauge stainless steel or better.
2. Enclosure door shall be provided with neoprene gasket, which shall be attached to the enclosure with oil-resistant adhesive, and held in place with stainless steel retaining strips.
3. Door clamps shall be provided on three sides of the enclosure door.
4. A hasp and staple shall be provided for padlocking.
5. Panel heaters, corrosion inhibitors and breather drains shall be furnished for condensation and corrosion control inside the panel. Panel heaters shall be of the forced air types, provided with integral thermostat control.

2.03 Panel Grounding

A. Where noted or specified, provide a ground bus tied to the facility grounding system.

1. The ground busbars shall be of nickel-plated copper, rated for at least 100 amperes.
2. The busbar shall be provided with two (2) screw clamp terminal blocks, which shall be capable of accepting conductors up to #2 AWG.
3. The busbar shall be provided with a minimum of twenty (20) screw clamp terminal blocks, which shall be capable of accepting conductors up to #10 AWG.

2.04 Panel Wiring

A. Wiring within the enclosure shall be continuous and shall be terminated only at terminal blocks or equipment terminals.

B. Not more than two wires shall be terminated at any terminal.

C. Wiring splices and wire nuts will not be permitted within the enclosure.

D. Wiring within the enclosure shall be protected as follows:

1. In general, all wiring within the enclosure shall be put in plastic wiring ducts. Wiring ducts shall be sized to include 100% (percent) spare capacity.
2. Wiring outside of the ducts shall be restrained by means of plastic ties.
3. Wiring passing a door hinge shall be grouped and wrapped in a protective wire harness.
4. Provide abrasion protection for any wire bundles passing through holes or across sheet metal edges.

E. In general, wiring within the enclosure shall be as follows:

1. 120VAC control wiring within and external to the enclosure shall be #14 AWG stranded.
2. DC control wiring within the enclosure shall be #16 AWG stranded.
3. Wiring for long distance DC signals shall be #14 AWG stranded.
4. Wiring for 4-20 mA DC analog signals shall be #16 AWG twisted shielded pair.

F. In general, wiring within the enclosure shall follow the following color convention to comply with NFPA 79 (1994), part 16.

G. AC and DC wiring shall be separated from each other. Where AC and DC wire runs parallel, the minimum separation between them shall be four (4) inches. Where AC and DC wire runs cross, they shall cross at 90°. Provide separate wiring duct for AC and DC wiring.

H. Equipment and signal ground wiring, as well as Neutral wiring, shall not be daisy-chained; they shall each be terminated at isolated, bussed terminal blocks.

I. Each conductor end shall be terminated at a terminal block or at an equipment wiring terminal. Each terminal block shall have a unique identification number. The terminal blocks shall be arranged and numbered in consecutive order, based on standard alpha-numeric order.

J. Terminal blocks within each enclosure shall be grouped for the voltage and type of circuit connected.

K. Provide 25% spare terminal blocks (minimum of six) for each type used in each enclosure.

2.05 Terminal Blocks

A. Terminal blocks within enclosures shall be of the high density modular types, constructed of nylon material, suitable for mounting on standard DIN rails. Termination type shall be tubular screw with serrated pressure plate. The terminal block system shall be manufactured by Phoenix Contact, Weidmuller, or pre-approved equal.

B. All current carrying parts (metal bodies) shall be made of nickel/tin-plated copper.

C. Ground terminals shall be color coded in accordance with international standard, which shall be yellow/green.

D. Matching jumper bridges shall be color coded to the wiring colors.

E. Panel power distribution fused terminal blocks shall be provided with disconnect lever puller mechanism and illuminated indication.

2.06 Panel Accessories

A. The Systems Integrator/enclosure fabricator shall be responsible for all accessories, including interposing relays, analog signal isolators, terminal blocks, power distribution blocks, grounding blocks, fuse blocks and fuses, circuit breakers, duplex receptacle, heaters, exhaust fans, louvers and filters, DIN mounting rails, plastic wiring channels, hardware, wire tags, engraved nameplates, and all such accessories needed for a professional class panel fabrication.

2.07 Pilot and Control Devices

A. Pilot Devices: Pushbuttons, selector switches, and indicating lights shall be 30.5mm, rated heavy-duty, oiltight, or watertight and corrosion resistant as required. All units shall be furnished with standard size legend plates with legends as indicated on the project Drawings.

B. For Class 1, Division 2 areas, devices shall either be explosion proof type, or all contacts and other items which may arc or spark shall be hermetically sealed. Hermetically sealed contacts and devices shall meet the current and voltage ratings required for the circuit.

C. Selector switches shall have the number of positions, switching arrangement, number and type of contact blocks indicated on the project Drawings.

D. Contact blocks shall have a minimum continuous current rating of 10 amperes at 240 VAC. Contact blocks shall have screw type connection terminals.

E. Indicating lights shall be LED type only. Provide flashing type lights where indicated.

F. Pilot device manufacturers shall be:

1. Square D, Class 9001, Type K
2. Allen-Bradley Bulletin 800H or 800T
3. General Electric type CR104P

G. Control relays shall be plug-in type with sockets and hold-in clips. Sockets shall have screw terminals. Contacts shall be silver-cadmium, rated 10 amperes at 240 VAC. Relays shall have as a minimum two pole, double throw contacts (2PDT). Relays shall have a manual operator and miniature pilot light. Coil voltages shall be

120 VAC, or as noted on the project Drawings. Relays shall be as manufactured by Allen-Bradley Bulletin 700, Type HA or HB, Square D, Idec, or approved equal.

H. Latching relays shall be similar to the control relays. Relay position shall be magnetically held, and shall be the single coil type.

I. Timing relays shall be solid sate, plug-in type with screw terminal sockets. Each relay shall have 5 adjustable timing ranges, switch selectable, and 4 timing modes, switch selectable. Timing ranges shall allow from 0.05 seconds to 999 minutes timing. Timing modes shall be ON delay, OFF delay, ONE SHOT, and REPEAT CYCLE. Output contacts shall be DPDT, rated 10 ampere at 240 VAC. Timing setting shall be by thumbwheel switches. Coil voltages shall be 120VAC, or as noted on the project Drawings.

J. Elapsed Time Totalizers (ETT's) shall be the synchronous motor driven type with digital readout to indicate the total time a piece of equipment is energized. Totalizer shall have a minimum of six digit wheels including a 1/10 digit wheel to provide the range of time measured in hours, unless noted otherwise. Units shall be non-resettable, and operate on 120V, 1 phase, 60 Hz. Elapsed Time Meter (ETM) shall be considered synonymous with Elapsed Time Totalizer (ETT).

2.08 Equipment Identification and Wire Tagging

A. All equipment and wiring identifications shall conform to and be compatible with the Owner's current labeling system, and shall be completed prior to final acceptance of the work. It is the responsibility of the Contractor to coordinate with the Owner's Engineer, to obtain from him or her, all labeling standards and documentation.

B. All control wiring shall be identified by means of computer-generated, heat shrink type wire marker. Wire numbers shall be as shown on the drawings.

C. Each component mounted within the enclosure shall be provided with equipment identification. Equipment and device nameplates or identification shall be of engraved laminated plastic, with black lettering on white background. Nameplates shall be as listed herein or as shown on the project Drawings.

D. The enclosure vendor shall be responsible for providing and sizing all instrument loop power supplies. The instrument loop power supplies shall be sized to include at least 100% spare capacity. The enclosure vendor shall submit power supply load calculations with the panel shop drawings.

2.09 Regulated Power Supply

A. When DC power supply is required for PLC discrete inputs, and 2-wire analog loops, provide at least two redundant 24 V DC regulated power supplies.

B. The power supply shall be sized to include 100% spare capacity.

C. Acceptable power supply manufacturers:

1. Phoenix Contact

2. SOLA
3. Approved equal

2.10 Uninterruptible 120VAC Power Supply

A. When panels include a programmable controller or computer, provide an uninterruptible power supply to condition incoming power and ride-through utility power interruptions.

B. Acceptable power supply manufacturers:

1. MGE Pulsar Evolution or approved equal.

2.11 Process Indicators

A. All process instruments shall be provided with integral or separately mounted local indicators. Separately mounted indicators shall be used in instances where the instrument is installed in an out of view location such as on a ceiling or low to the floor, or in congested areas where the viewing of the indicator is difficult. Provide process indicators at the following panels:

1. PLC-CB (2 x Chemical Tank Levels)
2. Chemical Fill Station Control Panel (6 x Chemical Tank Levels)

B. All indicators shall be scaled in engineering units and units shall have integral scaling factors for displaying engineering units. Nameplates shall indicate range for the instrument.

C. Provide NEMA 4X stainless steel or non-metallic enclosures for instruments installed in corrosive environments, in outdoor locations, and as noted on the drawings. Provide NEMA 1 or NEMA 12 enclosures for instruments installed indoors, in dry, de-humidified (air conditioned), non-corrosive locations. Provide NEMA 4X enclosures for instruments installed in indoor damp, wet, and corrosive locations, and as indicated on the drawings. Provide NEMA 7 explosion-proof enclosures and intrinsic safety barriers for instruments installed in explosive or potentially explosive, Class I, Div. 1 and Class I, Div. 2 locations, and as indicated on the drawings.

D. Level indicators and level indicating transmitters shall have the local elevation of the zero depth (i.e. 0’-0” = 800’-0” USGS elevation) engraved or otherwise permanently indicated on the indicator nameplate.

E. Displays shall have 4.5 digits, minimum 0.5” high, and shall be high intensity LED or backlighted LCD.

F. Indicators may be loop powered or operate on 120VAC, as indicated on the drawings. Provide integral power supplies.

G. Provide mounting hardware, brackets, clamps, and similar accessories required for a permanent and professional installation. All such hardware and mounting devices shall match the enclosure of the instrument with regard to corrosion resistance.

H. Provide output relays with contacts rated 2 amperes at 250VAC, form C or as required, with 0% to 100% adjustable deadband and selectable for automatic or manual reset.

I. Provide isolated 4-20mADC analog outputs capable of driving a loop of 800-ohm maximum resistance.

J. Flow indicators shall be combination rate and totalizer type units (FIQ) and shall have 6 digits and shall indicate current flow rate and accumulated flow totals.

K. All setup, scaling, and totalizer values shall be stored in nonvolatile memory without need for battery back up.

L. All instruments shall be rated for operation from –30 degrees F to 140 degrees F with a relative humidity of 0% to 90% noncondensing. Provided insulated enclosures with heaters and thermostats for outdoor operation where required.

PART 3 - EXECUTION

3.01 General

A. All panels shall be installed level and plumb.

B. Installation Hardware

1. All nuts and bolts shall be stainless steel.
2. Support channels mount externally, or mounted in a corrosive atmosphere, shall be either reinforced fiberglass or stainless steel unistrut channels. All cuts and holes on fiberglass unistrut channels shall be coated with appropriate resin coating to protect them from deterioration.
3. Do not mount equipment directly to masonry or concrete walls. Provide unistrut channels on wall.
4. All equipment mounting plates shall be of 0.25-inch thick minimum clear anodized aluminum.
5. All contact surfaces between dissimilar metals shall be gasketed to prevent galvanic reaction.

C. Touch up all nicks, scratches, etc. with materials as recommended by the enclosure manufacturer.

- END -

SECTION 13700 – CHEMICAL STORAGE TANKS

PART 1 – GENERAL

1.01 Description

A. Scope: Furnish and install integrally molded flanged outlet, high density crosslinked polyethylene tanks and accessories as specified and shown on the drawings. The chemical storage tanks and accessories specified in this section shall be provided by the same supplier providing the equipment specified in Section 11740 – Chemical Feed Pumps. Compliance with the requirements and stipulations specified herein may necessitate modifications to the manufacturer's standard equipment. In addition, the Contractor shall be responsible for ensuring a complete and operable chemical feed system and shall establish the exact limits of work between the Contractor and the equipment supplier.

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto. Latest revisions shall apply unless otherwise shown or specified.

C. Reference Codes and Standards:

1. ASTM D 638 – Tensile Properties of Plastics
2. ASTM D 883 – Standard Definition of Terms Relating to Plastics
3. ASTM D 1505 – Density of Plastics by the Density-Gradient Technique
4. ASTM D 1525 – Test Method for Vicat Softening Temperature of Plastics
5. ASTM D 1693 – ESCR Specification Thickness 0.125" F50-10% Igepal
6. ASTM F 412 – Standard Terminology Relating to Plastic Systems
7. ANSI Standards – B-16.5, Pipe Flanges and Flanged Fittings
8. Building Code: Uniform Building Code, [1997 J Edition]/IBC 2000
9. ARM: Low Temperature Impact Resistance (Falling Dart Test Procedure)

1.02 Quality Assurance

A. The manufacturer shall be regularly engaged in the design and manufacturer of chemical storage tank for a minimum of 10 years.

B. Tanks shall be manufactured from virgin materials.

C. Factory Testing

1. Material Testing
   a. Perform gel and low temperature impact tests in accordance with ASTM D 1998 on condition samples cut from each polyethylene chemical storage tank.
   b. Degree of Crosslinking: Use Method C of ASTM D 1998 – Section 11.4 to determine the orthoxylene insoluble fraction of crosslinked polyethylene gel test. Samples shall test at no less than 60%.

2. Tank Testing
   a. Dimensions: Take exeterior dimensions with the tank empty, in the vertical position. Outside diameter tolerance, including out-of-roundness, shall be per ASTM D 1998. Fitting placement tolerance shall be +/- ½" in vertical and +/- 1 degree radial.
   b. Visual: Inspect for foreign inclusions, air bubbles, pimples, crazing, cracking and delamination.
   c. Hydrostatic Test: Following fabrication, the bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top sidewall for a minimum of ½ hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to shipment.

1.03 Submittals

A. Submittals shall include information and materials specified in this Section, the General Conditions, and Section 01300, Submittals.

B. Submit the following for the Engineer's review and approval:

1. Integrally molded flanged outlet tank and Fitting Material
   c. Resin Manufacturer Data Sheet
   d. Fitting Material
   e. Gasket Style and Material
   f. Bolt Material
2. Dimensioned Tank Drawings
   a. Locations and orientation of molded in fitting openings, fittings, accessories, restraints and supports.
   b. Details of inlet and molded outlet fitting manways, flexible connections and vents.
3. Calculations and restraints shall be in accordance with the current code 2012 IBC (international Building Code).
4. Copy of manufacturer's standard warranty for each type of equipment provided.
5. Manufacturer's unloading procedure.
6. Manufacturer's instllation instructions.
7. Supporting information of Quality Management System.
8. Manufacturer's Qualifications: Submit to engineer a list of five (5) installations in the same service as proof of manufacturer's qualifications.
9. Factory Test Report:
   a. Material, specific gravity rating at 600 psi @ 100ºF, design hoop stress.
   b. Wall thickness verification.
   c. Fitting placement verfification including molded in outlet.
   d. Visual inspection.
   e. Impact test.
   f. Gel test.
   g. Hydrostatic test.

10. List of which components and materials shall be shipped preassembled and parts list for the other components and materials. Weights and physical dimensions shall be indicated for each part, assembly, and/or package to be shipped.

12. Manufacturer's operation and maintenance (O & M) manuals and materials. When numerous types and sizes are shown, the manuals shall be marked to clearly indicate the sizes and type specific to this project. Provide four (4) bound hard copy sets and two (2) CD's with complete electronic copy in pdf format – see Section 01300. O&M manuals must be received and reviewed by the Engineer prior to the equipment being put into permanent operation.
13. Provide start-up certification report specified in this Section.

1.04 Product Delivery, Storage, and Handling

4. The tank shall be shipped upright or lying down on their sides with blocks and slings to keep them from moving. Avoid sharp objects on trailers.

5. All fittings shall be installed and, if necessary, removed for shipping and shipped separately unless otherwise noted by the contractor.

6. Upon arrival at the destination, inspect the tank(s) and accessories for damage in transit. If damage has occurred, manufacturer shall be notified immediately.

7. The Contractor shall be responsible for the delivery, storage, and handling of products. Store products in accordance with manufacturer's recommended procedures.

8. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 – PRODUCTS

2.01 General

Tanks shall be rotationally-molded, integrally molded flanged outlet, high density crosslinked polyethylene, one-piece seamless construction, cylindrical in cross-section and vertical with flat / sloping bottoms in axis. Tanks shall be adequately vented as prescribed by manufacturer's venting bulletin. Where indicated, tanks shall be provided with ancillary mechanical fittings and accessories. Tanks shall be marked to identify the manufacturer, date of manufacture and serial numbers must be permanently embossed into the tank.

2.02 Polyethylene Storage Tanks

A. High Density Crosslinked Polyethylene resin used in the tank manufacture shall be by Exxon Mobil Chemicals or equal and shall contain ultraviolet stabilizer as recommended by resin manufacturer. Where black tanks are indicated, the resin shall have a carbon black compounded into it. The tank material shall be rotationally molded and meet or exceed the following properties:

Property	Type I XLPE	ASTM Test
Environmental Stress Cracking Resistance, F50, hours, 10% Igepal	>1,000	D1693
Tensile Strength, Ultimate psi, 2-inch/minimum	2,600	D638 Type IV Specimen
Elongation at Break, % ,2-inch minimum	400	D638 Type IV Specimen
Flexural Modulus, psi	100,000	D790

B. Wall thickness for a given hoop stress is to be calculated in accordance with ASTM D 1998. Tanks shall be designed using a hoop stress no greater than 600 psi. In NO case shall the tank thickness be less than design requirements per ASTM D 1998.

1. The wall thickness of any cylindrical portion at any fluid level shall be determined by the following equation:

   $T = P \times OD/2SD$ or $0.433 \times SG \times H \times OD/2SD$

   Where:
   - T = wall thickness, in
   - P = pressure, psi
   - SG = specific gravity, gm/cc
   - H = fluid head, ft
   - OD = outside diameter, ft
   - SD = hydrostatic design stress, 600 psi

   a. The minimum wall thickness shall be sufficient to support its own weight in an upright position without external support but shall not be less than 0.187" thick.
2. On closed top tanks the top head shall be integrally molded with the cylindrical wall. Its minimum thickness shall be equal to the thickness of the top of the straight sidewall. In most cases, flat areas shall be provided for attachment of large fittings on the dome of the tank.
3. The bottom head shall be integrally molded with the cylindrical wall. Knuckle radius shall be:

Tank Diameter, ft	Min Knuckle Radius, in
less than or equal to 6	1
greater than 6	1-1/2

C. Tanks with 3000 gal capacity or larger shall have at least 3 lifting lugs. Lugs shall be designed for lifting the tank when empty.

a. Unless otherwise indicated, manways shall be 19-in diameter or greater and equipped with an emergency pressure relief device.
b. Unless otherwise indicated, bolted sealed top manway shall be 19- inches or greater and be in locations easily accessible from the nearest worker access position. The sealed manway shall be constructed of polyethylene material. The bolts shall be chemically compatible with the chemical being stored. Gaskets shall be closed cell, crosslinked polyethylene foam, Viton, or EPDM materials.

D. Tank colors shall be natural (unpigmented), black (pigmented), or opaque colors as specified on the Data Sheet herein.

2.03 Tank Accessories

A. Ladder

1. Fiberglass access ladders shall be provided with the polyethylene chemical storage tanks at locations as shown. Use proper chemical resistant materials when anchoring to tank dome or sidewall. Safety cages shall be added to ladders as required. Ladders must be designed to OSHA standard 2206; 1910.27.
2. Ladders must be secured to the tank and secured to the concrete to allow for tank expansion / contraction due to temperature and loading changes per manufacturer's recommendations.
3. All ladders shall be designed to meet applicable OSHA standards. Reference: OSHA 2206; 1910.27; fixed ladders.

B. Restraint System

1. Metal components shall be stainless steel and tension ring with stainless steel cables and clamps.
2. Seismic system shall be designed to meet the proper seismic zone and specified wind load.

2.04 Tanks

A. Tanks Schedule: Tanks shall be as shown on the drawings and specified herein.

B. Fittings

1. Tank fittings shall be as shown on the Drawings. Fitting, gasket and bolt material shall be as specified herein or a material that is compatible with the product being stored and shall be a minimum of ¼" thick. Threaded fittings shall use American Standard Pipe Threads.
2. Bolted flange fittings shall be constructed with one 150-lb flange, one 150-lb flange gasket, and the correct number of all-thread bolts. The head of the bolts shall be encapsulated with polyethylene preventing fluid contact with the metal material. Encapsulated heads shall have a gasket to provide a sealing surface

against the inner wall of the tank. Bolt holes shall straddle the principal centerline of the tank.

3. Integrally Molded Flanged Outlet Fittings: These outlets shall be an integral part of the tank, molded from the same material as the tank and provide complete drainage of liquid through the sidewall of the tank. Metal and alloy inserts shall not be used. The tank should be properly supported- either with a high density crosslinked polyethylene cushion or a concrete pad designed for the fitting. Outlet should include Flexjoint expansion joint or equivalent to reduce vibration stress.
4. Down Pipes and Fill Pipes: Down pipes and fill pipes shall be supported at 6-ft max intervals. Down pipes and fill pipes shall be PVC or material compatible with the chemical stored.
5. U-Vents: Each tank must be vented for the material and flow and withdrawal rates expected. Vents should comply with OSHA 1910.106(F)(iii)(2)(IV)(9). U-vents shall be sized by the tank manufacturer.
6. Flange Adapters: Adapters may be used to adapt threaded or socket fitting components to 150-lb flange connections. Adapters shall be of material compatible with the chemical stored.
7. Flexible Connections: Provide flexible connectors on all tank sidewall fittings located on the lower 1/3 of the tank. Flexible connector material shall be compatible with the product being stored.

2.05 Level Indication

A. Float Indication: The level indicator shall be assembled to the tank and shall consist of PVC float, indicator, polypropylene rope, perforated interior pipe, PVC roller guides, clear PVC sight tube and necessary pipe supports. The level indicator shall act inversely to the tank contents and shall not allow entrance of tank contents into the sight tube at any time.
B. Ultrasonic Level Indication: Provide ultrasonic level indicator suitable for service in a non-hazardous/hazardous environment.

PART 3 - EXECUTION

3.01 Installation

A. All equipment shall be installed in accordance with the drawings, manufacturer's written instructions, and in accordance with all state and local codes, ordinances and regulations.

B. Lubricate all moving parts as recommended by the manufacturer’s written instructions.

C. Make sure that all equipment is securely anchored. Also, make certain that all connections are tight.

D. Install units level and plumb to ensure the units are uniformly supported.

3.02 Cleaning Up

Upon completion of work, the Contractor shall remove all construction equipment and temporary materials, and he shall also dispose of all rubbish and other unsightly debris caused by operations and shall leave the premises in as good or better condition than found.

3.03 Field Testing

A. Hydrostatic Test: The bottom tanks, including inlet and outlet fittings, shall be hydraulically tested with water by filling to the top of sidewall for a minimum of ½ hour and inspected for leaks. Following successful testing, the tank shall be emptied and cleaned prior to commissioning.

3.04 Manufacturer's Service and Start-Up Certification Report

A. The Contractor shall provide the services of a qualified representative of the manufacturer for a minimum of one (1) day to perform the following tasks:

1. Inspect the installation of the equipment.
2. Place the equipment in operation and make any necessary adjustments.
3. Perform tests specified in this Section and recommended by the equipment manufacturer.
4. Instruct Owner's personnel in the proper operation and maintenance (O & M) of the equipment (training).

B. If equipment is not completed for proper start-up and training procedures, the representative shall reschedule another visit at no additional cost to the Owner. Training will not be permitted without prior start-up and proper operation of the equipment. Training shall be performed separate and distinct from start-up and testing tasks. An abstract or outline of the start-up, testing and training procedures shall be provided to the Engineer at least five days prior to the scheduled visit. Manufacturer’s operation and maintenance manuals and materials shall be incorporated in the training procedures, with emphasis on items or materials or greatest importance.

C. A typed, bound report covering the manufacturer's representative's findings shall be submitted to the Engineer for review and approval. The report shall:

1. Describe the start-up procedures taken;
2. Include any inspections performed;
3. Outline in detail any deficiencies observed along with the corrective measures taken; and
4. Include the results of all field tests, including necessary graphs, charts, tables, etc., specified in this Section or required by the referenced standards. The report shall certify that the equipment is properly installed and functioning for the purpose intended. The report must be received and reviewed by the Engineer prior to the equipment being put into permanent operation.

D. The Contractor shall bear all expenses associated with the start-up, testing, and training procedures and report described above, including labor, transportation, lodging, and material costs.

3.05 Warranty

The Contractor shall guarantee the equipment to be free from defective material and workmanship for a period of one year from the date of acceptance of the equipment by the Owner. The Contractor shall replace any defective materials, components, or workmanship during this time, including but not limited to all materials, labor, shipping, and transportation, at no additional cost to the Owner. Any repair work performed during this one year period shall also be guaranteed to be free from defective material or workmanship for a period of one year from the date the work is complete and shall be addressed in the same manner at no additional cost to the Owner.

3.06 Acceptance of Equipment

Refer to Section 01650, Starting of Systems, for acceptance of equipment by Owner.

DATA SHEET

CHEMICAL STORAGE TANKS

1. TITLE:	Sodium Aluminate Storage Tank
2. LOCATION:	New Chemical Feed Building
3. QUANTITY:	Two (2)
4. CAPACITY:	4,600 gal each
5. NOMINAL DIAMETER:	10'-2"
6. OVERALL HEIGHT[1]:	9'-6.75"
7. COLOR:	Natural
8. INSULATION:	No
9. CHEMICAL STORED:	Sodium Aluminate, 38%
10. FLUID OPERATING TEMP:	Ambient
11. TANK SPECIFIC GRAVITY:	1.65
12. RESIN:	XLPE with OR-1000
13. FITTING MATERIAL:	PVC
14. GASKET MATERIAL:	EPDM
15. BOLT MATERIAL:	316SS
16. MANUFACTURER:	PolyProcessing Company; Base Bid

[1]Approximate overall height is measured along the straight cylindrical portion of the tank and includes the dome top.

-END-

DIVISION 15 - MECHANICAL

SECTION 15010 - GENERAL PROVISIONS

PART 1 - GENERAL

1.01 Scope

A. Refer to Drawings and Specifications for other Divisions of Work to determine and coordinate other materials and conditions affecting Division 15 Work.

B. Before purchase of any equipment or specialties, verify that the proposed equipment can be installed as shown in the related Drawings. The use of equipment requiring different connections or being of a shape or size other than that shown on the Drawings or specified herein, shall not constitute sufficient grounds for additional claims. Include costs for all additional and/or varying requirements of proposed equipment in the Bid.

1.02 Codes and Standards

A. All mechanical work installed under this contract shall conform to current codes and standards and all applicable requirements of Federal, State, and Local Authorities having jurisdiction, including OSHA standards.

B. Obtain all licenses, permits, etc., as required and bear complete cost of same. All materials shall be manufactured and tested in accordance with latest editions of U.L., ANSI and respective Association Standards. U.L. labeling shall be provided where specified for specific items.

C. Owner's Requirements or Regulations pertaining to safety, fire, conduct, parking, sanitary conditions, smoking, etc., shall be strictly adhered to by all Contractors and their employees and Subcontractors on the project.

1.03 Mechanical Reference Symbols and Details

A. Plumbing symbols and details are included on the Drawings.

B. Standard Details are typical and as such are subject to minor variations to suit specific job conditions.

1.04 Domestic Product Requirements

All steel and foundry products provided for in this project, including ferrous and non-ferrous metals, piping, fittings, and piping related products, shall be manufactured in the United States.

PART 2 - PRODUCTS

2.01 All materials shall be new unless use of an existing item is indicated on the Drawings or approved in writing by Engineer. Materials shall be best grade of each representative type, and of domestic manufacture. All pipe, fittings, and valves shall be, as a minimum, of service class suitable for working and test pressure for which they will be used, rated for respective media handled and shall comply with applicable code requirements.

2.02 Shop drawings shall show manufacturer's name, trade names, catalogue numbers, accessories, special features, and rating data.

PART 3 - EXECUTION

3.01 Notifications

A. Notify of installation requirements and schedule of trades that perform Work to be connected to mechanical systems and trades that perform do preparatory Work for mechanical systems.

B. Inform Engineer of installation schedule to allow sufficient time for inspecting without delaying work.

C. Coordinate Work to avoid cutting work in place and to avoid interference with other work.

D. Inform personnel performing mechanical Work as to the requirements and availability of the applicable specifications and codes.

3.02 Protection

A. Handle Mechanical Systems items to avoid injury to persons and to avoid damage to materials or to completed Work. Satisfactorily repair or remove and replace Work that has been damaged.

B. Plug or cap pipes and fittings, when not in use, to prevent entrance of extraneous material. Cover or encase equipment and finished materials to prevent soiling, staining or damage.

C. Cover trenches and holes when not in use.

3.03 Delivering and Storing

A. Deliver mechanical system accessories, small unmarked parts, adhesives, mechanical items to site in manufacturer's original unopened, labeled containers.

B. Store materials and equipment to prevent damage and injury. Store ferrous materials to prevent rusting. Store equipment to prevent staining and discoloring.

3.04 Design Drawings

A. Design Drawings are diagrammatic and indicate relation of piping, connections and equipment. Do not deviate from basic requirements of Drawing without prior approval from Engineer.

3.05 Installation

A. All installation of mechanical systems shall be accomplished by mechanics thoroughly skilled in trades involved.

3.06 Cleaning Up

A. At all times keep the premises free from accumulations of waste materials, or rubbish caused by his operations. At the completion of his work, leave the project site in a clean condition.

-END-

SECTION 15060 – PROCESS AND YARD PIPING

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and install all pipe, fittings and appurtenances necessary to complete Work shown or specified.

B. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.

C. Definitions

1. Abbreviations
   a. AASHTO - American Association of State Highway and Transportation Officials
   b. ANSI - American National Standards Institute
   c. ASTM - American Society for Testing & Materials
   d. AWWA - American Water Works Association
   e. PFI - Pipe Fabricators Institute
2. All pipe, fittings and references to pipe diameter on the drawings or in specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.02 Quality Assurance

A. Mark pipe and fittings according to the applicable specification or standard.

B. Perform factory and field tests in accordance with the applicable specification or standard.

1.03 Submittals

A. Submittals shall be as specified in the General Conditions.

B. Submit shop drawings with performance data, physical characteristics, data on accessories, and dimensioned layouts of piping and valves.

1.04 Product Delivery, Storage and Handling

A. The Contractor is responsible for the delivery, storage and handling of products.

B. Load and unload all pipe, fittings and appurtenances by hoists or skidding, and do not drop, skid or roll products. Pad slings, hooks and pipe tongs, and use in such a manner to prevent damage to the products

C. Keep stored products safe from damage or deterioration. Keep the interior of pipe, fittings and appurtenances free from dirt or foreign matter. Store gaskets, plastic pipe and fittings, and other products, which deteriorate by sunlight, in a cool

location out of direct sunlight. Gaskets shall not come in contact with petroleum products.

D. Do not stack ductile iron pipe higher than the limits shown in ANSI/AWWA C600. Stacking of cast iron, clay, concrete, copper, plastic and steel pipe shall meet the requirements of the pipe manufacturer. Do not stack fittings.

E. Promptly remove damaged products from the job site and replace with undamaged products at no cost to the owner.

PART 2 - PRODUCTS

2.01 General

A. All pipe, fittings and appurtenances shall be as shown on the drawings or as required by the manufacturer and ANSI/AWWA specifications. All pipe, fittings and appurtenances shall be new and unused.

B. Public Work Projects – steel or foundry products used or supplied in performance of the contract shall be U.S. manufactured steel products in accordance with IC.5-16-8-2

2.02 Buried Yard Piping and Fittings

A. Ductile Iron Pipe and Fittings

1. Pipe
   a. Ductile iron pipe shall meet the requirements of ANSI/AWWA C151/A21.51-91. Design and manufacture pipe for a working pressure of 150 psi plus a 100 psi surge pressure. Additionally, a safety factor of 2.0 and a depth of cover, indicated on the drawings or as required by manufacturer and ANSI/AWWA specification, shall be included. Minimum pressure class shall be as follows:

Size Range	Minimum Pressure Class
All Sizes	150 psi

   b. Pipe joints shall be push-on type meeting the requirements of ANSI/AWWA C110/A21.11.
2. Fittings
   a. Fittings shall be ductile iron. Fittings for standard size pipe shall meet the requirements of ANSI/AWWA C110/A21.10. Compact or short body fittings, 3 inches through 24 inches shall meet the requirements of ANSI/AWWA C153/A21.53. Design and manufacture fittings for a pressure rating of at least 150 psi.
   b. Fitting joints shall be mechanical joints meeting the requirements of ANSI/AWWA C110 /A21.11.
3. Adapters
   a. Adapters from push-on or mechanical joint ductile iron pipe to flange joint valves or fittings shall be ductile iron. Adapters shall meet the requirements

of ANSI/AWWA C110. Design and manufacture adapters for a pressure rating of 150 psi.

b. Adapter ends connecting to ductile iron pipe shall be one of the following: plain-end-push-on joint; mechanical joint; or restrained push-on joint. Adapters with plain-end-push-on joints or mechanical joints may be used when restrained joints are not required. Adapters shall have restrained joints when the distance to a valve or fitting falls within the length shown on the restrained joint detail in the Drawings. Mechanical joints and push-on joints shall meet the requirements of ANSI/AWWA C111/A21.11.

c. Adapter ends connecting to flange joint valves or fittings shall have joints complying with the specifications for the applicable valves or fittings.

4. Line the inside surfaces of all pipe, fittings and adapters for liquid service with a single cement mortar lining and bituminous seal coat. Cement mortar lining and seal coat shall meet the requirements of ANSI/AWWA C104. Pipe, fittings and adaptors for air and gas lines shall be unlined. Coat the outside surfaces of all pipe, fittings and adapters with coating complying with ANSI/AWWA C151.

5. Gaskets for mechanical joints and push-on joints for water and wastewater service shall meet the requirements of ANSI/AWWA C111/A21.11.

6. Nuts and Bolts

a. Nuts and bolts for mechanical joints shall be high strength, heat treated, alloy steel. Nuts shall be hexagon nuts, and bolts shall be tee head bolts. Nuts and bolts shall meet the requirements of ANSI/AWWA C111/A21.11.

b. Nuts and bolts for restrained push-on joints shall meet the requirements of the joint manufacturer.

B. Polyvinyl Chloride Pipe and Fittings, 6-inches and Smaller

1. Pipe and Fittings

a. Pipe and fittings shall be manufactured from unplasticized, Class 12454 polyvinyl chloride meeting the requirements of ASTM D1784.

b. Polyvinyl chloride pipe shall conform to ASTM D2241.

c. Polyvinyl chloride fittings shall meet the requirements of ASTM D2466.

d. Pipe and fittings shall be Schedule 80 or SDR21 and obtained from one manufacturer. SDR21 pipe and fittings shall be rated for 200 psi and be bell and socket gasket joints meeting ASTM D3139, with elastomeric gaskets meeting ASTM F477. Schedule 80 pipe and fittings shall be used for sodium hypochlorite service only, joints shall be socket, solvent weld type.

2. Welding rods shall be of the same material as pipe and fittings.

3. Primer shall be stabilized tetrahydroftiran, or a primer approved by the Engineer and supplied by the pipe and fitting manufacturer, for hot, windy conditions.

4. Solvent joint cement shall meet the requirements of ASTM D2564. Cement containers shall be no larger than 1 pint and have a dauber secured to the container lid.

C. PVC Double Containment Piping System

1. Furnish a complete double-containment piping system including piping, fittings, anchors, terminations, access tees, carrier pipe supports and associated pipe joining method. The system shall be designed, fabricated and installed to meet ASME/ANSI B31.3.

2. Carrier pipe and containment pipe shall be Schedule 80 PVC. Pipe shall be Iron Pipe Size Dimensions manufactured in accordance with ASTM D 1785. Fittings shall be produced in accordance with ASTM D-2467. Containment pipe shall be at least 2 sizes larger than carrier pipe.
3. Supports and guides for carrier pipe shall be provided of same resin as carrier pipe. Supports shall be placed in a manner that a maximum of 0.1" deflection is allowed between supports. Supports shall allow axial movement of carrier pipe within containment pipe. Supports shall maintain a concentric relationship between carrier pipe and containment pipe.
4. Low-point drains shall provide adequate flows to completely drain annular space. Drains shall be located per contract drawings and be of same resin as carrier pipe.

2.03 Exposed Pipe and Fittings

A. Polyvinyl Chloride Pipe and Fittings

1. Pipe and Fittings
   a. Pipe and fittings shall be manufactured from unplasticized, Class 12454-B polyvinyl chloride, corresponding to ASTM D1784.
   b. Polyvinyl chloride pipe shall correlate with ASTM D1785.
   c Pipe and fittings shall be Schedule 80 Pipe. Fitting joints shall be socket, solvent weld. Fittings for pipe connecting to diaphragm valves shall be flanged.
   d. Socket, solvent weld fittings shall meet ASTM D2467.
   e. Flanges shall be polyvinyl chloride, 150 pounds and flat face, with ANSI Drilling.
   g. Pipe and fittings shall be obtained from one manufacturer.
2. Primer shall be stabilized tetrahydrofuran, or a primer approved by the Engineer and supplied by the pipe and fitting manufacturer, for hot, windy conditions.
3. Solvent joint cement shall comply with ASTM D2564 Cement containers shall be no larger than 1 pint and shall have a dauber secured to the container lid.
4. Gaskets for flange joints, unions, and strainers shall be viton.
5. Nuts and bolts used in chemical piping shall be monel metal, hex head or NC threads.

B. PVC Pipe Expansion Joints

1. PVC pipe expansion joints shall be telescoping design with triple (3) EPDM o-ring seals, including center pressure seal and outer debris seals, and internal support piston. Maximum joint travel length shall be 6 inches. Expansion joints shall be pressure rated to 235 psi for water at 73°F, and be fabricated from PVC material conforming to ASTM D1784. Sockets shall meet the dimensional requirements of ASTM D2467. Install per manufacturer's requirements. PVC expansion joints shall be by Flexicraft Industries, or equal.

C. PVC Tubing

Tubing for chemical lines shall be standard wall clear PVC tubing and be chemical resistant. Tubing shall have a temperature range of +25° to +150°F and a durometer of Shore A 70±5. Characteristics of tubing shall be as follows:

I.D.	O.D.	Max. PSI @ 70°F
3/16"	0.375"	250
1/4"	0.438"	250
3/8"	0.594"	225
1/2"	0.750"	200
5/8"	0.891"	200
3/4"	1.031"	150
1"	1.300"	125
1-1/4"	1.62"	100
1-1/2"	1.438"	100
2"	2.490"	75

PVC tubing shall be installed using stainless steel clamps and fittings to adapt to hard-piped systems

2.04 Piping Insulation

A. Polyisocyanurate Insulation meeting the requirements of ASTM C591, type IV. Thermal conductivity of 0.19 btu-in/hr-ft2-°F or lower at 75°F mean temperature. Minimum 4 lb/cu.ft. density. Flame spread/smoke developed performance tested via method ASTM E-84, UL 723, or NFPA 255 of 25/50 or better at thicknesses of 1.0 inches or less.

B. Insulation Manufacturers: Trymer, Dyplast Products, or equal.

C. Aluminum Piping Jacket Materials:

1. JRA, 0.016-in. aluminum, ASTM B209, with Pittsburgh seam, butt joint strips, matching fitting covers, stucco embossed finish and weather mastic.

D. Insulate exterior above grade piping indicated on the Drawings with the following types and thicknesses of insulation:

1. Insulation: Polyisocyanurate, 2-in. thickness for 2-in and larger pipes, 1-1/2-in thickness for 1-1/2-in and smaller pipes.
2. Jacketing: Aluminum, stucco embossed

2.05 Wall Pipe and Wall Sleeves

A. Wall pipe refers to wall castings which convey fluid or air as part of the piping system, as opposed to wall sleeves which serve as a casing pipe in which another pipe is inserted through it.

B. Wall pipe shall be used for ductile iron process piping in submerged applications and shall be ductile iron pipe meeting AWWA Standards with a minimum pressure rating of 150 psi. The type of joints vary depending upon the joints vary depending upon the joints of the connecting pipe, and shall meet the joint requirements of this Section. Wall pipe installed in a submerged application shall have waterstops.

C. Wall sleeves in a submerged application shall be plain-end ductile iron with waterstops. The pipe inserted through the wall sleeve shall be sealed watertight with Link-Seal and non-shrink grout or other method approved by the Engineer.

D. Wall sleeves for non-ductile iron piping for interior wall penetrations in new concrete structures shall be ductile iron or carbon steel. Carbon steel sleeves shall be thoroughly coated per Section 09900, Painting, prior to installation. Watertight sealing of the inserted pipe shall be provided unless otherwise indicated by the Engineer.

PART 3 - EXECUTION

3.01 Inspection

A. General

1. The quality of all materials, the process of manufacture and the finished products shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, after delivery to the site or at both places; and the products shall be subject to rejection at any time for failure to meet any of the specifications' requirements, even though sample products may have been previously accepted as satisfactory at the place of manufacture.
2. Prior to being installed, each pipe and fitting shall be carefully inspected. Those not meeting the specifications shall be rejected and removed immediately from the work.

B. Ductile Iron Pipe

1. In any pipe showing a distinct crack and which it is believed there is no incipient fracture beyond the limits of the visible crack, the cracked portion, if so approved by the Engineer, may be cut off. Therefore, this portion may be removed before the pipe is installed, at the expense of the Contractor. This shall ensure that the pipe used is perfectly sound. The cut shall be made in the sound barrel at a point at least 12 inches from the visible limits of the crack.
2. All cutting shall be done with a machine having steel cutters or knives adapted to the purpose and all cut ends shall be examined for possible cracks caused by cutting.

3.02 Installation of Buried Piping

A. Laying Piping

1. All excavation shall be in accordance with federal, state and local OSHA requirements. Proper tools and facilities shall be provided and used by the Contractor for safe working conditions.
2. All pipe and fitting shall be cleaned of all debris, dirt and other foreign material before being laid, and it shall be kept clean until accepted in the completed work.

3. Lay and maintain pipe to the lines and grade shown on the drawings, to maintain the minimum depth specified. Install fittings in the locations shown on the drawings or as directed by the Engineer.
4. When the exact location of buried utilities is unknown and piping is to be constructed parallel and close to said utilities, adjust the alignment of the piping to least interfere with these utilities. This applies unless otherwise shown on the drawings or specified by the Engineer.
5. For pipe 10 inches and smaller, pressure piping shall be laid at a depth that provides at least 4-6" of cover. These depths of cover apply unless otherwise depicted on the drawings or specified by the Engineer. Furthermore, cover shall be measured as the vertical distance from the top of the pipe to the finish grade elevation.
6. Do not lay pipe in water or when the trench or weather conditions are unsuitable for proper installation.
7. Lower pipe and fittings into the trench by hand, hoists or ropes or other suitable tools or equipment which will not damage products, coatings or linings. Do not drop or dump pipe or fittings into the trench.
8. Pipe laying shall proceed upgrade, beginning at the lower end of the pipe line.
9. Use laser beam equipment, surveying instruments or other proven techniques to maintain accurate alignment and grade, when required.
10. Deflection of pressure pipe from a straight line or grade shall not exceed the limits specified in this Section. If the alignment requires joint deflections in excess of the allowable deflection per joint, furnish and install fittings or a sufficient number of shorter lengths of pipe.
11. Laying of ductile iron piping shall meet the requirements of ANSI/AWWA C600, unless otherwise specified in this Section or as approved by the Engineer.
12. Open excavation shall be satisfactorily protected at all times. At the end of each day's work, the open ends of all pipes shall be protected against the entrance of animals, children, earth or debris by bulkheads or stoppers. The bulkheads or stoppers shall be perforated to allow passage of water into the installed pipe line, thereby preventing flotation of the pipe line. Any earth or other material that may find entrance into the main sewer or into any lateral sewer must be removed at the Contractor's expense. The cost of all such plugs, and the labor connected therewith, must be included in the regular bid for the sewers.

B. Pipe Bedding, Haunching and Initial Backfill

1. Each pipe section shall be laid in a firm foundation of bedding material, then haunched and backfilled with care, see Standard Detail Sheet.
2. Prior to pipe installation, carefully bring bedding material to grade along the entire length of pipe to be installed. To provide adequate support for the pipe, the following bedding procedures are recommended.
3. When Class I material is used for bedding, little or no compaction is necessary, due to the nature of the angular particles. A depth of 4 to 6 inches is generally sufficient to provide uniform bedding. This material must also be utilized for haunching, and initial backfill, to a plane 12 inches above the pipe.
4. Beneath the pipe bedding material shall have a minimum thickness of 4 inches, or a thickness of one-eighth of the outside diameter of the pipe, whichever is greater. This material shall also extend up the sides of the pipe to a height of one-sixth of the pipe's outside diameter.

5. In yielding subsoils, use Class II material unless a concrete cradle is ordered for bedding, and undercut the trench bottom to the necessary depth and backfill with graded, crushed stone to form a firm foundation. See the Standard Detail Sheet for additional information. No additional payment shall be made for stabilizing yielding subsoils.
6. When excavation occurs in rock or hard shale, undercut the trench bottom and place a minimum of 6 inches of crushed stone bedding prior to pipe installation. No additional payments shall be made for rock removal.
7. Excavate bell holes in advance of pipe laying so the entire barrel will bear uniformly

C. Where the trench crosses existing sidewalks, backfill with compacted suitable excavated material. Place backfill in lifts. Compact each lift of backfill to not less than 90% of the maximum dry density, according to AASHTO T99, Method A. Trenches shall be backfilled with compacted backfill to within 8-inches of the surface. The remaining bottom 4-inches of the trench is to be filled with crushed stone and compacted in place, prior to placing concrete for the sidewalk.

D. Backfill trenches not requiring compacted backfill with suitable excavated material. Fill and restore any settlement of the backfill. In unpaved areas, backfill shall be mounded above finish grade to allow for settlement. Grade unpaved area to be restored 6 inches below finish grade after settlement of backfill and immediately before restoration of vegetated areas. Place 6 inches of topsoil over area to be restored.

E. Jointing

1. Clean the ends of the pipe satisfactorily just before laying. Subsequently, the joint shall be made in a satisfactory manner according to the manufacturer's recommendations for that specific joint and as approved by the Engineer. All joint work shall be done by experienced workmen.
2. Joints shall be as specified in this Section.
3. Piping shall be tested as specified in this Section.

3.03 Installation of Exposed Small Pipe and Fittings (3-Inch and Smaller)

A. Piping shall be installed in a neat and workmanlike manner. Exposed piping shall be installed vertically or horizontally parallel to the walls and ceiling wherever possible and supported where necessary not exceeding 8 feet on centers for rigid piping and 4 feet on center for non-rigid piping (PVC, polyethylene, and other plastic piping).

B. Install piping free of sags and bends.

C. Install exposed interior and exterior piping at right angles or parallel to building walls. Diagonal runs are prohibited, except where indicated.

D. Install piping tight to slabs, beams, joists, columns, walls, and other building elements. Allow sufficient space above removable ceiling panels to allow for ceiling panel removal.

E. Where insulation is required, install piping to allow application of insulation plus 1inch (25 mm) clearance around insulation.

F. Locate groups of pipes parallel to each other, spaced to permit valve servicing.

G. All joints showing evidence of leaking shall be reworked.

H. Any system of small piping shall incorporate sufficient unions to permit ready disassembly and reassembly as may be required

I. Supports

1. Provide all necessary supports to keep the pipe and appurtenances stable at the lines and grades shown on drawings or as directed by the Engineer, and without strain upon the piping and connected equipment.
2. Piping shall be supported from the floor by suitable saddle stands or concrete piers. Piping along walls shall be supported by suitable wall brackets with attached roll or saddle, or by wall brackets with hanger rods. For piping supported from the ceiling, approved rod anchors of a type capable of supporting the pipe shall be used.
3. Supports shall be located wherever necessary and not exceed 4 feet on center unless otherwise required by the manufacturer.
4. Supports located in tanks (supported from wall or cantilevered walkway, submerged, or non-submerged) shall be stainless steel or fiberglass. Supports in chemical and corrosive rooms shall be fiberglass or non-metallic. Fiberglass and non-metallic supports w/ hangers shall be as manufactured by Aickinstrut, Inc., or as approved by the Engineer.
5. Supports shall be anchored using stainless steel hardware.

J. PVC Solvent Welded Joints

1. Ensure quality jointing during installation. Strictly adhere to the pipe material manufacturer's joining procedures and ASTM D2855 "Standard Practice for Making Solvent-Cemented Joints with PVC Pipe and Fittings." Pay particular attention to these procedures making each individual joint.
2. General jointing procedures are as follows:
   a. Bevel end of male pipe.
   b. Apply primer to female end.
   c. Apply primer to male end.
   d. Reapply primer to the socket – primer must not dry.
   e. Apply glue to the male pipe using appropriately sized applicator brush.
   f. Apply glue with a brush to the socket.
   g. Reapply glue to the male pipe.
   h. Join the pipe and socket home and apply quarter twist – hold for 30 seconds.

3.04 Installation of PVC Double Containment Piping System

A. Install double-containment piping in compliance with manufacturer's recommended procedures.

B. All joining shall be done as described above for PVC solvent welded joints.

C. The carrier pipe and the containment piping shall be tested hydrostatically to 150% of operating pressure per ASME B31.3. The carrier pipe must be pressurized to the same pressure as the containment pipe to prevent collapsing of product pipe.

3.05 Setting Appurtenances

Install all fittings and appurtenances in the lines as indicated on the Drawings or as specified by the Engineer.

3.06 Joints

A. Ductile Iron Push-on Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. Deflect pipe after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-Foot Pipe Length
4"	5°	18-1/2"
6"	5°	18-1/2"
8"	5°	18-1/2"
10"	5°	18-1/2"
12"	5°	18-1/2"

B. Mechanical Joints

1. Pipe must be cleaned and installed as specified by the manufacturer and ANSI/AWWA C600 requirements. Additionally, all lumps, blisters, excess bituminous coating and foreign material must be removed from the bell and spigot end of each pipe.

2. Evenly tighten the nuts using a torque wrench. The torque shall be within the range listed in the following table:

Pipe Size	Bolt Size	Torque Range
4" thru 24"	3/4"	75 to 90 ft.-lb.

3. Deflect pipe, fittings or valves after jointing, if deflection is required. The amount of deflection shall not exceed the limits shown in the following table:

Pipe Size	Maximum Deflection Angle	Maximum Deflection Based Upon 18-Foot Pipe Length
4"	8°-18’	31"
6"	7°-7’	27"
8"	5°-21’	20"
10"	5°-21’	20"
12"	5°-21’	20"

3.07 Wall Penetrations, Wall Pipes, and Wall Sleeves

A. Details for the installation of wall penetrations, wall pipes, and wall sleeves are shown on the Drawings.

B. Wall pipes and sleeves installed for a submerged application in which one or both sides of the wall, floor, or ceiling will be submerged shall have waterstops. All submerged or exterior wall penetrations, wall pipes, and wall sleeves which leak shall be replaced at no extra cost to the Owner.

C. Exterior walls refer to walls which are on the exterior of a building or structure, either buried or exposed. Interior walls refer to a wall between two interior rooms in a building or structure.

D. Wall sleeves may be used for all non-process piping. In new wall submerged applications or on new exterior walls, floors, or ceilings, the inserted pipe shall be sealed watertight with Link-Seal or other method as approved by the Engineer.

E. Wall sleeves may be used for process and non-process piping on interior walls, floors, or ceilings. The annular space between the inserted pipe and sleeve shall be filled as shown on the Drawings. This annular space may be left open only if approved by the Engineer.

F. Penetrations of existing interior, exterior, or submerged walls, floors, or ceilings shall be core-drilled and the inserted pipe sealed watertight with Link-Seal or other method approved by the Engineer.

G. New interior, exterior, and submerged walls may be core-drilled and follow the same requirements as existing walls only if prior approval is granted by the Engineer and only on a case-by-case basis for each application.

3.08 Hydrostatic Test

A. Hydrostatic test shall be performed on all process piping, pressure piping, plant water piping, and chemical piping. Test procedures shall meet the requirements of ANSI/AWWA C600.

B. The piping shall be complete and shall have been in place for not less than 10 days prior to being tested.

C. Test closed-end pressure piping and plant water lines as follows:

1. Expel all air from the piping prior to the application of test pressure. Tap the piping at high points, if necessary, to release all air from the piping. Plug taps after the test is successfully completed. Plugs shall be watertight.
2. Test piping at a static pressure of 150 pounds per square inch over a period of not less than eight consecutive hours. The test will be considered successful when the pressure drop over the test period is 5 pounds per square inch or less. If the pressure drop exceeds 5 pounds per square inch, repair the leaks and repeat the test. Repair leaks and repeat the test until the pressure drop over the test period is 5 pounds per square inch or less.

D. Test open-end pressure piping and process piping as follows:

1. The ends of piping being tested shall have test plugs or caps adapted with a tap of adequate diameter to fill and pressurize the system with water.
2. When a section is terminated at a manhole with a plain end (spigot), the pipe must extend into the manhole of sufficient length to accommodate a restraining cap. The bench-wall shall be formed in the manhole after the test section has been approved.
3. Water shall be introduced into the section to be tested at the lower end. The upper end shall have an orifice at the top of the plug or cap to expel air when filling the system with water All air shall be expelled from the pipe.
4. The test plugs or caps shall be capable of withstanding an internal pressure of 175 psi.
5. Process piping and gravity flow systems shall be tested in conformance with Section 13 of ANSI/AWWA C600, at 50 pounds per square inch over a period of not less than four hours. The system will not be acceptable until all leaks have been repaired.
6. Pumped flow systems shall be subjected to an internal pressure equal to 50% more than the maximum operating pressure, but in no case less than 50 psig or greater than 120 psig.
7. Hydrostatic test may be dangerous if, because of ignorance or carelessness, a line is improperly prepared. It is extremely important that the various plugs be installed in such as way as to prevent blowouts. Inasmuch as a force of 2,500 pounds is exerted on an 8-inch plug by an internal pipe pressure of 50 psi, it should be realized that sudden expulsion of a poorly installed plug or cap can be dangerous. As a safety precaution, no one shall be allowed in the manholes when the pipe is pressurized.

3.09 Flushing

A. Water, Wastewater and Sludge Piping

Flush piping with a flushing velocity of at least 2.5 feet per second. Following are flows required to provide a flushing velocity of 2.5 feet per second:

Pipe Size	Inside Diameter	Flow at a Velocity of 2.5 Feet per Second
4"	4"	98 gpm
6"	6"	220 gpm
8"	8"	390 gpm
10"	10"	620 gpm
12"	12"	880 gpm

1. Flush piping and hydrants until the water discharged is clear
2. Flush potable water piping prior to disinfection.

B. Air and Chemical Piping: Piping systems conveying the following services shall be cleaned after erection and testing by purging with dry compressed air (DCA) or nitrogen (N) until the specified dew point is reached and held for 30 minutes.

Services	Purge Gas	Dew Point
Dry Compressed Air – Plant & Instrument	DCA	-40°F
Chlorine	N	-40°F

3.10 Valve Leakage Testing

A. Test valves for leakage at the same time that the connecting pipelines are tested. See pressure testing requirements. Protect or isolate any parts of valves, operators or control instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace valves showing leaks and retest at no additional cost to the Owner.

3.11 Valve Field Testing

A. Operate manual valves through 10 full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. If valves stick or bind, repair or replace the valve and repeat the tests.

-END-

SECTION 15080 - PROCESS VALVES

PART 1 - GENERAL

1.01 Description

A. Scope

1. This section includes valves and appurtenances applicable to process chemical piping. Furnish and install valves and appurtenances necessary to complete work shown or specified.
2. All valves of a single type shall be provided by a single manufacturer.
3. Valve size and all references to pipe diameter on the drawings or specifications are intended to be nominal size or diameter and shall be interpreted as such.

1.02 Codes and Abbreviations

A. Codes, specifications and standards referred to by title or number in this specification shall be adhered to, and latest revisions shall apply in all cases.

B. Definitions

1. ANSI - American National Standards Institute
2. ASTM - American Society for Testing & Materials
3. AWWA - American Water Works Association
4. PFI - Pipe Fabricators Institute

1.03 Quality Assurance

A. Mark valves according to the applicable specification or standard.

B. Perform factory and field tests in accordance with the applicable specification or standard.

1.04 Submittals

A. Submittals shall include information and materials specified in this Section, the General Conditions, and Section 01300, Submittals.

B. Submit the following for the Engineer's review and approval:

1. Manufacturer's Certificate of Compliance with the referenced specifications and applicable standards.
2. Certified copies of factory tests and reports, if specified in this Section or required by the referenced standards.
3. Copy of manufacturer's standard warranty for each type of equipment provided.
4. Shop drawings with performance data, descriptive literature, weights and dimensions, and other physical characteristics verifying compliance with this Section. When numerous options and sizes are shown, the shop drawings shall

be marked to clearly indicate the sizes and types specific to this Section and project.

5. Manufacturer's installation instructions and recommended testing procedures.
6. Manufacturer's operation and maintenance (O&M) manuals and materials. When numerous types and sizes are shown, the manuals shall be marked to clearly indicate the sizes and types specific to this project.

1.05 Product Delivery, Storage and Handling

A. The Contractor shall be responsible for the delivery, storage and handling of products.

B. Load and unload all valves and appurtenances by hoists or skidding. Do not drop products. Do not skid or roll products on or against other products. Use sling, hooks and pipe tongs in such a manner to prevent damage to products.

C. Keep stored products safe from damage or deterioration. Keep the interior of valves and appurtenances free from dirt or foreign matter. Drain and store valves in a manner that will protect valves from damage by freezing. Store gaskets and other products which will deteriorate from sunlight in a cool location out of direct sunlight. Gaskets shall not come in contact with petroleum products.

D. Store valves and appurtenances in accordance with manufacturer's recommendations.

E. Do not stack valves, valve boxes or valve stands.

F. Promptly remove damaged products from the job site and replace with undamaged.

PART 2 - PRODUCTS

2.01 General

All valves and appurtenances shall be new, unused and as shown on the drawings and specified in this Section. Valve opening direction shall be determined by the Engineer.

2.02 Plug Valves

1. Eccentric Plug Valves for water and wastewater service shall be non-lubricated with a resilient sealing surface. Valves shall have mechanical joint ends conforming to ANSI/AWWA C110 requirements. Port areas shall be at least 80% of full pipe area. Valves shall have permanently lubricated stainless steel slave-type bearings, or other lubricated type bearings, in the upper and lower stem journals. Valve seats shall be corrosion resistant, having a high nickel content.
2. Bonnet shaft seals shall be capable of being replaced while line and valve remain in service, thereby eliminating the need to take process treatment units out of service. All exposed nuts, bolts, springs and washers shall be zinc-coated steel. Means of actuation shall be by tee wrench and extension stem.

3. The valves shall be capable of providing drop-tight shutoff with flow in either direction up to the specified maximum line pressure differential.
4. The plug face material shall be nitrile-butadiene or neoprene.
6. Valves and actuators for buried service shall have seals on all shafts and gaskets on valve and actuator covers to prevent the entry of fluid.
7. Valves in buried service shall have totally enclosed and sealed operators with a 2-inch square AWWA operating nut, valve box, and stem extensions.
8. Each actuator shall be capable of seating and unseating the valve and have a maximum torque to the valve shaft of 50 foot-pounds on operating nuts.
9. Plug valves shall be DeZurik, or equal.

2.03 Chemical Valves

A. PVC Ball Valves - 2-in. and Smaller

1. Manufacturers
   a. Hayward
   b. George Fischer
   c. Or equal
2. PVC Cell Class 12454 per ASTM D1784
3. Rated for 150 psi at 70°F
4. True union, full port design
5. PVC body, ball, and stem.
6. PTFE seats and EPDM O-ring seals
7. Socket end connections.
8. Hand lever actuator, low-torque, ¼-turn operation

B. PVC Ball Valves – 2.5-inches and Larger

1. Manufacturers
   a. Hayward
   b. George Fischer
   c. Or equal
2. PVC Cell Class 12454 per ASTM D1784
3. Rated for 150 psi at 70°F
4. True union, full port design
5. PVC body, ball, and stem.
6. PTFE seats and FPM O-ring seals
7. Double O-ring stem seals
8. Socket end connections.
9. Hand lever actuator, low-torque, ¼-turn operation

C. Vented PVC Ball Valves – 4-inches and smaller

1. Manufacturers
   a. Hayward
   b. George Fischer
   c. Or equal
2. Use on sodium hypochlorite piping systems
3. PVC Cell Class 12454 per ASTM D1784

4. Rated for 235 psi at 70°F
5. True union, full port, vented ball design
6. PVC body, ball, and stem.
7. Reversible PTFE seats and FPM O-ring seals
8. Double O-ring stem seals
9. Socket end connections.
10. Hand lever actuator, low-torque, ¼-turn operation

D. Diaphragm valves for chemical service shall be Weir type constructed from PVC Type I, ASTM D 1784 Cell Classification 12454. All diaphragms shall be genuine Viton. All valves shall have built-in position indicator with polypropylene handwheel. Valves less than 2½" shall be pressure rated to 235 psi for water at 73° F, shall have spigot style fittings, and shall be Spears series 2737 or approved equal. Valves 2½" to 4" shall be pressure rated to 150 psi for water at 73° F, shall have flange style fittings, and shall be Spears series 2733 or approved equal. All flanged diaphragm valve connections shall have Viton gaskets.

PART 3 - EXECUTION

3.01 Inspection

A. The quality of all materials, the process of manufacture and the finished products shall be subject to inspection and approval by the Engineer. Such inspection may be made at the place of manufacture, on the work after delivery or at both places. The products shall be subject to rejection at any time on account of failure to meet any of the specifications' requirements even though sample products may have been accepted as satisfactory at the place of manufacture.

1. Prior to being installed, each pipe, fitting, valve and hydrant shall be carefully inspected, and those not meeting the specifications shall be rejected and promptly removed from the work.

3.02 Installation of Buried Valves

A. General

1. Install valves in conjunction with and in conformance with piping installation as specified in the Contract Documents.
2. Use proper tools and facilities for safe working conditions.
3. Clean each valve of all debris, dirt and other foreign material before being laid and keep clean until accepted in the completed work.
4. Install valves and hydrants in the locations shown on the drawings.
5. Lower valves into the trench by hand, by means of hoists or ropes or by other suitable tools or equipment which will not damage products, coatings or linings. Do not drop or dump valves into the trench.

B. Setting Valves and Boxes

1. Clean valve interiors of foreign matter before installation. Tighten stuffing boxes. Inspect valves in opened and closed positions to ensure all parts are in working condition.
2. Set buried valves and valve boxes plumb. Center valve boxes on the valves or valve operators. Locate valves outside the area of roads and streets where feasible. Tamp backfill around each valve box to a distance of 4 feet on all sides of the box, or to the undisturbed trench face if less than 4 feet.

3.03 Installation of Exposed Valves

A. General

1. Installation of valves shall be in conjunction with and in conformance with piping installation as specified in Sections 15060, Process and Yard Piping.
2. All valves shall be cleared of debris, dirt, etc., before being installed and shall be kept clean until accepted at completion of work. During installation, no debris, tools, clothing, lumber or other materials shall be placed in the valves.
3. Valves shall be installed in a neat workmanlike manner. Proper implements, tools and facilities shall be provided and used by the Contractor for the safe and convenient prosecution of the work. All valves shall be carefully installed in such a manner as to prevent damage to valve materials, protective coatings and liners.
4. The valves and appurtenances shall be inspected for defects prior to installation.
5. Valves shall be installed in such a manner that no undue strain is placed upon piping joints, equipment or structures.

B. Supports

1. The Contractor shall provide all supports necessary to support the valves and appurtenances in a firm, substantial manner at the lines and grades shown on drawings or as directed, and without strain upon the piping and connected equipment.
2. Valves shall be supported from the floor by suitable saddle stands or concrete piers. Valves along walls may be supported by suitable wall brackets. For piping supported from the ceiling, approved rod anchors of a type capable of screw adjustments after erection of the piping and valves and with suitable adjustable concrete inserts or beam clamps shall be used.
3. Provide wall bracket guides for extension stems at intervals recommended by the manufacturer.

D. Jointing

1. Refer to Section 15060 for PVC solvent weld pipe jointing requirements.

3.04 Setting Appurtenances

Install all valves and appurtenances in the lines as indicated on the drawings.

3.05 Testing

Testing shall be in conjunction with and in conformance with piping testing as specified in Section 15060.

3.06 Valve Leakage Testing

Test valves for leakage at the same time that the connecting pipelines are tested. See Section 15060 for pressure testing requirements. Protect or isolate any parts of valves, operators, or control and instrumentation systems whose pressure rating is less than the pressure test. Valves shall show zero leakage. Repair or replace valves showing leaks and retest.

3.07 Valve Field Testing

Operate manual valves through 10 full cycles of opening and closing. Valves shall operate from full open to full close without sticking or binding. If valves stick or bind, repair or replace the valve and repeat the tests.

3.08 Warranty

The Contractor shall guarantee the equipment to be free from defective material and workmanship for a period of one year from the date of acceptance of the equipment by the Owner. The Contractor shall replace any defective materials, components, or workmanship during this time, including but not limited to all materials, labor, shipping, and transportation, at no additional cost to the Owner. Any repair work performed during this one year period shall also be guaranteed to be free from defective material or workmanship for a period of one year from the date the work is complete and shall be addressed in the same manner at no additional cost to the Owner.

-END-

SECTION 15447 - EYEWASH AND EMERGENCY SHOWER

PART 1 - GENERAL

1.01 Description

A. Scope: Furnish and install eyewash and emergency shower and related items at the locations shown on the Drawings necessary to complete work shown.

1. In general, eyewash and emergency shower consist of furnishing, installing, and connecting all fixtures from the piping connections all as shown on the drawings and as required to make a complete job. The work includes all valve and appurtenances as shown or as required.

B. Codes, specifications, and standards referred to by number or title shall form a part of this specification to the extent required by the references thereto Latest revisions shall apply, unless otherwise specified

1.02 Submittals

A. Submittals shall be as specified in the General Conditions and Section 01300.

B. Submit the following:

1. Certified copies of reports of factory tests specified in this Section and required by the referenced standards
2. Shop drawings with physical characteristics, including dimensions and pipe connection requirements, and installation instructions.

1.03 Product Delivery, Storage, and Handling

A. The Contractor shall be responsible for the delivery, storage, and handling of products.

B. Promptly remove damaged products from the job site. Replace damaged products with undamaged products.

PART 2 - PRODUCTS

2.01 Eyewash and Emergency Shower

A. Provide emergency shower and eyewash stations with 1¼-inch IPS water supply in the locations shown on the Drawings.

B. Each eyewash and emergency shower shall have a capacity of 30 to 50 gallons per minute with a supply pressure of 20 to 50 pounds per square inch.

C. The shower head shall be 10-inch diameter, yellow, impact-resistant plastic, mounted 7 feet above the floor level and positioned to discharge vertically downward.

D. Shower Valve: Chrome-plated brass 1-inch IPS stay-open ball valve operated by stainless steel push flag handle.

E. Eye Wash: Ten inch diameter, yellow, impact-resistant bowl. Chrome-plated brass sprayhead assembly with twin, soft flow, eye wash heads and protective sprayhead covers, with integral flow control to assure safe steady flow under varying water supply conditions. The eyewash shall be mounted on the shower riser pipe approximately 40 inches above the floor and shall function independently of the shower.

F. Eye Wash Valve: Chrome-plated ½-inch IPS stay-open ball valve, hand-operated by stainless steel push flag handle Valves for outdoor installations shall be frost-proof

G. Standard: One and one-fourth (1¼) inch galvanized steel pipe, safety yellow coated with floor flange and provisions for vertical or horizontal supply.

H. Identification Sign: Fourteen inch by 3-1/2 inch sign designed for wall-mounting. Sign shall read: EMERGENCY SHOWER AND EYE WASH FOUNTAIN.

I. Emergency shower/eye wash unit shall be Bradley, or equal: Model S19-310 for interior units.

PART 3 - EXECUTION

3.01 Installation

A. All items shall be installed in accordance with the manufacturer's installation instructions.

B. Drill holes required for mounting or pipe penetrations to correct size and location within 1/4-inch tolerance. Fill annular areas and voids of pipe penetrations with material suitable for the substrate.

C. Mount surface mounted accessories with toggle bolts or expansion bolts as applicable to the substrate, plumb and align.

3.02 Inspection

A. Check opening schedule to receive recessed unit for correct dimensions, plumbness of blocking or frames and preparation that would affect installation of accessories.

B. Check areas to receive mounted units for conditions that would affect quality and execution on work.

3.03 Adjust and Clean

A. Adjust accessories for proper operation. Verify unit works properly.

B. After completion of installation, clean and polish all exposed surfaces.

-END-

SECTION 15930 - HVAC POWER VENTILATORS AND LOUVERS

PART 1 - GENERAL

1.01 Summary

A. Section Includes

1. HVAC Power Ventilators and Louvers

B. Related Sections

1. Section 01300 – Submittals
2. Section 07900 – Joint Sealers
3. Division 16 - Electrical

1.02 References

A. Air Movement and Control Association Inc. (AMCA)

1. 99 - Standards Handbook
2. 200 - Publication, Air Systems
3. 201-90 - Publication, Fans and Systems
4. 202-88 - Publication, Troubleshooting
5. 203-90 - Publication, Field Performance Measurement of Fan Systems
6. 211-05 - Publication, Certified Ratings Program – Product Rating Manual for Fan Air Performance
7. 300-96 - Standard Reverberant Room Method for Sound Testing of Fans
8. 311-05 - Publication Certified Ratings Program – Product Rating Manual for Fan Sound Performance
9. 99-0401-86 - Classification for Spark Resistant Construction
10. 99-2408-69 - Operating Limits for Centrifugal Fans

B. Air Movement and Control Association Inc. (AMCA), American National Standards Institute (ANSI):

1. 204-05 - Standard Balance Quality and Vibration Levels for Fans
2. 210-99 - Standard Laboratory Methods of Testing Fans for Aerodynamic Performance Rating

C. American National Standards Institute (ANSI):

1. 11-r1999 - Method of Evaluating Load Ratings of Bearings

D. American Society of Civil Engineers (ASCE):

1. 7-02 - Minimum Design Loads for Building and Other Structures

E. American Society of Heating, Refrigerating and Air Conditioning Engineers, Inc. (ASHRAE):

1. Chapter 45 - 2003 Handbook, HVAC Applications
2. Chapter 7 - 2001 Fundamentals handbook, Sound-Vibration
3. Chapter 32 - 2001 Fundamentals handbook, Duct Design
4. Chapter 18 - 1992 HVAC System and Equipment handbook, Fans

F. American Society for Testing and Materials (ASTM):

1. E330-02 - Standard Test Method for Structural Performance of Exterior Windows, Doors, Skylight and Curtain Walls by Uniform Static Air Pressure Difference

G. National Fire Protection Association (NFPA)

1. 70 - National Electrical Code
2. 90A-02 - Standard for the Installation of Air-Conditioning and Ventilating Systems
3. 92A-06 - Recommend Practice for Smoke-Control System
4. 92B-05 - Standard for Smoke Management System in Malls, Atria, and Large Areas
5. 96-04 - Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

H. Occupational Safety and Health Administration (OSHA):

1. 1910.212 - General requirements for Machine Guarding
2. 1910.219 - General requirements for guarding safe use of mechanical power transmission apparatus
3. 1926.300 - General requirements for safe operation and maintenance of hand and power tools

I. Underwriters Laboratories (UL):

1. 507 - Electric Fans
2. 555 - Fire Dampers
3. 555S - Smoke Dampers
4. 705 - Standard Power Ventilators
5. 762 - Standard Power Roof Ventilators for Restaurant Exhaust Appliances
6. 793 - Snow Load

1.03 Submittals

A. General: Submit in accordance with Section 01300 Submittals

B. Provide dimensional drawings and product data on each fan

C. Provide fan curves for each fan at the specified operation point, with the flow, static pressure and horsepower clearly plotted

D. Provide outlet velocity and fan's inlet sound power readings for the eight octave bands, decibels, and sones

E. Strictly adhere to QUALITY ASSURANCE requirements as stated in section 1.04 of this specification

F. Provide manufacturer's certification that exhaust fans are licensed to bear Air Movement and Control Association (AMCA), Certified Rating Seal for sound and air performance

G. Installation, Operation, and Maintenance Manual (IOM): Provide manufacturer's installation, operations, and maintenance manual, including instructions on installation, operations, maintenance, pulley adjustment, receiving, handling, storage, safety information and cleaning. A troubleshooting guide, parts list, warranty and electrical wiring diagrams.

1.04 Quality Assurance

A. Performance ratings: Conform to AMCA standard 211 and 311. Fans must be tested in accordance with ANSI/AMCA Standard 210-99 and AMCA Standard 300-96 in an AMCA accredited laboratory. Fans shall be certified to bear the AMCA label for air performance seal

B. Classification for Spark Resistant Construction, levels A, B and C, conform to AMCA 99

C. Each fan shall be given a balancing analysis which is applied to wheels at the outside radius. The maximum allowable static and dynamic imbalance is 0.05 ounces (Balance grade of G6.3)

D. Comply with the National Electrical Manufacturers Association (NEMA), standards for motors and electrical accessories

E. The High Wind models have been analyzed and stamped by a state license P.E. to the ASCE 7-02 Standard which meets the IBC, Florida and Miami-Dade codes

F. Each High Wind model is subject to be certified by a third party to the ASTM E330 Static Pressure Difference Standard

G. All High Wind models have been analyzed using Computational Fluid Dynamics (CFD). The CFD simulates the flow of high speed (150MPH) winds over the surface of objects

H. The Finite Element Analysis (FEA) is the results from the CFD and it can accurately predict the stress, strain, and deflection resulting from high wind loads

1.05 Delivery, Storage, and Handling

A. Delivery

1. Deliver materials to site in manufacturer’s original, unopened containers and packaging, with labels clearly indicating manufacturer, material, products included, and location of installation

B. Storage

1. Store materials in a dry area indoors, protected from damage, and in accordance with manufacturer’s instructions. For long term storage follow manufacturer's Installation, Operations, and Maintenance Manual

C. Handling

1. Handle and lift fans in accordance with the manufacturer’s instructions. Protect materials and finishes during handling and installation to prevent damage. Follow all safety warnings posted by the manufacturer

1.06 Warranty

A. Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under Contract Documents

1. The warranty of this equipment is to be free from defects in material and workmanship for a period of one year from the purchase date. Any units or parts which prove defective during the warranty period will be replaced at the Manufacturers option when returned to Manufacturer, transportation prepaid
2. Motor Warranty is warranted by the motor manufacturer for a period of one year. Should motors furnished by us prove defective during this period, they should be returned to the nearest authorized motor service station

1.07 Maintenance

A. Refer to Manufacturer's Installation, Operation and Maintenance Manual (IOM), to find maintenance procedures

PART 2 - PRODUCTS

2.01 Manufacturers

A. Greenheck, PO Box 410, Schofield, Wisconsin 54476. Phone (715) 359-6171. Fax (715)355-2399. Website: www.greenheck.com

2.02 Louvers

A. Model: See Louver Schedule, end of this specification

1. General Description
   a. Frame Depth = 6 in.
   b. Sizing: Nominal
   c. Blade/Jamb Seals: Yes
   d. Actuator Type: 120 VAC
   e. Actuator Fail. Pos.: Closed
   f. NEMA Enclosure: 4x
   g. Frame Type: Channel
   h. Axle Bearings: Synthetic
   i. Actuator Mount: Internal
   j. Actuator Operating Mode: Two Position
   k. Louver Material: Aluminum
   l. Axle Material: 316 SS
   m. Actuator Location: Left
2. Options and Accessories
   a. Finish Type: Medium bronze anodized
   b. Bird Screen: Internal
   c. Bird Screen Material: Aluminum
   d. Bird Screen Type: ¾ x 0.050 Flat Expanded
   e. Bird Screen Finish: Mill

2.03 Direct Drive Sidewall Mounted Propeller Fans

A. Model: See Fan Schedule, end of this specification

1. General Description
   a. Fan arrangement shall be exhaust
   b. Sidewall mounted applications
   c. Performance capabilities up to 7,100 cubic feet per minute (cfm) and static pressure to 0.625 inches of water gauge
   d. Fans are available in eight sizes with nominal wheel diameters ranging from 8 inches through 24 inches (8 - 24 unit sizes)
   e. Maximum continuous operating temperature 130 Fahrenheit (54.4 Celsius)
   f. Each fan shall bear a permanently affixed manufacture's engraved metal nameplate containing the model number and individual serial number
2. Wheel
   a. Propeller shall be aluminum blade riveted to steel hub
   b. A standard square key and set screw or tapered bushing shall lock the propeller to the motor shaft
   c. Statically and dynamically balanced in accordance with AMCA Standard 204-05
   d. The propeller and fan inlet will be matched and shall have precise running tolerances for maximum performance and operating efficiency
3. Motors
   a. Motor enclosure: Totally enclosed air over (TEAO)

b. Motors are permanently lubricated, sleeve bearing type on sizes 8-12 and ball bearing type on sizes 14-24 to match with the fan load and furnished at the specific voltage and phase
c. Accessible for maintenance

4. Drive Frame
   a. Drive frame assemblies and fan panels shall be galvanized steel
   b. Drive frame shall have welded wire or formed channels and fan panels shall have prepunched mounting holes, formed flanges and a deep formed one piece inlet venture
5. Disconnect Switches
   a. NEMA rated: 4X
   b. Positive electrical shut-off
   c. Wired from fan motor to junction box
6. Options/Accessories
   a. Damper
      1) Type: Gravity
      2) Prevents outside air from entering back into the building when fan is off
      3) Balanced for minimal resistance to flow
      4) Galvanized frames with pre-punched mounting holes
   b. Finishes
      1) Types: Permatector
   c. Wall Housing
      1) Mounting arrangement: Flush Exterior
      2) Constructed of galvanized steel with heavy gauge mounting flanges and prepunched mounting holes
      3) Housing shall include OSHA approved motor guard
      4) Reduces installation time and provides maximum installation flexibility
   d. Wall Collar
      1) Constructed of galvanized steel with heavy gauge mounting flanges and prepunched mounting holes
   e. Motor Side Guard
      1) Guard type OSHA Guard
      2) Protective guard completely enclose the motor and drive side of the fan
      3) Coated with Permatector, a thermal setting polyester urethane
   f. Weatherhood
      1) Shall shield wall opening and dampers from rain and snow
      2) Material type: Aluminum
      3) Turndown Angle: 45 degrees
      4) Screen: Birdscreen
      5) Finishes: None

PART 3 - EXECUTION

3.01 Manufacturer’s Instructions

A. Compliance: Comply with manufacturer's product data, including technical bulletins, product catalog installation instructions

3.02 Examination

A. Examine areas to receive fans. Notify the Engineer of conditions that would adversely affect installation or subsequent utilization and maintenance of fans. Do not proceed with installation until unsatisfactory conditions are corrected

3.03 Preparation

A. Ensure openings are square, accurately aligned, correctly located, and in tolerance

3.04 Installation

A. Install fans system as indicated on the Installation, Operation and Maintenance Manual (IOM) and contract drawings

B. Install fans in accordance with manufacturer's instructions

3.05 System Startup

A. Refer to Installation, Operation, and Maintenance Manual (IOM)

3.06 Adjusting

A. Adjust exhaust fans and louvers to function properly

B. Lubricate bearings

3.07 Cleaning

A. Clean as recommended by manufacturer. Do not use material or methods which may damage finish surface or surrounding construction

3.08 Protection

A. Protect installed product and finished surfaces from damage during construction

B. Protect installed exhaust fans to ensure that, except for normal weathering, fans will be without damage or deterioration at time of substantial completion

SCHEDULE OF FANS

ITEM	MODEL	VOL. (CFM)	RPM	HP	EXT. SP (IN. WG)	TOTAL SP (IN. WG)	WALL OPENING	DAMPER
EF-1	SE1-8-426-D	177	1550	1/40	0.1	0.129	14.25” SQ.	WD-320 (10X10)
EF-2	SE1-12-426-D	965	1550	1/10	0.1	0.103	19.25” SQ.	WD-320 (14X14)

SCHEDULE OF LOUVERS

ITEM	MODEL	WIDTH	HEIGHT	VOL. (CFM)	PRESS. DROP (IN. WG)
LVR-1	EAD-601	16”	16”	177	0.023
LVR-2	EAD-601	20”	30”	965	0.061

- END -

SECTION 15762- UNIT HEATERS

PART 1 - GENERAL

1.01 Section includes

A. Gas Unit Heaters – Condensing type gas furnace with 93% minimum efficiency provided by an indirect-fired tubular heat exchanger with individually fired tubes coupled to a secondary recuperative heat exchanger for maximum heat recovery.

1.02 Submittals

A. See Section 01300 - Submittals, for submittal procedures.

B. Product Data: Provide product data information including arrangements, materials of construction, electrical characteristics, options and accessories provided with unit.

C. Shop Drawings:

1. Indicate cross sections of cabinets, grilles, bracing and reinforcing, mounting instructions and typical elevations.
2. Submit schedules of equipment and enclosures typically indicating physical size of unit, weights, capacities and electrical requirements, options and accessories provided or required.
3. Indicate mechanical and electrical service locations and requirements.

D. Warranty: Submit a one year manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.03 Quality Assurance

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum three years documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. as suitable for the purpose specified and indicated.

1.04 Warranty

A. The Contractor shall guarantee the equipment to be free from defective material and workmanship for a period of one year from the date of acceptance of the equipment by the Owner. The Contractor shall replace any defective materials, components, or workmanship during this time, including but not limited to all materials, labor, shipping, and transportation, at no additional cost to the Owner. Any repair work performed during this one year period shall also be guaranteed to be free from defective material or workmanship for a period of one year from the date the work is complete and shall be addressed in the same manner at no additional cost to the Owner.

B. Provide one-year manufacturer’s warranty for each unit heater.

PART 2 - PRODUCTS

2.01 Gas Unit Heaters (UH-1 and UH-2)

A. Manufacturers:

1. Modine (Effinity^{93} Series)
2. Substitutions: Refer to Section 01300 – Submittals.

B. Efficiency: Minimum 93%

C. Venting/Combustion Air

1. The unit shall be separated combustion.
2. The venting shall be a power exhausted arrangement with a separate combustion air intake pipe connection to allow for fresh combustion air from outside the conditioned space.
3. The unit shall be tested to insure proper ignition when the unit is subjected to 40 mile per hour wind velocities.
4. The unit shall also include a factory mounted differential pressure switch designed to prevent main burner ignition until positive venting has been proven.
5. Venting shall be Schedule 40 PVC.

D. Casing: Corrosion resistant 20-gauge aluminized steel with baked-on polyester powder paint (7-mil thickness). Unit shall be furnished with horizontal air deflectors capable of directing airflow up or down.

E. Heat Exchanger

1. Material: Primary - 409 stainless steel; Secondary – Al29-4C stainless steel.
2. Each heat exchanger tube shall be individually and directly flame-fired.
3. The heat exchanger tube shall be crimped to allow for thermal expansion and contraction.
4. The flue collector box shall be made of 20 gauge AL29-4C stainless steel.
5. Heat exchanger(s) seams and duct connections shall be certified to withstand 0.9” W.C. external static pressure without burner flame disturbance.
6. The burner(s) shall be in-shot type, directly firing each heat exchanger tube individually and are designed for good lighting characteristics without noise of extinction for both natural and propane gas.
7. The ignition controller(s) shall be 100% shut-off with continuous retry.
8. The gas pressure shall be between 6-7" W.C for natural gas. Provide gas pressure regulator to reduce the inlet gas pressure for the operating controls if required to achieve specified pressure rating.
9. The solid state ignition system shall directly light the gas by means of a direct spark igniter each time the thermostat calls for heat.
10. The unit gas controls shall be provided with the following:
    a. Single-stage gas controls with a single-stage combination gas control, an ignition control, and a single-stage low voltage thermostat. The unit fires at 100% full fire based on a call for heat from a room thermostat.
    b. An automatic reset high limit switch mounted in the air stream to shut off the gas supply in the event of overheating.

c. An automatic reset high limit switch mounted on the power exhauster housing to shut off the gas supply in the event of overheating flue gas temperatures.
d. A condensate drain line overflow switch that senses if the condensate line is clogged and shuts the unit heater down.
e. A time delay relay that delays the start of the air mover to allow the heat exchanger a warm-up period after a call for heat. The time delay relay shall also continue the air mover operation after the thermostat has been satisfied to remove any residual heat on the heat exchanger.
f. The unit shall be orificed for up to 2000' elevation above sea level

F. Electrical

1. All electrical components shall carry UL, ETL, or CSA listing.
2. Low voltage terminal board.
3. A single 115V to 24V step down transformer shall be provided for all unit controls.

G. Motor: Single-speed, totally enclosed (TE), rated at 115V/60Hz/1Ph.

H. Fan: Direct drive corrosion resistant epoxy coated steel or aluminum propeller type, statically and dynamically balanced, with fan guard.

I. Mounting: The unit shall be equipped with tapped holes to accept 3/8”-16 threaded rod for suspension, with a minimum of 4 suspension points.

J. Special Options: Provide the following:

1. Wall mounted remote on/off switch (per each)
2. 24 volt remote NEMA 4X thermostat (per each)

PART 3 - EXECUTION

3.01 Installation

A. Install in accordance with manufacturer's instructions and as indicated on the plans.

3.02 Refer to Section 01650 for acceptance of equipment by Owner.

3.03 Schedules

A. UH-1 & UH-2

1. Basis of Design	EFFINITY
2. Model	PTC55
3. KW Capacity	12.5
4. Electrical	115 V / 1Phase / 60 HZ
5. Total AMPS	2.7
6. Motor	115 V / 1 Phase / 60 Hz
7. Motor HP	1/8
8. Motor RPM	1440
9. Fan CFM	1097
10. Fan Throw	43 Feet Horizontal (@ Max. Mounting Ht. = 12')
11. Air temperature rise	43 degrees F.
12. Gas Type	Natural Gas
13. Accessories	Single stage room thermostat with a 50°- 90°F range

-END-

DIVISION 16 – ELECTRICAL

SECTION 16000 - BASIC ELECTRICAL REQUIREMENTS

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish all labor, materials, tools, and equipment, and perform all work and services necessary for, or incidental, to the furnishing and installation of all electrical work as shown on the Drawings, and as specified in accordance with the provisions of the Contract Documents and completely coordinate with the work of other trades involved in the general construction. Although such work is not specifically shown or specified, all supplementary or miscellaneous items, appurtenances, and devices incidental to or necessary for a sound, secure, and complete installation shall be furnished and installed as part of this work. The Contractor shall obtain approved Shop Drawings showing wiring diagrams, connection diagrams, roughing-in and hook up details for all equipment and comply therewith. All electrical work shall be complete and left in operating condition in accordance with the intent of the Drawings and the Specifications for the electrical work.

B. Where the word "Contractor" appears in these Technical Specifications it shall be construed to mean the Electrical Contractor.

C. THE CONTRACTOR SHALL REFERENCE THE FUNCTIONAL DESCRIPTIONS AND OTHER REQUIREMENTS FOUND IN 13600 – INSTRUMENT AND CONTROLS FOR ADDITIONAL REQUIREMENTS PERTAINING TO WORK UNDER THIS CONTRACT. THE FUNCTIONAL DESCRIPTIONS REFERENCED HEREIN SHALL BE CONSIDERED AS PART OF THE WORK REQUIRED UNDER THIS CONTRACT. CONTRACTOR IS RESPONSIBLE FOR COORDINATING WITH SCADA SYSTEM SUPPLIER FOR ALL CONNECTIONS REQUIRED BY THE SCADA SYSTEM.

D. THE CONTRACTOR SHALL BE RESPONSIBLE FOR ALL INTERCONNECTING DEVICES, CONDUIT, WIRE, AND APPURTENANCES NOT FURNISHED BY OTHERS BUT REQUIRED FOR THE OPERATION OF EQUIPMENT AS DESCRIBED IN THE FUNCTIONAL DESCRIPTIONS WHETHER SPECIFICALLY SHOWN ON THE DRAWINGS OR NOT.

E. The scope of work for this project primarily includes, but is not limited to, the following:

1. Furnish and install electrical equipment as specified and shown on the Contract for the new Chemical Feed Building. Electrical work includes but is not limited to, electrical service, lighting, pump controls, HVAC, and instrumentation.
2. Other electrical work as specified herein and indicated on the Drawings.

F. All electrical equipment shall conform to the applicable NEMA specifications. All electrical equipment shall be properly identified in accordance with these Specifications and Contract Drawings. Nameplates shall be engraved high pressure plastic laminate, black with white lettering for 120/208 or 120/240V equipment, and red with white lettering for 277/480 or 480V equipment. The nameplates shall be attached to the equipment cabinets with two (2) stainless steel sheet metal screws for nameplates up to 2-inch wide. For nameplates over 2-inch wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. All panelboards, starters, control panels, cabinet enclosures, and equipment switches shall be labeled in the manner described, or in an equally approved manner.

G. All materials, equipment, sizes and capacities of electrical equipment incorporated in the project shall conform to the latest requirements of the current National Electric Code, the National Electrical Manufacturer's Association, the State and local electrical codes, and to applicable rules and regulations of the local electrical utility serving the project.

H. All material and equipment must be the product of an established and reputable manufacturer; must be new and of first class construction; must be designed and guaranteed to perform the service required; and must bear the label of approval of the Underwriters Laboratories, Inc., where such approval is available for the product of the listed manufacturer as approved by the Engineer.

I. When a specified or indicated item has been superseded or is no longer available, the manufacturer's latest equivalent type or model of material or equipment as approved by the Engineer shall be furnished and installed at no additional cost to the Owner.

J. Where the Contractor's selection of equipment of specified manufacturers or additionally approved manufacturers requires changes or additions to the system design, the Contractor shall be responsible in all respects for the modifications to all system designs, subject to approval of the Engineer. The Contractor's bid shall include all costs for all work of the Contract for all trades made necessary by such changes, additions or modifications or resulting from any approved substitution.

K. Furnish and install controls for each piece of equipment requiring the controls under this Contract. The controls shall be the size and type recommended by the manufacturer for the application and as otherwise specified or indicted on the Drawings. Refer to Divisions 1 and 13 of the Specifications for control, connection and coordination descriptions and requirements.

L. Furnish and install all stands, racks, brackets, supports, and similar equipment required to properly serve the equipment which is furnished under this Contract, or equipment otherwise specified or indicated on the Drawings.

1.02 Drawings

A. Conduits and wiring are shown diagrammatically only, and the layout does not necessarily show the total number of conduits for the circuits required, nor are the locations of indicated runs intended to show the actual routing of conduits. The Contractor shall furnish, install, and place in satisfactory condition ready for operation, all conduits, cables, and all other material needed for the complete lighting, power, and other electrical systems shown or indicated in the Contract Documents. Additional conduits and the required wiring shall be installed by the Contractor for wherever needed to complete the installation of the specific equipment furnished, at no additional cost to the Owner.

1.03 Equipment Location

A. The Drawings show the general location of feeders, transformers, outlets, conduits, and circuit arrangements. Because of the small scale of the Drawings, it is not possible to indicate all of the details involved. The Contractor shall carefully investigate the structural and finish conditions affecting all of his work and shall arrange such work accordingly; furnishing such fittings, junction boxes, and accessories as may be required to meet such conditions. The Contractor shall refer to the entire Drawing set to verify openings, special surfaces, and location of other equipment, or other special equipment prior to roughing-in for panels, switches, and other outlets. The Contractor shall verify all equipment dimensions to insure that proposed equipment will fit properly in spaces indicated.

1.04 Local Conditions

A. The Contractor shall examine the site and become familiar with conditions affecting the work. He shall investigate, determine, and verify locations of any overhead or buried utilities on or near the site, and shall determine such locations in conjunction with all public and/or private utility companies and with all authorities having jurisdiction. All costs, both temporary and permanent to connect all utilities, shall be included in the Bid. Costs for connecting electrical service include meter base, CT cabinet, underground duct bank, etc. Coordination with the serving utility is required prior to the bid to ensure these items have been adequately accounted for in the bid. The Contractor shall be responsible for scheduling and coordinating with the local utility for temporary and permanent services.

1.05 Submittals

A. The Contractor shall submit to the Engineer Shop Drawings of all electrical materials, apparatus, appliances, equipment and miscellaneous devices shown or specified and shall be in accordance with the requirements of the General Conditions and Section 01300, Submittals.

B. Shop Drawings shall be sufficiently complete in detail to enable the Engineer to determine compliance with Contract requirements. Details and information shown shall include but are not necessarily limited to the following:

1. Performance characteristics.

2. Physical sizes.
3. Material and equipment specifications, and construction and methods of fabrication details.
4. Compliance with standards (e.g. UL, NEMA), rules, regulations, and codes.
5. Accessories.
6. Complete wiring diagrams showing circuit designations as shown on the Drawings. A complete wiring diagram shall be submitted for each controller furnished.
7. Complete product data sheets for all components of the specified equipment.
8. Electrical ratings (voltage, current, KVA, phase, etc.)
9. Weights of components parts and assembled unit weights.
10. Complete assembly, layout, and installation drawings with clearly marked dimensions.

C. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

D. Shop Drawings will be approved only to the extent of the information shown. Approval of an item of equipment shall not be construed to mean approval for components of that item for which Contractor has provided no information.

E. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's specification section.

F. Each submittal shall be identified by the applicable specification section.

1.06 Applicable Codes and Requirements

A. Conformance

1. All work, equipment and materials furnished shall conform with the existing rules, requirements and specifications of the Insurance Rating Organization having jurisdiction, the serving electrical utility company, the latest edition of the National Electrical Code (NEC), the National Electric Manufacturers Association (NEMA), the Institute of Electrical and Electronic Engineers (IEEE), the Insulated Power Cable Engineers Association (IPCEA), the American Society of Testing Materials (ASTM), the American National Standards Institute (ANSI), the requirements of the Occupational Safety Hazards Act (OSHA), and all other applicable Federal, State and local laws and/or ordinances.
2. All material and equipment shall bear the inspection labels of Underwriters Laboratories, Inc., if the material and equipment is of the class inspected by said laboratories.
3. All work shall be in accordance with local codes.

B. Nonconformance

1. Any paragraph of requirements in these Specifications, or Drawings, deviating from the rules, requirements and Specifications of the above organizations shall

be invalid and their (the above organizations) requirements shall hold precedent thereto. The Contractor shall be held responsible for adherence to all rules, requirements and specifications as set forth above. Any additional work or material necessary for adherence will not be allowed as an extra, but shall be included in the Bid Price. Ignorance of any rule, requirement, or Specification shall not be allowed as an excuse for nonconformity. Acceptance by the Engineer does not relieve the Contractor from the expense involved for the correction of any errors which may exist in the drawings submitted, or in the satisfactory operation of any equipment.

C. Certification

1. Upon completion of the work, the Contractor shall obtain certificate(s) of inspection and approval from the National Board of Fire Underwriters or similar inspection organization having jurisdiction and shall deliver same to the Engineer and the Owner.

1.07 Permits and Inspections

A. The Contractor shall reference the General Conditions.

1.08 Temporary Lighting and Power

A. The Contractor shall reference the General Conditions.

1.09 Tests

A. Upon completion of the installation, the Contractor shall perform tests for operation, load (Phase) balance overloads, and short circuits. Tests shall be made with and to the satisfaction of the Owner and Engineer.

B. The Contractor shall perform all field tests and shall provide all labor, equipment, and incidentals required for testing and shall pay for electric power required for the tests. All defective material and workmanship disclosed shall be corrected by the Contractor at no cost to the Owner. The Contractor shall show by demonstration in service that all circuits and devices are in good operating condition. Test shall be such that each item of control equipment will function not less than five (5) times.

C. The grounding system shall be tested to assure continuity and compliance with the requirement that ground resistances do not exceed 5 ohms when measured by a megohmeter or equivalent device. Ground resistance measurements of each grounding electrode shall be taken and certified by the Contractor. Upon completion of the Project, the Contractor shall submit to the Engineer the measured ground resistance of each ground rod and grounding system, indicating the location of the rod and grounding system as well as the resistance and soil conditions at the time the measurements were made. Ground resistance measurements shall be made in normally dry weather not less than 48 hours after rainfall and with the ground under test isolated from other grounds. Ground resistance shall also be measured from each piece of equipment to the grounding electrode. Reference Section 16170, Grounding and Bonding, for additional requirements.

D. Each lighting and power distribution panelboard shall be tested with main circuit breaker disconnected from the feeder, branches connected, branch circuit breakers closed, all fixtures in place and permanently connected, lamps removed or omitted from the fixtures, and all wall switches closed.

E. Testing (Insulation Resistance Test) of all incoming and outgoing cables for switchgears, distribution and power panels, motor control centers, and similar equipment shall be done after the cables are in place and just prior to final terminations. All data shall be recorded, as per Exhibit "A", attached to the end of this Section.

F. The Contractor shall furnish all equipment and personnel as required.

G. Feeder circuits shall be tested with the feeder conductors disconnected from the supplied equipment. Each individual power circuit shall be tested at the panel or motor control center with the power equipment connected for proper operation.

H. Megohmmeter tests of the insulation resistance of rotating machines and power feeders shall be conducted. The results will be accepted when the megger shows the insulation resistance to be not less than one megohm per 100 volts at 10°C using a 1,000-volt megger.

I. All transformers shall be Megohmmeter tested in accordance with the manufacturer's recommendations.

1.10 Documentation

A. Required Documentation

The work requirements of this Section is in addition to and does not supersede testing and adjusting specified in other portions of the Contract Documents. The Contractor shall submit to the Engineer test records and reports for all testing.

1.11 Field Test of Equipment

A. The equipment to be tested shall include, but not be limited to, the following:

- Panelboards
- Conduit System
- Cable and Wire
- Grounding System
- Lighting Fixtures (Indoor and Outdoor)

B. Refer to each specific specification section for detailed field tests.

1.12 Final Field Test of System

A. The Contractor shall complete the installation and testing of the electrical installation at least two (2) weeks prior to the start-up and testing of all other equipment. During

the period between the completion of electrical installation and the start-up and testing of all other equipment, the Contractor shall make all components of the Work available as it is completed for their use in performing Preliminary and Final Field Tests.

B. Before each test commences, the Contractor shall submit a detailed test procedure, and also provide test engineer resume, manpower and scheduling information for the approval by the Engineer. In addition, the Contractor shall furnish detailed test procedures for any of his equipment required as part of the field tests of other systems.

C. The Contractor shall perform an infrared inspection to locate and correct all heating problems associated with electrical equipment. The infrared inspection shall apply to existing and new equipment.

1.13 Protective Device Setting and Testing

A. All protective devices in the electrical equipment, shall be set, adjusted, calibrated and tested in accordance with the manufacturers' recommendations, the coordination study, and best industry practice.

B. Proper operation of all equipment associated with the device under test and its compartment shall be verified, as well as complete resistance, continuity and polarity tests of power, protective and metering circuits. Any minor adjustments, repairs and/or lubrication necessary to achieve proper operation shall be considered part of this Contract.

C. All solid state trip devices shall be checked and tested for setting and operation using manufacturers recommended test devices and procedures.

D. Circuit breakers and/or contactors associated with the above devices shall be tested for trip and close functions with their protective device.

E. When completed, the Contractor shall provide a comprehensive report on all equipment tested indicating condition, readings, faults and/or deficiencies in same. Inoperative or defective equipment shall be brought immediately to the attention of the Engineer.

F. Prior to placing any equipment in service, correct operation of all protective devices associated with this equipment shall be demonstrated by field testing under simulated load conditions.

1.14 Schedules and Plant Operations

A. Since the testing required in 1.12 above shall require that certain pieces of equipment be taken out of service, all testing procedures and schedules must be submitted to the Engineer for review and approval one month prior to any work beginning. When testing has been scheduled, the Engineer must be notified forty-eight hours prior to any work to allow time for load switching and/or alternation of equipment. In addition, all testing that requires temporary shutdown of plant

equipment must be coordinated with the Owner/Engineer so as not to affect proper plant operations.

B. At the end of the workday, all equipment shall be back in place and ready for immediate use should a plant emergency arise. In addition, should an emergency condition occur during testing, at the request of the Owner, the equipment shall be placed back in service immediately and turned over to plant personnel.

C. In the event of accidental shutdown of plant equipment, the Contractor shall notify plant personnel immediately to allow for an orderly restart of affected equipment.

1.15 Materials Handling

A. Materials arriving on the job site shall be stored in such a manner as to keep material free of rust and dirt, and so as to keep material properly aligned and true to shape. Rusty, dirty, or misaligned material shall be rejected. Electrical conduit shall be stored to provide protection from the weather and accidental damage. Rigid non-metallic conduit shall be stored on even supports and in locations not subject to direct sun rays or excessive heat. Cables shall be sealed, stored, and handled carefully to avoid damage to the outer covering or insulation and damage from moisture and weather. Adequate protection shall be required at all times for electrical equipment and accessories until installed and accepted. Materials damaged during shipment, storage, installation, or testing shall be replaced or repaired in a manner meeting with the approval of the Engineer. The Contractor shall store equipment and materials in accordance with Section 01550, Site Access and Storage.

PART 2 - PRODUCTS

2.01 Product Requirements

A. Unless otherwise indicated, the materials to be provided under this Specification shall be the products of manufacturers regularly engaged in the production of all such items and shall be the manufacturer's latest design. The products shall conform to the applicable standards of UL and NEMA, unless specified otherwise. International Electrotechnical Commission (IEC) standards <u>are not</u> recognized. Equipment designed, manufactured, and labeled in compliance with IEC standards is not acceptable.

B. All items of the same type or ratings shall be identical. This shall be further understood to include products with the accessories indicated.

C. All equipment and materials shall be new, unless indicated or specified otherwise.

D. The Contractor shall submit proof if requested by the Engineer that the materials, appliances, equipment, or devices that he provides under this Contract meet the requirements of Underwriters Laboratories, Inc., in regard to fire and casualty hazards. The label of or listing by the Underwriters Laboratories, Inc., will be accepted as conforming with this requirement.

2.02 Substitutions

A. Any reference in the Specifications or on the Drawings to any article, service, product, material, fixture, or item of equipment by name, make, or catalog number shall be interpreted as establishing the type, function, and standard of quality and shall not be construed as limiting competition.

2.03 Concrete

A. The Contractor shall furnish all concrete required for the installation of all electrical work, Concrete shall be Class A unless otherwise specified, and in complete conformance with the applicable requirements of Division 3 of the Specifications.

B. The Contractor shall provide concrete equipment pads for all free standing electrical apparatus and equipment located on floors or slabs that are existing or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, etc. The exact location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of these pads. Equipment pads shall be 4 inches high unless otherwise indicated on the Drawings. Pads shall be reinforced with steel wire mesh and shall have dowel rods inserted into the floor for anchorage.

C. The Contractor shall provide concrete foundations for all free standing electrical apparatus and equipment located outdoors or where floors or slabs are not existing or provided by others. The Contractor shall provide all necessary anchor bolts, channel iron sills, etc. The location and dimensions shall be coordinated for each piece of equipment well in advance of the scheduled placing of the foundations. Equipment foundations shall be constructed as detailed on the Drawings or if not detailed on the Drawings shall be 6 inches thick minimum reinforced with #4 bars at 12-inch centers each way placed mid-depth. Concrete shall extend 6 inches minimum beyond the extreme of the equipment base and be placed on a compacted stone bed (#57 stone or ABC) 6 inches thick minimum.

D. Concrete and reinforcing steel shall meet the appropriate requirements of Division 3 of the Specifications.

PART 3 - EXECUTION

3.01 Cutting and Patching

A. Coordination

1. The work shall be coordinated between all trades to avoid delays and unnecessary cutting, channeling and drilling. Sleeves shall be placed in concrete for passage of conduit wherever possible.

B. Damage

1. The Contractor shall perform all chasing, channeling, drilling and patching necessary to the proper execution of his Contract. Any damage to the building or any equipment shall be repaired by qualified mechanics of the trades involved at the Contractor's expense. If, in the Engineer's judgment, the repair of damaged equipment would not be satisfactory, then the Contractor shall replace damaged equipment at his own expense.

3.02 Excavation and Backfilling

A. The Contractor shall perform all excavation and backfill required for the installation of all electrical work. All excavation and backfilling shall be in complete accordance with the applicable requirements of Division 2.

3.03 Corrosion Protection

A. Wherever dissimilar metals, except conduit and conduit fittings, come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

-END-

SECTION 16111 - CONDUIT

PART 1 - GENERAL

1.01 The Requirement

A. Under this Section, the Contractor shall furnish and install all conduits and conduit fittings to complete the installation of all electrically operated equipment as specified herein and as required.

B. The Drawings indicate the general location of conduits both exposed and concealed; however, the Contractor shall install these conduits in such a manner to avoid all interferences.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed shop tests
   a. None required.
2. Field tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.
   b. All conduit shall be tested to ensure continuity and the absence of obstructions by pulling through each conduit a swab followed by a mandrel 85% of the conduit inside diameter. After testing, all conduits shall be capped after installation of suitable pulling tape.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to equipment specifications and product data sheets identifying all materials used and methods of fabrtion.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The material covered by this Specification is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 Conduits

A. Unless specified otherwise herein, or indicated on the Drawings, all conduits shall be rigid, hot-dipped galvanized steel. Minimum size conduit shall be 3/4 inch unless specifically indicated otherwise on the Drawings. Unless specified otherwise herein or indicated on the Drawings, all encased conduits shall be PVC Schedule 40, minimum size 1 inch. The Contractor, at his option, for ease of installation to accommodate saddle size, may increase the size of encased conduits to 2-inch. However, no combining of circuits/conductors will be permitted in these larger conduits.

All components of the conduit system shall be of the same material of construction. Rigid galvanized steel conduit systems shall include fittings, couplings, connectors, and other components compatible with and approved for such systems. Coated conduit systems shall include factory coated fittings couplings, connectors, and other components compatible with and approved for coated conduit systems.

Reference the "Conduit Uses" portion of this specification for additional information regarding conduit.

B. Rigid Aluminum Conduit

1. Aluminum conduits shall be rigid type, heavy wall, and as manufactured by Allied Tube and Conduit Corporation, Wheatland Tube Company, Jones & Laughlin Steel Company, or equal.
2. Each length of conduit shall be shipped with a coupling on one end and a color coded thread protector at the other end.

C. Liquid-Tight Flexible Metal Conduit

1. Liquid-tight flexible conduit (LFMC) shall be galvanized steel, single strip, with a copper strip interwoven and suitable as a grounding means. LFMC shall be UL listed. LFMC shall have an extruded moisture and oil-proof PVC jacket. LFMC shall be Liquatite Type "LA" as manufactured by Electri-Flex, "Ultratite" Type UL"Ultralite" as manufactured by Alflex Corporation, Type "A" as manufactured by Anaconda, or equal.
2. Watertight connectors shall be used with liquid-tight flexible metal conduit on both ends. LFMC shall be used to connect all vibrating equipment installed outdoors, in wet or damp areas, and other applications as directed by the Engineer.

D. Rigid Nonmetallic Conduit

1. Rigid nonmetallic conduit shall be Schedule 40 polyvinyl chloride (PVC), 90°C, UL rated and shall conform to NEMA TC-2. Fittings and conduit bodies shall conform to NEMA TC3.
2. Rigid non-metallic conduit shall be as manufactured by Carlon, Triangle Conduit and Cable, Cantex, Inc., or equal.

E. PVC Coated Metallic Conduit

1. PVC coated rigid steel conduit shall be furnished and installed as specified herein and indicated on the Drawings. The product shall be rigid galvanized steel conduit covered with a bonded 40 mil (minimum) thickness PVC jacket and coated inside with urethane. The conduit shall comply with NEMA RN-1 and shall be "Plasti-Bond Red" as manufactured by Robroy Industries, "OCAL-Blue" as manufactured by Ocal, Inc., Perma-Cote Supreme by Perma-Cote Industries, or equal.

F. Conduit Fittings

1. Fittings for rigid metal conduit, rigid nonmetallic conduit, flexible metal conduit, liquid-tight flexible metal conduit, and electrical metallic tubing shall conform to UL 467 and UL 514 as applicable.
2. Set screw or indentor type connectors shall not be used. Fittings for conduit installed in wet locations and underground shall provide a watertight joint. Fittings for rigid conduit shall be threaded.
3. Fittings or bushings shall be installed in easily accessible locations.
4. Where exposed conduits pass across structural expansion joints, approved weatherproof telescopic type expansion fittings shall be used. Fittings shall be OZ/GEDNEY Type AX, or equal, watertight, permit a movement up to 4 inches, and shall be equipped with approved bonding jumpers around or through each fitting. Bonding jumpers shall be Appleton, Crouse-Hinds, OZ/Gedney, or equal. Where embedded conduits pass through expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of ¾-inch from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, or equal. Where embedded conduits pass through structural expansion joints, approved watertight, concrete-tight deflection/expansion fittings shall be used. Fittings shall compensate for movement of ¾-inch from the normal in all directions. Fittings shall be OZ/GEDNEY Type DX, or equal.
5. Conduit fittings ("condulets") shall be used on exposed conduit work for lighting and power outlets, convenience outlets, changes in direction of conduit runs and breaking around beams. "Condulets" shall be cast ferrous alloy, galvanized or cadmium plated, as manufactured by Crouse-Hinds, OZ/Gedney, Appleton Company, or equal. Coated fittings and boxes shall be used with coated conduit in all chemically aggressive areas or where called for on the Drawings. Covers shall be of a design suitable for the purpose intended. In damp areas, the outside condulets shall be made watertight. Install all condulets with the covers

accessible. Use proper tools to assemble conduit system to prevent injury to the plastic covering. No damage to the covering shall be permitted.

6. Conduit fittings shall be cast type of non-ferrous metal or malleable iron thoroughly coated inside and outside with metallic zinc or cadmium after all machining has been completed. Cast fittings shall be provided with heavy threaded hubs to fit the conduit required. Covers shall be of the same material as the fittings to which they are attached and shall be screwed on with rubber or neoprene gaskets between the covers and fittings. Cast fittings 1-1/2 inches and above shall be of the "mogul" type. Where cast fittings are used to house wiring devices such as receptacles and switches, they shall be of the "deep" type.
7. Coated fittings shall be used with coated conduit. All conduit nipples, elbows, couplings, boxes, fittings, unions, expansion joints, connectors, bushing, and other components of the raceway system shall be factory coated to maintain the corrosion-resistant integrity of the conduit system. The coated conduit and its respective components shall all be provided by the same manufacturer. Coated conduit shall be used in all areas specified herein or indicated on the Drawings.
8. Conduit seals shall be Type EYS as manufactured by Crouse-Hinds, Appleton equivalent, OZ/Gedney equivalent, or equal.

PART 3 - EXECUTION

3.01 Conduit and Fittings

A. Unless otherwise specified herein or indicated on the Drawings, the minimum size conduit shall be 3/4 inch for exposed work and 1 inch for conduit encased in concrete or mortar.

B. Conduit home runs for some lighting circuits are not necessarily indicated on the Drawings; however, the circuit numbers are shown. Conduit shall be furnished and installed for these lighting circuits and shall be installed as required to suit field conditions, subject to review and acceptance by the Engineer.

C. Conduit shall be installed concealed unless otherwise indicated or specified. Conduit may be run exposed on walls only where concealing is not practical, or at the direction of the Engineer.

D. Where exposed, maintain a minimum distance of 6 inches from parallel runs of flues or water pipes. Conduit runs shall be installed in such locations as to avoid steam or hot water pipes. A minimum separation of 12 inches shall be maintained where conduit crosses or parallels hot water or steam pipes.

E. For floor mounted equipment, conduit may be run overhead and dropped down, where underfloor installation is not practical. Groups of conduits shall be uniformly spaced, where straight and at turns. Conduit shall be cut with a hacksaw or an approved conduit-cutting machine and reamed after threading to remove all burrs. Securely fasten conduit to outlets, junction and pull boxes to effect firm electrical contact. Join conduit with approved couplings. Conduits shall be freed from all obstructions.

F. Empty conduit systems shall be furnished and installed as indicated on the Drawings and shall have pull wires installed. The pull wire shall be No. 14 AWG zinc-coated steel, or of plastic material, having not less than 200 pound tensile strength. Not less than 12 inches of slack shall be left at each end of the pull wire.

G. Each piece of conduit installed shall be free from blisters or other defects. Each piece installed shall be cut square, taper reamed, and a coat of sealing compound applied to threads. Threads on conduits shall be painted with a conducting compound prior to making up in a fitting. Conduit connections shall be made with standard coupling and the ends of the conduit shall butt tightly into the couplings. In exposed work only, where standard coupling cannot be used, only Erickson couplings are permitted, or as otherwise acceptable to the Engineer.

H. Conduit threaded in the field shall be of standard sizes and lengths.

I. All bends shall be made with standard factory conduit elbows or field bent elbows. Field bending of conduit shall be done using tools approved for the purpose. Heating of conduit to facilitate bending is prohibited. Field bends shall be not less than the same radius than a standard factory conduit elbow. Bends with kinks shall not be acceptable.

The equivalent number of 90° bends in a single conduit run are limited to the following:

1. Runs in excess of 300 feet: 0
2. Runs of 300 feet to 201 feet: 1
3. Runs of 200 feet to 101 feet: 2
4. Runs of 100 feet and less: 3

All conduit for fiber optic cable shall have a minimum bending radius of 16 inches. Final bending radius shall be determined by the fiber optic cable manufacturer.

J. Unless otherwise specified herein, indicated on the Drawings, or required by the NEC, conduit shall be supported every 8 feet and shall be installed parallel with or perpendicular to walls, structural members, or intersections of vertical planes and ceilings with right angle turns consisting of fittings or symmetrical bends. Conduits shall be supported within 1 foot of all changes in direction. Supports shall be approved pipe straps, wall brackets, hangers or ceiling trapeze. All fasteners, clamps, straps, and anchors shall be stainless steel. The use of perforated strap hangers or Mineralac conduit hangers are prohibited. Perforated strap hangers shall not be used. In no case shall conduit be supported or fastened to another pipe or installed to prevent the removal of other pipe for repairs. Fastenings shall be by expansion bolts on concrete; by machine screws, welded threaded studs, or spring-tension clamps on steel work. Explosive-drive equipment may be used to make connections where the use of this equipment complies with safety regulations. Wooden plugs inserted in masonry and the use of nails as fastening media are prohibited. Threaded C-clamps may be used on rigid steel conduit only. Conduits or pipe straps shall not be welded to steel.

K. The load applied to fasteners shall not exceed 1/4 of the proof test load. Fasteners attached to concrete ceilings shall be vibration and shock resistant. Holes cut to a depth of more than 1-1/2 inches in reinforced concrete beams or to a depth of more than 3/4 inch in concrete joints shall not cut the main reinforcing bars. Holes not used shall be filled. Spring steel fasteners may only be used to support lighting branch circuit conduits to structural steel members. Conduits shall be fastened to all sheet metal boxes and cabinets with two (2) locknuts where required by the National Electrical Code to insure adequate bonding for grounding. Where insulated bushings are used, or where bushings cannot be secured firmly to the box or enclosure, a bonding jumper shall be installed to maintain suitable grounding continuity. Locknuts shall be the type with sharp edges for digging into the wall of metal enclosures. Bushings shall be installed on the ends of all conduits and shall be of the insulating type where required by the National Electrical Code.

L. Conduit installed in concrete floor slabs or walls shall be located so as not to affect the designed structural strength of the slabs. Conduit shall be installed within the middle one-third of the concrete slab except where necessary to not disturb the reinforcement. The outside diameter of conduit shall not exceed one-third of the slab thickness, and conduits shall be spaced no closer than three (3) diameters except at cabinet locations. Curved portions of bends shall not be visible above the finish slab. Where embedded conduits cross expansion joints, suitable watertight expansion fittings and bonding jumpers shall be provided. Conduit larger than 1-inch trade size shall be parallel with or at right angles to the main reinforcement. When at right angles to the reinforcement, the conduit shall be close to one of the supports of the slab. Conduits shall not be stacked more than two (2) diameters high in floor slabs.

M. Install polyvinyl chloride (PVC) coated steel conduits when entering or exiting concrete except under electrical equipment where the conduit is not subject to physical abuse. Extend stub-ups at least 12 inches above and below grade or finish floor. Conduits extending through the concrete floor shall be installed using straight runs (for vertical penetrations) or factory elbows (for conduits installed within the slab) of PVC coated rigid steel conduit.

N. All conduit extending through the floor behind panels or into control centers or similar equipment may be PVC Schedule 40 and shall extend a minimum of 6 inches above the floor elevations, where practicable, with no couplings at floor elevations.

O. Unless specifically identified on the Drawings as "Direct Buried," all conduits in the earth, including conduits below slabs-on-grade, shall be concrete encased. Joints in conduit shall be staggered so as not to occur side by side. Rigid non-metallic (PVC) conduit shall be connected to PVC coated rigid steel conduit at the point where it leaves the ground, with the transition to metal conduit occurring inside the concrete encasement.

P. No more than three (3) 90 degree bends will be allowed in any one conduit run. Where more bends are necessary, a condulet or pull box shall be installed. All bends in 1/2-inch and 3/4-inch conduit shall be made with a conduit bender, and all larger sizes shall have machine bends. Joints in threaded conduit shall be made up watertight with the appropriate pipe thread sealant or compound applied to male

threads only; and, all field joints shall be cut square, reamed smooth, and properly threaded to receive couplings. No running threads are permitted. All conduit ends at switch and outlet boxes shall be fitted with an approved locknut and bushing forming an approved tight bond with box when screwed up tightly in place.

Q. Conduits stubbed up through concrete floors for connections to freestanding equipment and for future equipment shall be provided with an adjustable top or coupling threaded inside for plugs, set flush with the finished floor. Wiring shall be extended in rigid metal conduit to equipment except that, where required, flexible metal conduit may be used 6 inches above the floor. Screwdriver operated threaded flush plugs shall be installed in conduits from which no equipment connections are made.

R. Where outlets are shown near identified equipment furnished by this or other Contractors, it is the intent of the Specifications and Drawings that the outlet be located at the equipment to be served. The Contractor shall coordinate the location of these outlets to be near the final location of the equipment served whether placed correctly or incorrectly on the Drawings. Changes in outlet locations required to serve the equipment furnished by other Contractors on the Project shall be brought to the attention of the Engineer.

S. Conduit shall be protected immediately after installation by installing flat non-corrosive metallic discs and steel bushings, designed for this purpose, at each end. Discs shall not be removed until it is necessary to clean the conduit and install the conductors. Before the conductors are installed, insulated bushings shall be installed at each end of the conduit.

T. Where "all-thread" nipples are used between fittings and electrical equipment, they shall be so installed that no threads are exposed.

U. Connections from rigid conduit to motors and other vibrating equipment, limit switches, solenoid valves, level controls, and similar equipment, shall be made with short lengths of liquid-tight flexible metal conduit. These conduits shall be installed in accordance with the NEC and shall be furnished and installed with appropriate connectors with devices which will provide an excellent electrical connection between the equipment and the rigid conduit for the flow of ground current. Flexible metal conduit and liquid-tight flexible metal conduit length shall be five feet (5 feet), maximum.

V. Flexible metal conduit or liquid-tight flexible metal conduit installed between rigid metal conduit and motor terminal box and/or any other apparatus shall have a green insulated grounding conductor running through flexible conduit. This conductor shall be terminated to the nearest pull box, motor terminal box, or any other apparatus ground terminal.

W. All threaded ends of conduits shall be coated with an approved conducting compound as manufactured by Thomas & Betts, or equal prior to making up the joint.

X. Conduits installed within or underneath floor slabs, underground direct-buried or concrete encased conduits, and all conduits installed in areas subject to liquid

inadvertently entering the conduit system shall be sealed or plugged at both ends in accordance with NEC Article 300-5(g). This requirement applies to both conduits containing conductors and "spare" conduits. Where practicable, the interior of the conduit shall be sealed as well as around the conductors by using conduit sealing bushings: Type CSB as manufactured by O/Z Gedney, or equal. Where the conduit fill does not allow the use of these bushings, the conduits shall be tightly caulked or plugged.

Conduit passing through the walls and floors of buildings below grade shall be installed with appropriate watertight fittings to prevent the entrance of ground water around the periphery of the conduits. For vertical conduit penetrations through openings in concrete floors, the fittings shall be Type FSK Floor Seals as manufactured by OZ/Gedney. For conduit penetrations through openings in concrete walls, the fittings shall be Type WSK Thruwall seals as manufactured by OZ Gedney. Conduits shall be sloped away from the buildings toward splice boxes, handholes and/or manholes to provide drainage away from the building wall.

Conduits passing through sleeves in interior walls and floors shall be tightly caulked.

Y. Weatherproof, insulated throat "Meyers" hubs shall be used on all conduit entries to boxes and devices without integral hubs in process areas to maintain NEMA 4X integrity. The Contractor shall furnish and install "Meyers" hubs on all conduit entries into non-cast enclosures such as metallic or non-metallic control panels, control component enclosures, wireways, pull boxes, junction boxes, control stations, and similar type equipment when this type of equipment is located in process areas requiring NEMA 4X integrity. This specified requirement for "Meyers" hubs does not apply to any area of the plant facilities where NEMA 4X integrity is not required.

Z. The use of two (2) locknuts and a grounding bushing shall be required at all conduit terminations where hub type fittings are not required; such as electrical rooms, control rooms, and office areas.

AA. Conduit installation shall be arranged to minimize cleaning. No horizontal runs of conduit will be permitted in brick or masonry walls.

AB. Install non-metallic conduits in accordance with manufacturer's instructions where specified herein or indicated on the Drawings.

AC. Join non-metallic conduit using cement as recommended by the manufacturer. Clean and wipe non-metallic conduit dry before joining. Apply full even coat of cement to entire area inserted in fitting. Allow joint to cure for twenty (20) minutes (minimum).

AD. Use proper installation tools approved for the purpose to assemble coated conduit systems to prevent damage to the covering and maintain the corrosion-resistant integrity of the conduit system. No damage to the covering is permitted. Use “touch-up” compounds to repair minor damage to the interior or exterior coatings. Painting shall be as specified in Section 09900, Painting.

3.02 Conduit Uses and Applications

A. No PVC conduit shall be installed exposed unless specifically accepted in writing by the Engineer. Where PVC conduit is allowed to be installed exposed, the conduit shall be Schedule 80 as required by the NEC. Reference Article 300-5(d) of the NEC.

B. PVC Schedule 40 conduit shall be furnished and installed in concrete slabs (for slab-on-grade construction) and in walls when the conduit is shown to be encased. Rigid steel conduit shall be installed in all elevated slabs when the conduits are shown to be encased.

C. PVC coated rigid steel conduit shall be furnished and installed, where exposed, in the following areas:

   1. Where conduit exits concrete, as specified.

D. Aluminum conduit shall be used where conduit is exposed in all indoor and outdoor locations.

E. Other conduit uses not specifically listed above shall be brought to the attention of Engineer for a decision.

-END-

SECTION 16123 - BUILDING WIRE AND CABLE

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish, install, connect, test, and place in satisfactory operating condition, ready for service, all cables and wires indicated on the Drawings and as specified herein or required for proper operation of the installation, with the exception of internal wiring provided by electrical equipment manufacturers. The work of connecting cables to equipment, machinery, and devices shall be considered a part of this Section. All hardware, junction boxes, bolts, clamps, insulators, and fittings required for the installation of cable and wire systems shall be furnished and installed by the Contractor.

B. The Contractor shall submit Shop Drawings and other material required to substantiate conformance with the requirements set forth on the Drawings and in Section 16000, Basic Electrical Requirements, and Section 01300, Submittals. Shop drawings shall include, but not be limited to, detailed specifications and product data sheets for the power, control, and instrumentation cable required for this project.

C. The wire and cable to be furnished and installed for this project shall be the product of manufacturers who have been in the business of manufacturing wire and cable for a minimum of ten (10) years.

D. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All testing shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witness Shop Tests
   a. Not required.
2. Shop Test
   a. Prior to the first shipment of each size of power, control, and instrumentation cable to be furnished and installed under this Contract, samples of each size of cable shall be subjected to complete physical and electrical factory production tests at the manufacturer's plant. Other cable and wiring shall be tested in accordance with the applicable ICEA Standards. Six copies of certified test data sheets shall be submitted to the Engineer for approval prior to installation at the site. Subsequent shipment of each size of wire shall be covered by certificates of compliance which shall list Contractor's name, point of delivery, reel numbers, size of wire, length of wire, and date of shipment. Certificates shall attest the wires and cables comply with specification requirements and that wires and cables are equal in every respect to wires and cables which have been successfully tested.
   b. All test data or certificates shall be submitted.

3. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.
   b. After installation, all wires and cables shall be tested for insulation levels and continuity. Insulation resistance between conductors of the same circuit and between conductor and ground shall be tested. Testing for insulation levels shall be as follows:
      1) For 600V power and control cable, apply 1,000 VDC from a Megaohmeter for all 600V wires and cables installed in lighting, control, power, indication, alarm and motor feeder circuits. Testing for continuity shall be "test light" or "buzzer".
      2) 600V instrumentation signal cable shall be tested from conductor to conductor, conductor to shield, and conductor to ground using a Simpson No. 260 volt-ohmmeter, or approved equal. The resistance value shall be 200 Megaohms or greater.

B. Low voltage wires and cables shall be tested before being connected to motors, devices or terminal blocks.

C. Voltage tests shall be made successively between each conductor of a circuit and all other conductors of the circuit grounded.

D. If tests reveal defects or deficiencies, the Contractor shall make the necessary repairs or shall replace the cable as directed by the Engineer, without additional cost to the Owner.

E. All tests shall be made by and at the expense of the Contractor who shall supply all testing equipment.

1.03 Submittals

A. The Contractor shall obtain from the wire and cable manufacturer and submit the following:

   1. Shop Drawings
   2. Reports of Certified Shop and Field Tests
   3. Wiring Identification Methods

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed material's compliance with the Contract Documents.

B. Partial, incomplete, or illegible Submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Cable pulling calculations.
3. Wiring identification methods and materials.

1.05 Identification

A. Each cable shall be identified as specified in Part 3, Execution, of this Specification.

1.06 Cable Pulling Lubricants

A. The Contractor shall submit a list with a minimum of four manufacturer's standard lubricants which may be used interchangeably for each type of lubricant required. Lubricant shall be non-hardening type.

1.07 Cable Pull Calculations

A. The Contractor shall submit cable pulling calculations. These calculations, to be performed by a currently registered professional engineer in the State of Indiana, shall define pulling tension and sidewall loading (sidewall bearing pressure values) for all installations of 600VAC, #1/0 conductors and larger greater than 200 feet in length. Calculations for straight horizontal installations of 600VAC, #1/0 conductors and larger greater than 200 feet are not required.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The wire and cable covered by this Specification is intended to be standard equipment of proven performance as manufactured by the Okonite Company, Rome Cable Corporation, Southwire Company, or equal. Wire and cable shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings. Only one manufacturer for each wire and cable type shall be permitted.

2.02 600 Volt Power Wire and Cable

A. 600 volt cable and wire shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.

B. Conductors shall be tin or alloy coated (if available), stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.

C. Uncoated conductors shall only be allowed if specifically accepted by the Engineer.

D. 600 volt individual power wire and cable shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal. Multi-conductor power cables shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.03 600 Volt Control Cable

A. 600 volt control cable shall consist of stranded, copper conductor with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations. The individual conductors of the multiple conductor cable shall be color coded for proper identification. Color coding shall be equal to ICEA S-68-514, Table K-1. Cables shall meet requirements of IEEE-383.

B. Conductors shall be tin or alloy coated (if available) stranded copper per ASTM B-8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum wire size shall be No. 14 AWG.

C. Uncoated conductors shall only be allowed if specifically accepted by the Engineer.

D. 600 volt individual conductor control wire shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal. Multi-conductor control cable shall be Okoseal-N Type TC Cable as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.04 Lighting and Receptacle Wire and Cable

A. The lighting and receptacle branch circuit wire shall consist of stranded, copper conductors with insulation rated THHN, 90°C for dry locations and THWN, 75°C for wet locations.

B. Conductors shall be tin or alloy coated (if available), stranded copper per ASTM-B8 and B-33, and Class B or C stranding contingent on the size unless otherwise specified. Minimum size wire shall be No. 12 AWG.

C. Uncoated conductors shall only be allowed if specifically accepted by the Engineer.

D. Lighting and receptacle cables and wire shall be Okoseal-N as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

2.05 Instrumentation Cable

A. The instrumentation cable for analog signals shall be single, shielded, twisted pairs or triads with 600 volt insulation and shall have a 90°C insulation rating.

B. Conductors shall be tin or alloy coated (if available), soft, annealed copper, stranded per ASTM-B8, Class B stranding unless otherwise specified. Minimum size wire shall be No. 16 AWG.

C. The instrumentation cable shall be Okoseal-N Type P-OS for single pair or triad applications and Okoseal-N Type SP-OS for multiple pair or triad applications as manufactured by the Okonite Company, Rome Cable Corporation equivalent, Southwire Company equivalent, or equal.

PART 3 - EXECUTION

3.01 600V Cable Installation

A. The cable and wires shall be installed as specified herein and shown on the Drawings.

B. The cables shall be terminated in accordance with the cable and/or termination product manufacturer's instructions for the particular type of cable.

C. To minimize oxidation and corrosion, wire and cable shall be terminated using an oxide-inhibiting joint compound recommended for "copper-to-copper" connections. The compound shall be Penetrox E as manufactured by Burndy Electrical, or equal.

D. Splices shall not be allowed in the underground manhole and handhole systems. If splices are required, the Contractor shall obtain approval in writing from the Engineer prior to splicing. Splicing materials shall be barrel type butt splice connectors and heat shrink tubing as manufactured by 3M, Ideal, or equal. No splicing of instrumentation cable is allowed. The use of screw-on wire connectors (wire nuts) for power or control wiring will only be permitted if specifically accepted by the Engineer. Reference Section 16130 for additional requirements regarding control wiring.

E. Wire and Cable Sizes

1. The sizes of wire and cable shall be as shown on the Drawings, or if not shown, as approved by the Engineer. If required due to field routing, the size of conductors and respective conduit shall be increased so that the voltage drop does not exceed 2-1/2%.
2. Minimum wire size within control panels, motor control centers, switchboards and similar equipment shall be No. 12 AWG for power and No. 14 AWG for control.

F. Number of Wires

1. The number of wires indicated on the Drawings for the various control, indication, and metering circuits were determined for general schemes of control and for particular indication and metering systems.
2. The actual number of wires installed for each circuit shall, in no case, be less than the number required; however, the Contractor shall add as many wires as may be required for control and indication of the actual equipment selected for installation at no additional cost to the Owner. The addition of conductors shall be coordinated with and approved by the Engineer to avoid violations of the NEC regarding conduit fill.

3. All spare field conductors shall be terminated on the terminal blocks mounted within the equipment.

G. Wiring Identification

1. All wiring shall be identified at each termination, shall have a unique wire number, and shall be labeled at both ends. Wire numbers shall correspond with the equipment terminal wire numbers as indicated in the accepted Shop Drawings. Where no wire numbers are indicated, the Contractor shall advise the Engineer in writing prior to assigning wire numbers. Wire numbers shall not be duplicated.
2. In addition to color coding, for all 1-phase and 3-phase systems, identify each cable (single or multi-conductor) and conductor at each end, in each manhole, pullbox, cable tray, or other component of the raceway system. This identification is applicable to all power, control, alarm, signal, and instrumentation cables, and conductors.
3. Identify each cable (single or multi-conductor) and groups or bundles of individual single conductors in each manhole, pullbox, cable tray or other component of the raceway system with circuit identification markers. Implement a "from-to" cable/conductor bundle tagging system as part of this identification effort.
4. For instrumentation wiring, the Contractor shall provide, on the Shop Drawings, a schedule indicating the wire number, color code, if applicable, origin and destination devices, and terminals.
5. Wire identification shall be accomplished through the use of a portable printer and white, polyolefin wire marking sleeves. The wire identification system shall be a "Bradymarker" XC Plus Printer with "Bradysleeve" wire marking sleeves, Panduit equivalent, Seton equivalent, or equal.
6. The Contractor shall submit a written description outlining his intended method of wiring identification and supporting information (i.e., product data sheets, etc.) identifying the materials to be used. The Contractor shall meet with the Owner and the Engineer to come to an agreement regarding wire identification prior to the installation of any wiring.

H. Cable Identification Tags

1. The Contractor shall furnish all labor and materials and affix in a permanent way to each cable in manholes, cable compartments and vaults, junction boxes, pull boxes and points of termination, a bronze metal tag, 1/2-inch in diameter, with a 1/8-inch diameter hole, with copper wire through the hole, the cable identification number approved by the Engineer. The tag shall be attached to the cable by twisting the ends of the copper wires. All cables shall be tagged with its full ID number immediately after it has been pulled.

I. Cable Installation

1. All interior cable not protected by a compartment enclosure shall be run in conduit.

J. Wiring Supplies

1. Only electrical wiring supplies manufactured under high standards of production and meeting the approval of the Engineer shall be used.
2. Rubber insulating tape shall be in accordance with ASTM Des. D119. Friction tape shall be in accordance with ASTM Des. D69.

K. Training of Cable

1. The Contractor shall furnish all labor and material required to train cables around cable vaults within buildings and in manholes and handholes in the outdoor underground duct system. Sufficient length of cable shall be provided in each handhole, manhole, and vault so that the cable can be trained and racked in an approved manner. Instrumentation cable shall be racked separate from all other AC and DC wiring to maintain the required separation specified herein. In training or racking, the radius of bend of any cable shall be not less than the manufacturer's recommendation. All manhole cables shall be arc and fire-proofed. The training shall be done in such a manner as to minimize chaffing.

L. Connections at Control Panels, Limit Switches, and Similar Devices

1. Where stranded wires are terminated at panels, and/or devices, connections shall be made by solderless lug, crimp type ferrule, or solder dipped.
2. Where enclosure sizes and sizes of terminals at limit switches, solenoid valves, float switches, pressure switches, temperature switches, and other devices make 7-strand, No. 12 AWG, wire terminations impractical, the Contractor shall terminate external circuits in an adjacent junction box of proper size and complete with terminal strips and shall install No. 14 AWG stranded wires from the device to the junction box in a conduit. The #12 AWG field wiring shall also be terminated in the same junction box to complete the circuit.

M. Pulling Temperature

1. Cable shall not be flexed or pulled when the temperature of the insulation or of the jacket is such that damage will occur due to low temperature embrittlement. When cable will be pulled with an ambient temperature within a three day period prior to pulling of 40°F or lower, cable reels shall be stored during the three day period prior to pulling in a protected storage area with an ambient temperature not lower than 55°F and pulling shall be completed during the work day for which the cable is removed from the protected storage.

N. Color Coding

1. Conductor insulation shall be color coded as follows:
   a. 480V AC Power
      Phase A - BROWN
      Phase B - ORANGE
      Phase C - YELLOW
      Neutral - WHITE

b. 120/208V or 120/240V AC Power
   Phase A - BLACK
   Phase B - RED
   Phase C - BLUE
   Neutral – WHITE
c. DC Power
   Positive Lead - RED
   Negative Lead - BLACK
d. DC Control
   All wiring - BLUE
e. 120VAC Control
   Single conductor 120 VAC control wire shall be RED except for a wire entering a motor control center compartment or control panel which is an interlock. This conductor shall be color coded YELLOW.
f. 24VAC Control
   All wiring - ORANGE
g. Equipment Grounding Conductor
   All wiring - GREEN

2. Conductors No. 2 AWG and smaller shall be factory color coded with a separate color for each phase and neutral, which shall be used consistently throughout the system. Larger cables shall be coded by the use of colored tape.

3.02 Instrumentation Cable Installation

A. The Contractor shall install all cable or conductors used for instrumentation wiring (4-20 mA DC, etc.) in rigid galvanized steel or PVC coated rigid galvanized steel conduit. The use of asbestos cement or plastic conduit will not be permitted. Analog signal wires shall exclusively occupy these conduits. No other wiring for AC or digital DC circuits shall be installed in these conduits.

B. All shielding shall be continuous and shall be grounded in accordance with the instrumentation equipment manufacturer's recommendations, as approved.

C. A raceway containing instrumentation cable shall be installed to provide the following clearances:

   1. Raceway installed parallel to raceway conductors energized at 480 through 208 volts shall be 18 inches and 208/120 volts shall be 12 inches.
   2. Raceway installed at right angles to conductors energized at 480 volts or 120/208 volts shall be 6 inches.

D. Where practical, raceways containing instrumentation cable shall cross raceway containing conductors of other systems at right angles.

E. Where instrumentation cables are installed in panels, manholes, handholes, and other locations, the Contractor shall arrange wiring to provide maximum clearance between these cables and other conductors. Instrumentation cables shall not be installed in same bundle with conductors of other circuits.

F. Grounding of cable shield shall be accomplished at one point only, unless otherwise required by instrumentation system's manufacturer.

G. Additional pullboxes shall be furnished and installed for ease of cable pulling and the cable manufacturer's recommended conduit fill factor shall be followed. Where required for specifically directed by the Engineer, the Contractor shall moisture seal the cables at all connections with OZ Gedney Type "CSB", or equal, sealing bushings.

H. Special instrument cable shall be as specified or recommended by the vendor of the equipment or instruments requiring such wiring. Installation, storage, terminations, etc., shall be per manufacturer's recommendations.

I. All cable, insulation and jacket shall have adequate strength to allow for it to be pulled through the conduit systems. Sufficient conductors shall be installed to provide space and serve future equipment where shown and specified. All conductors shall be color coded and all wires shall be suitably tagged with permanent markers at each end.

3.03 Fiber Optic Cable Installation

A. The Contractor shall install the fiber optic cable furnished by the General Contractor and/or the Instrumentation and Control Subcontractor. The cable shall be installed and terminated in its respective raceway system(s) and terminal equipment as specified herein, indicated on the Drawings, and in accordance with the cable manufacturer's instructions.

3.04 Schedules

A. The conduit and wire schedules on the Drawings list conduit size, wire size, type, and number required.

B. All conduits and wiring shall be furnished and installed under this Contract.

C. The definition of the term conduit shall include all types of raceways used on this project.

D. In all cases where the word “install” or “installed” refers to conduit, it shall mean install all conduit, raceways, fittings, supports, boxes and appurtenances. In addition it shall include all grounding and bonding. Pull cords are to be pulled upon completion of each raceway.

E. In all cases where the word “install” or “installed” refers to cable, it shall include pulling the cable and testing the cable for insulation resistance, continuity and absence from grounds, as well as terminating all conductors and testing for proper connection.

F. The conduit and wire schedules do not indicate all of the conduit and wire required for the project. The Contractor is advised to refer to these Specifications and Drawings for the additional conduit and wire requirements. All lighting, receptacle and control circuits may require field routing by the Contractor.

G. Conduits leaving or entering a building or structure may be shown in a different arrangement as compared to the duct bank. The Contractor shall arrange conduits penetrating the building based on field conditions. The Drawings are not meant to represent actual conduit arrangements required. Furthermore, spare conduits from duct banks into buildings or structures are required and shall be furnished and installed based on field conditions and Engineer approval.

H. Certain runs of underground duct banks are not detailed, such as site lighting home runs, but all underground ducts shall comply with the requirements of these Specifications.

-END-

SECTION 16141 - WIRING DEVICES

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install all switches and receptacles for lighting and miscellaneous power applications of the type and at the locations as specified herein and as shown on the Drawings.

B. All switches and receptacles shall be furnished and installed in outlet boxes.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required.
2. Field Tests
   a. All field testing shall be done in accordance with the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include, but not be limited to:

1. Product data sheets.

1.05 Supplies and Spare Parts

A. The Contractor shall furnish 10% (minimum of 1) spare of each receptacle, switch, and plug furnished and installed for this project.

B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.06 Identification

A. Each switch and receptacle shall be identified with the equipment item number, manufacturer's name or trademark, and such other information as the manufacturer may consider necessary, or as specified, for complete identification.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The equipment covered by these Specifications is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. The Contractor shall use the products of a single manufacturer for each type of wiring device.

C. The Contractor shall use the products of a single manufacturer for all device plates. Plate variations are allowed for the following devices:

1. Where the selected plate manufacturer does not manufacture a suitable finish plate.
2. For heavy-duty receptacles rated at more than 30A.
3. Where non-standard plates are required, specified, or shown.

D. The Contractor shall furnish and install all wiring devices and device plates. Wiring devices as listed herein are intended to indicate type, function, and quality of the products.

E. The receptacles, switches, device plates, and other appurtenances shall comply with the requirements of these Specifications. Receptacles installed in toilet, locker, and bathrooms shall be of ground fault interrupter type to meet the minimum NEC requirements. Ground fault circuit interrupter receptacles shall also be furnished and installed as specified herein, indicated on the Drawings, and required by the NEC.

F. The Contractor shall provide specification grade devices which shall be as manufactured by Appleton, Crouse-Hinds, Leviton, Harvey Hubbell Co., General Electric Company, Bryant Electric Company, Pass & Seymour, or equal.

2.02 Wiring Devices

A. Wiring devices shall be in accordance with the following for nonhazardous areas:

1. Wall Switches, Single Pole, 20 A, 120-277V equivalent to Hubbell No. 1221, Pass & Seymour No. 20AC1, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3031, Hubbell equivalent, Pass & Seymour equivalent, or equal.
2. Wall Switches, Double Pole, 20 A, 120-277V equivalent to Hubbell No. 1222, Pass & Seymour No. 20AC2, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3032, Hubbell equivalent, Pass & Seymour equivalent, or equal.
3. Wall Switches, Three-Way, 20 A, 120-277V equivalent to Hubbell No. 1223, Pass & Seymour No. 20AC3, Leviton equivalent, or equal. Switches rated 30 A, 120-277V shall be Leviton 3033, Hubbell equivalent, Pass & Seymour equivalent, or equal.
4. Wall Switches, Four-Way, 20 A, 120-277V equivalent to Hubbell No. 1224, Pass & Seymour No. 20AC4, Leviton equivalent, or equal.
5. Convenience Receptacles 20 A, 125V, duplex polarized with grounding connection equivalent to Hubbell No. 5362, Pass & Seymour equivalent, Leviton equivalent, or equal.
6. Hubbell Cat. No. GF-5362, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, 120V, duplex, ground fault circuit interrupting type.

B. Special Purpose Receptacles shall be rated to carry, at least where required the full load amperes and voltage of the unit connected thereto. These receptacles shall be provided with grounding poles and shall be equivalent to the following:

1. Hubbell Cat. No. HBL-5661, Pass & Seymour No. 5871, Leviton equivalent, or equal, for 20A, 250VAC, 1-phase service.
2. Hubbell Cat. No. HBL-9330, Pass & Seymour No.3801, Leviton equivalent, or equal, for 30A, 250VAC, 1-phase service.
3. Hubbell Cat. No. 9430, Pass & Seymour No. 5740, Leviton equivalent, or equal, for 30A, 208/120V, 3-phase service.
4. Hubbell Cat. No. 9450, Pass & Seymour No. 5750, Leviton equivalent, or equal, for 50A, 208/120V, 3-phase service.
5. Hubbell Cat. No. 9460, Pass & Seymour No. 5760, Leviton equivalent, or equal, for 60A, 208/120V, 3-phase service.
6. Hubbell Cat. No. 9330, Pass & Seymour No. 5930, Leviton equivalent, or equal, for 30A, 208V, single-phase service.
7. Hubbell Cat. No. 9315, Pass & Seymour equivalent, Leviton equivalent, or equal, for 30A, 277V, single-phase service.
8. Hubbell Cat. No. 23CM10, Pass & Seymour equivalent, Leviton equivalent, or equal, for 20A, single, 125V, polarized with grounding connection, twist lock type. Matching plug shall be Hubbell Cat. No. 23CM11, Pass & Seymour equivalent, Leviton equivalent, or equal.
9. Crouse-Hinds "Arktite" Series, Appleton equivalent, Killark equivalent, or equal, 30A, 3P, 600 Volt, twist lock, weatherproof, power receptacle and box with matching plug.

C. For hazardous areas the following shall be provided:

1. Wall Switches, single pole, 20 A, 120 V equivalent to Crouse Hinds Cat. No. EFD3591 or EFDC3591 (as required); Appleton No. EDS175F1 or EDSC175F1, Killark equivalent, or equal.
2. Convenience Receptacles 20 A, 120-250 VAC, 2 wire, 3 pole equivalent to Crouse Hinds Cat. No. CPS152-201, Appleton No. CPE1-2375, Killark equivalent, or equal.

D. Plugs for hazardous and non-hazardous receptacles shall be provided:

1. One mating plug of the same or better grade for each 10 convenience receptacles, minimum of 2 each.
2. Plugs and respective cable shall be provided for equipment furnished under other Divisions (steam cleaners, welders, etc.) as necessary.

2.03 Device Plates

A. Wall plates with gaskets for flush-mounted receptacles and switches shall be made of Type 304 stainless steel, not less than 0.040 of an inch thick, with beveled edges and milled on the rear so as to lie flat against the wall. Wall plates shall be equivalent to Hubbell Series 9600, Pass & Seymour series 93000, Leviton equivalent, or equal.

B. Device plates for weatherproof and watertight installations shall be Appleton Type FSR, Crouse-Hinds #DS185, or equal for wall switches and Appleton Type FSK, Crouse-Hinds #WLRD, or equal for convenience receptacles. “In-use” weatherproof covers shall be rugged, die-cast aluminum as manufactured by Thomas & Betts "Red Dot," or equal.

2.04 Plugs

A. The Contractor shall furnish suitable plugs with equipment furnished under the respective Contract. Plugs shall be black rubber or plastic. For waterproof receptacles, the plugs shall be similar in construction to the receptacles and shall be encased in corrosion resistant yellow housing provided with clamping nuts and stuffing gland cable outlets.

2.05 Process Instruments

A. The Contractor shall furnish and install a local disconnect switch at each process instrument (e.g., level transmitter, flow transmitter, analytical instrument etc.,) to disconnect the 120VAC power supply to the instrument. The device shall be a NSSC series manual motor starting switch without overload protection as manufactured by Crouse-Hinds, Appleton equivalent, or equal. For hazardous locations, the device shall be a front operated general use snap switch mounted in an EFS enclosure as manufactured by Crouse-Hinds, Appleton equivalent, or equal.

PART 3 - EXECUTION

3.01 Installation

A. Switch boxes shall be of unit construction and of sizes as required to adequately house the number of switches required. No sectional type switch boxes shall be permitted.

B. Where more than one switch occurs at one point, gang plates shall be used.

C. All device plates shall be set true and plumb, and shall fit tightly against the finished wall surfaces and outlet boxes.

D. All devices shall be flush-mounted in finished areas, unless otherwise noted. The Contractor shall determine the proper position of every outlet, and relocate any outlet without additional cost to the Owner if same is incorrectly or improperly located. The Engineer reserves the right to change the location of any outlet or connecting equipment up to the time of roughing in without additional cost to the Owner, provided conduit runs are not increased by more than 10 feet.

E. In all areas where thermal or acoustic insulation is applied to the ceiling or walls, outlet boxes shall be set to finish flush with the finished surface of the insulation.

F. When indicated height would place any of the equipment at an unsuitable location such as at a molding or break in wall finish, the Engineer shall determine final location.

G. For the below-named items mounting heights from finish floor, or finish grade to top is applicable. Mounting heights shall be as follows, unless otherwise specified herein, indicated on the Drawings, or required by the Americans with Disability Act (ADA):

1. Single-pole light switches, 48 inches.
2. Duplex receptacles in dry areas, 16 inches
3. Duplex receptacles in pump rooms, 48 inches

3.02 Circuiting

A. Convenience receptacles shall be grouped on circuits separate from the lighting circuits. A maximum of eight (8) convenience outlets are permitted per 20A, 120V circuit.

-END-

SECTION 16170 - GROUNDING AND BONDING

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install grounding systems complete in accordance with the minimum requirements established by Article 250 of the NEC. Article 250 of the NEC shall be considered as a minimum requirement for compliance with this Specification.

B. Grounding of all instrumentation and control systems shall be furnished and installed in accordance with the manufacturer/system requirements and IEEE 1100-92, Powering and Grounding of Sensitive Electronic Equipment. Conflicts shall be promptly brought to the attention of the Engineer.

C. In addition to the NEC requirements, building structural steel columns shall be permanently and effectively grounded:

D. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required.
2. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Reports of certified field tests.

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.
2. Drawings and written description of how the Contractor intends to furnish and install the grounding system.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The equipment covered by these specifications shall be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 Ground Rods and Grid

A. Ground rods shall be rolled to a commercially round shape from a welded copper-clad steel manufactured by the molten-welding process or by the electro-formed process (molecularly bonded). They shall have an ultimate tensile strength of 75,000 pounds per square inch (psi) and an elastic limit of 49,000 psi. The rods shall be not less than 3/4 inch in diameter by 10 feet in length; and the proportion of copper shall be uniform throughout the length of the rod. The copper shall have a minimum wall thickness of 0.010 inch at any point on the rod.

B. The maximum resistance to ground of a driven ground rod shall not exceed 5 ohms under normally dry conditions. Where the resistance obtained with one (1) ground rod exceeds 5 ohms, additional ground rods shall be installed not less than 6 feet on centers. Except where specifically indicated otherwise, all exposed non current-carrying metallic parts of electrical equipment, metallic raceway systems, grounding conductors in nonmetallic raceways and neutral conductors of wiring systems shall be grounded.

C. The ground connection shall be made at the main service equipment and shall be extended to the point of entrance of the metallic water service. Connection to the water pipe shall be made by a suitable ground clamp or lug connection to a plugged tee. If flanged pipes are encountered, connection shall be made with the lug bolted to the street side of the flanged connection. If there is not suitable metallic water service to the facility, the ground connection shall be made to the driven ground rods on the exterior of the building.

D. Where ground fault protection is employed, care shall be taken so that the connection of the ground and neutral does not interfere with the correct operation of the ground fault protection system.

2.03 Fittings

A. Grounding connections to equipment shall be bolted. Cable end connections may be made by use of the crucible weld process or bolted type connectors. Bolted type connectors for this application shall consist of corrosion resistant copper alloy with silicone bronze bolts, nuts and lockwashers which are designed for this purpose.

2.04 Grounding Conductors

A. A green, insulated equipment grounding conductor, which shall be separate from the electrical system neutral conductor, shall be furnished and installed for all circuits. Equipment grounding conductors shall be furnished and installed in all conduits. Use of conduits as the NEC required equipment grounding conductor is not acceptable.

2.05 Equipment Grounds

A. Equipment grounds shall be solid and continuous from a connection at earth to all distribution panelboards. Ground connections at panelboards, outlets, equipment, and apparatus shall be made in an approved and permanent manner.

PART 3 - EXECUTION

3.01 Installation

A. Metal surfaces where grounding connections are to be made shall be clean and dry. Steel surfaces shall be ground or filed to remove all scale, rust, grease, and dirt. Copper and galvanized steel shall be cleaned with emery cloth to remove oxide before making connections.

B. Ground Grid

1. A main ground grid shall be provided for each structure and interconnecting structure grids consisting of driven ground rods. The ground rods shall be driven deep enough to obtain a ground resistance of not more than 5 ohms and shall be interconnected by the use of copper cable bus, welded to the rods by the crucible weld process. The grounding cables shall be installed after the excavations for the building have been completed and prior to the pouring of concrete for the footings, mats, etc. Copper "pigtails" shall be connected to the ground system and shall enter the buildings and structure from the outside and shall be connected to steel structures, and equipment as described in this Section and as required to provide a complete grounding system.
2. Grounding conductors shall be continuous between points of connection; splices shall not be permitted.
3. Where conductors are exposed and subject to damage from personnel, traffic, etc., conductors shall be installed in metal raceway. The raceway shall be bonded to the grounding system.
4. Connections to ground rods shall be exposed to permit maintenance and inspection for continuity and effectiveness of grounding system.

5. Where subsurface conditions do not permit use of driven ground rods to obtain proper ground resistance, rods shall be installed in a trench or plate electrodes shall be provided, as applicable and necessary to obtain proper values of resistance.

C. Raceways

1. Conduit which enters equipment such as switchgear, motor control centers, transformers, panelboards, variable frequency drives, instrument and control panels, and similar equipment shall be bonded to the ground bus or ground lug, where provided, and as otherwise required by the NEC.

-END-

SECTION 16190 - SUPPORTING DEVICES

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install structural steel supports for mounting and installing all electrical, lighting, alarm systems, instrumentation, and communications equipment furnished under this Contract.

B. Equipment shall be installed strictly in accordance with recommendations of the manufacturer and best practices of the trade resulting in a complete, operable, and safe installation. The Contractor shall obtain written installation manuals from the equipment manufacturer prior to installation.

C. Reference Section 16000, Basic Electrical Requirements.

1.02 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable Specification section.

1.03 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.
2. Complete assembly, layout, installation, and foundation drawings with clearly marked dimensions.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 Materials

A. Materials used in accordance with this Section shall be as specified herein.

PART 3 - EXECUTION

3.01 Installation

A. Concrete or Masonry Inserts

1. The Contractor shall be responsible for the furnishing and installation of all conduit sleeves, anchor bolts, masonry inserts, and similar devices required for installation of equipment furnished under this Contract.
2. If a time delay for the arrival of any special inserts or equipment drawings, etc. occurs, the Contractor may, if permitted by the Engineer, make arrangements for providing approved recesses and openings in the concrete or masonry and, upon subsequent installation, the Contractor shall be responsible for filling in such recesses and openings. Any additional costs that may be incurred by this procedure shall be borne by the Contractor.
3. The Contractor shall furnish leveling steel channels for all switchgear, switchboards, motor control centers, and similar equipment. The leveling steel channels shall be provided for installation in the equipment supporting pads. Coordination of the installation of these channels with the concrete pad is essential and required. Pad height shall be as required to maintain coverage of the reinforcement bars while not exceeding the maximum mounting heights requirements of the NEC.

B. Support Fastening and Locations

1. All equipment fastenings to columns, steel beams, and trusses shall be by beam clamps or welded. No holes shall be drilled in the steel. Where supports or hangers are required for heavy electrical equipment units exceeding fifty pounds, a registered professional engineer shall check the steel. Where required, additional sections shall be provided for a safe installation. Supports and hangers shall be PVC coated as required to suit the application and shall be compatible with the balance of the installation.
2. All holes in hung ceilings for support rods, conduits, and other equipment shall be made adjacent to bars where possible, to facilitate removal of ceiling panels.
3. For interior dry areas, a bracket and channel type support of zinc chromated galvanized steel construction shall be provided wherever required for the support of starters, switches, panels, and miscellaneous equipment.
4. For outdoor service or in indoor damp/wet process areas, the support system shall be made of either Type 304 stainless steel, PVC coated rigid galvanized steel, or aluminum. The materials of construction shall be coordinated with the process/chemical area in which the support system will be installed.
5. All hardware (bolts, nuts, washers, etc.) shall be Type 304 stainless steel.
6. All supports shall be rigidly bolted together and braced to make a substantial supporting framework. Where possible, control equipment shall be grouped together and mounted on a single framework. Wherever this occurs, a provision

shall be made for ready access to the wiring for connections to the equipment by means of boxes with screw covers.

7. Aluminum support members shall not be installed in direct contact with concrete. Stainless steel or non-metallic "spacers" shall be used to prevent contact of aluminum with concrete.
8. Actual designs for supporting framework should take the nature of a picture frame of channels and bracket with a plate for mounting the components. The Contractor is responsible for the design of supporting structure; he shall submit design details to the Engineer for acceptance before proceeding with the fabrication.
9. Wherever dissimilar metals come into contact, the Contractor shall isolate these metals as required with neoprene washers, nine (9) mil polyethylene tape, or gaskets.

-END-

SECTION 16195 - ELECTRICAL IDENTIFICATION

PART 1 - GENERAL

1.01 The Requirement

A. All electrical equipment shall be properly identified in accordance with these Specifications and the Contract Drawings. All switchgear, switchboards, motor control centers, variable frequency drives, lighting and distribution panelboards, combination starters, control panels, pull/junction boxes, enclosures, disconnect switches, control stations, and similar equipment shall be identified in the manner described, or in an equally approved manner.

B. The types of electrical identification specified in this section include, but are not limited to, the following:

1. Exposed conduit color banding.
2. Operational instructions and warnings.
3. Danger signs.
4. Equipment/system identification signs.
5. Nameplates.

1.02 Signs

A. "DANGER-HIGH-VOLTAGE" signs shall be securely mounted on the entry doors of all electrical rooms.

1.03 Lettering and Graphics

A. The Contractor shall coordinate names, abbreviations, and other designations used in the electrical identification work with the corresponding designations shown, specified or scheduled. Provide numbers, lettering, and wording as indicated or, if not otherwise indicated, as recommended by manufacturers or as required for proper identification and operation/maintenance of the electrical systems and equipment.

1.04 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit shop drawings. Each submittal shall be identified by the applicable specification section.

1.05 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The material covered by these Specifications is intended to be standard material of proven performance as manufactured by reputable concerns. Material shall be fabricated, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as specified herein and shown on the Drawings.

2.02 Nameplates

A. Nameplates shall be engraved, high pressure plastic laminate, black with white lettering.

2.03 High Voltage Signs

A. Standard "DANGER" signs shall be of baked enamel finish on 20 gage steel; of standard red, black and white graphics; 14 inches by 10 inches size except where 10 inches by 7 inches is the largest size which can be applied where needed, and except where a larger size is needed for adequate vision.

2.04 Conduit Markers

A. All conduits shall be labeled in accordance with the conduit and wire schedules. Color coded conduit markers shall be standard preprinted, flexible permanent, plastic sheet conduit markers, extending 360 degrees around conduits; designed for attachment to conduit by adhesive. Lettering shall indicate the conduit number as indicated in the conduit schedule. Provide 8 inch minimum length for 2 inch and smaller conduit and 12 inch length larger than 2 inch conduit.

PART 3 - EXECUTION

3.01 Nameplates

A. Nameplates shall be attached to the equipment enclosures with (2) two stainless steel sheet metal screws for nameplates up to 2-inches wide. For nameplates over 2-inches wide, four (4) stainless steel sheet metal screws shall be used, one (1) in each corner of the nameplate. The utilization of adhesives is not permitted.

3.02 Conduit Identification

A. Where electrical conduit is exposed in spaces with exposed mechanical piping which is identified by a color-coded method, apply color-coded identification on the electrical conduit in a manner similar to the piping identification. Except as

otherwise indicated, use orange as the coded color for conduit marker backgrounds. Conduit identification shall be made after the conduit has been painted.

3.03 Operational Identification and Warnings

A. Wherever reasonably required to ensure safe and efficient operation and maintenance of the electrical systems and electrically connected mechanical systems and general systems and equipment, including prevention of misuse of electrical facilities by unauthorized personnel, install plastic signs or similar equivalent identification, instruction, or warnings on switches, outlets, and other controls, devices, and covers or electrical enclosures. Where detailed instructions or explanations are needed, provide plasticized tags with clearly written messages adequate for the intended purposes. Signs shall be attached as specified above for nameplates.

3.04 Power Source Identification

A. After installation of all field equipment (i.e. valves, motors, fans, unit heaters, instruments, etc) install nameplates at each power termination for the field equipment. Nameplate data shall include equipment designation (tag number), power source (MCC number, panelboard, etc), circuit number, conduit number from schedule and voltage/phase.

B. Contractor to coordinate with the Engineer and the Owner regarding exact nameplate placement during construction.

C. Nameplates shall be as specified herein.

-END-

SECTION 16440 - DISCONNECT SWITCHES

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install separately mounted, individual disconnect switches as specified herein and indicated on the Drawings.

B. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required.
2. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Spare Parts List

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of disconnect switch.
3. Assembled weight of each unit.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 Tools, Supplies, and Spare Parts

A. The equipment shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment, and with all spare parts as recommended by the equipment manufacturer.

B. One complete set of spare fuses for each ampere rating installed shall be furnished and delivered to the Owner at the time of final inspection.

C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.06 Identification

A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Switches shall be manufactured by Eaton Cutler-Hammer, Siemens Energy and Automatic, Inc., or Owner/Engineer-approved equal.

2.02 Disconnect Switches

A. Disconnect switches shall be heavy-duty type and/or as specified in these Specifications. Switches shall be furnished and installed as shown on the Drawings and as required by the NEC. Handles shall be lockable.

B. Switches shall be NEMA Type HD, single-throw, externally operated, fused or non-fused as required. Switches of the poles, voltage, and ampere ratings shown shall be furnished in NEMA 1A (gasketed) enclosures in indoor dry areas, and in NEMA 4X Type 304 stainless steel enclosures for damp/wet indoor process areas. Enclosures for outdoor applications shall be NEMA 4X Type 304 stainless steel. Switches located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application.

C. Disconnect switches shall be quick-make, quick-break and with an interlocked cover which cannot be opened when switch is in the "ON" position and capable of being locked in the "OPEN" position.

D. A complete set of fuses for all switches shall be furnished and installed as required. Time-current characteristic curves of fuses serving motors or connected in series with circuit breakers shall be coordinated for proper operation. Fuses shall have voltage rating not less than the circuit voltage.

E. Switches shall be furnished with auxiliary contacts to indicate switch position via SCADA system.

PART 3 - EXECUTION

3.01 Installation

A. All disconnect switches to be mounted five (5) feet above the floor, at the equipment height where appropriate, or where shown otherwise.

B. The Contractor shall furnish and install fuses of various types as required with the continuous ampere ratings as required or shown on the Drawings.

-END-

SECTION 16470 - PANELBOARDS

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install panelboards of voltage and current ratings as specified herein and indicated on the Drawings. Panelboards shall be furnished with circuit breaker ratings, number of breakers, number of poles and locations conforming with the panelboard schedules on the Drawings.

B. Reference Section 16000, Basic Electrical Requirements.

1.02 Standards

A. Panelboards shall conform to all applicable Federal, UL, and NEMA standards. Materials and components shall be new and conform to grades, qualities and standards as specified herein and shown on the Drawings.

B. Panelboards shall comply with the following industry standards:

1. UL Listing/Approval
2. UL Standards
   a. Panelboards - UL 67
   b. Cabinets and Boxes - UL 50
3. National Electrical Code
4. NEMA Standard - PB1

1.03 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required
2. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.04 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.
2. Reports of Certified Shop Tests.
3. Spare Parts List.
4. Operation and Maintenance Manuals.

B. Each submittal shall be identified by the applicable specification section.

1.05 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Complete assembly, layout, and installation drawings with clearly marked dimensions for each panelboard.
3. Complete panelboard schedules indicating circuit designations and connected loads as shown on the Drawings for each panelboard.

D. The submittal information shall reflect the specific equipment identification number as indicated on the Drawings (e.g., LP-1, PP-1, etc.).

1.06 Tools, Supplies, and Spare Parts

A. The panelboards and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. For each panelboard, the Contractor shall furnish to the Owner all spare parts as recommended by the equipment manufacturer including one (1) molded case circuit breaker of each type, size, and rating used except for main circuit breakers.

B. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

C. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size shall have the same parts number.

1.07 Identification

A. Each panelboard shall be identified with the identification number indicated on the Drawings. A nameplate shall be securely affixed in a conspicuous place on each panelboard. Nameplates shall be as specified in Section 16195, Electrical - Identification.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 Conductors (Main Bus and Branch Connectors)

A. All main bus shall be copper sized in accordance with UL standards to limit the temperature rise on any current carrying part to a maximum of 50 degrees C above a maximum ambient temperature of 40 degrees C.

2.03 Lighting Panelboards

A. General

1. The lighting panelboards shall be dead-front type with automatic trip-free, non-adjustable, thermal-overload, branch circuit breakers. Panelboards shall be of the configuration and rating as specified herein and indicated on the Drawings.
2. The panelboards shall be equipped with a main breaker or main lugs complete with branch circuit breakers, as shown on the Drawings. The panelboards shall be enclosed in a cabinet suitable for flush or surface mounting. Some panelboards shall be furnished and installed within motor control center structures as shown on the Drawings.
3. Lighting panelboards shall be fully rated and shall have a short circuit rating of 10,000 amperes symmetrical, minimum. In the event the results of the Contractor's short circuit fault analysis, as accepted by the Engineer, indicate that a higher short circuit rating of the panelboards is required, furnish complete panelboards with that higher rating.
4. Lighting panelboards shall be Cutler-Hammer Pow-R-Line Series, Siemens Energy and Automation, Inc. equivalent, or Owner/Engineer-approved equal.

B. Cabinets

1. Except for lighting panelboards installed in motor control centers, the cabinet shall be NEMA 12 (minimum) constructed of No. 12 U.S.S. code gauge galvanized steel. The door shall be fastened to the cabinet with concealed hinges and shall be equipped with flush-type catches and locks. All locks shall be keyed alike. The cabinet shall have wiring gutters on sides and shall be at least 5-3/4 inches deep. The Contractor shall provide an engraved nameplate for the panelboard. The nameplate shall include the panelboard designation, voltage, phase, wires, and bus rating.
2. An Underwriter's Laboratories, Inc. inspection label shall appear on the interior of the cabinet.

C. Bus Work

1. Main bus bars shall be of ample size so that a current density of not more than 1000 amperes per square inch of cross section will be attained. This current

density shall be based on the application of the full load connected to the panel plus approximately 25% of the full load for spare capacity. The main bus shall be full capacity as based on the preceding for the entire length of the panel so as to provide full flexibility of circuit arrangement.

2. Solid neutral bus bars are required. Ratings shall be in accordance with applicable standards.
3. A separate ground bus shall be provided with lugs for termination of equipment grounding conductors.
4. Branch bus work shall be rated to match the maximum branch circuit breaker which may be installed in the standard space.
5. All bus shall be tin plated copper.

D. Circuit Breakers

1. Circuit breakers shall be bolt-on, molded-case type conforming to NEMA Standard AB 1. Trip elements of circuit breakers shall be 20A unless otherwise shown on the Contract Drawings. Minimum branch circuit breaker shall be 100A frame for 60A and above except where shown otherwise on the Drawings or where a larger frame size is standard for the continuous current rating required. Breakers shall have an interrupting rating of 10,000 amperes symmetrical at 240 VAC, minimum. All breakers shall have quick-make, quick-break, toggle mechanism for manual as well as automatic operation. Tandem or half-size breakers are not acceptable.
2. Where indicated, or where required by Code, circuit breakers for receptacle circuits shall be equipped with integrally mounted ground fault interrupters complete with "TEST" push button and shall be of a type which fit standard panelboard spaces for the breaker continuous current rating required.
3. Instrument power panel branch circuit breakers set for control instrumentation, telephone, fire alarm, or auxiliary equipment circuits requiring continuous operation shall be provided with a lock-on device. Circuit breakers used for lighting circuit switching shall be approved for the purpose and shall be marked "SWD". Where required by Article 440 of the NEC, circuit breakers installed for air conditioning units shall be HACR type.

E. Directories

1. Approved directories with glass or noncombustible plastic cover, and with typewritten designations of each branch circuit, shall be furnished and installed in each panelboard. The Contractor shall maintain in each panel, during the duration of the Contract, a handwritten directory clearly indicating the circuit breakers in service. This directory shall be updated as work progresses, and final, typewritten directories, as specified above, shall be installed at the end of the project. Designations and circuit locations shall conform with the panelboard schedules on the Drawings, except as otherwise authorized by the Engineer.
2. The Contractor shall provide directories identifying panelboards and indicating the size of the feeder (cable and conduit) serving the panel, circuit numbers, and a description of associated branch circuits including branch circuit trip and connected load for each circuit.

2.04 Combination Power Units

A. The Contractor shall furnish and install a combination power unit as specified herein and indicated on the Drawings. The unit shall be a combination of a dry type transformer and a lighting panelboard. The transformer and panelboard shall meet the requirements for these products as specified elsewhere in these Specifications. Combination power units located outdoors shall be suitable for outdoor use rated NEMA 3R.

B. The combination power unit shall be a Mini-Power Center as manufactured by Cutler-Hammer, Siemens Energy and Automation, Inc. equivalent, or Owner/Engineer-approved equal.

2.05 Painting

A. All metal surfaces of the panelboard enclosures shall be thoroughly cleaned and given one prime of zinc chromate primer. All interior surfaces shall then be given one shop finishing coat of a lacquer of the nitro-cellulose enamel variety. All exterior surfaces shall be given three coats of the same lacquer. The color of finishing coats shall be light gray ANSI #61.

B. Prior to final completion of the work, all metal surfaces of the equipment shall be cleaned thoroughly, and all scratches and abrasions shall be retouched with the same lacquer as used for shop finishing coats.

PART 3 - EXECUTION

3.01 Mounting

A. The lighting panelboards and combination power units shall be furnished and installed as shown on the Drawings and as recommended by the equipment manufacturer.

B. Panelboards shall be set true and plumb in locations as shown on the Drawings. The top of panelboard enclosure shall not exceed six (6) feet above finished floor elevation.

C. Enclosures shall not be fastened to concrete or masonry surfaces with wooden plugs. Appropriate cadmium plated or galvanized steel bolts shall be used with expansion shields or other metallic type concrete insert for mounting on concrete or solid masonry walls. Cadmium plated or galvanized steel toggle bolts shall be used for mounting on concrete block or other hollow masonry walls. Bolt diameter shall be as required considering the size and weight of the completed panelboard and enclosure to provide adequate structural support.

D. The Contractor shall not use factory furnished knockouts with surface back boxes. The Contractor shall punch or drill required openings during installation and shall equip flush back boxes with manufacturer's standard pattern of knockouts. The Contractor shall equip cabinet doors exceeding 40 inches in height with vertical bolt three point locking mechanism.

E. The Contractor shall install cabinets (and other enclosure products) in plumb with the building construction. Flush enclosures shall be installed so that the trim will rest against the surrounding surface material and around the entire perimeter of the enclosure.

-END-

SECTION 16481 - INDIVIDUAL MOTOR CONTROLLERS

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install separately mounted, individual motor controllers for 120 volt single phase, and 208 and 480 volt three phase motors as specified herein and indicated on the Drawings. Individual motor controllers specified in this Section include combination type magnetic motor starters and manual motor starters.

B. Reference Section 16000, Basic Electrical Requirements and Section 16902, Electric Controls and Relays.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required.
2. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. The Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.
2. Spare Parts List.

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete, or illegible submittals will be returned to the Contractor without review for resubmittal.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.

2. Complete layout and installation drawings with clearly marked dimensions for each type/size/rating of individual motor controller for RVSS starters show stub up area.
3. Wiring diagrams for each individual motor controller. One wiring diagram which is typical for an equipment group (e.g. exhaust fans) is not acceptable. Each wiring diagram shall include wire identification and terminal numbers. Indicate all devices, regardless of their physical location, on the diagrams. Identify on each respective wiring diagram specific equipment names and equipment numbers consistent with those indicated on the Drawings.
4. Bill of material list for each individual motor controller.
5. Nameplate schedule for each individual motor controller.
6. Manufacturer's installation instructions.
7. Time-current curves for each type and size protective device if requested by the Engineer.
8. Approximately shipping weight of RVSS starter.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items that the Contractor intends to provide are acceptable and shall be submitted.

1.05 Tools, Supplies, and Spare Parts

A. The equipment shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

B. The Contractor shall furnish the following minimum spare parts:

1. One (1) overload relay complete with heater for each type, size, and rating used.
2. One (1) motor circuit protector & motor contactor for each type, size, and rating used.
3. One (1) spare control power transformer for each type and size used.
4. Two (2) spare fuses for each size and type used.

C. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

D. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.06 Identification

A. Each equipment item shall be identified with a nameplate. The nameplate shall be engraved indicating the circuit number and equipment name with which it is

associated. Equipment identification shall be in accordance with Section 16195, Electrical - Identification.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

B. Individual motor controllers specified in this section shall be as manufactured by Eaton Cutler- Hammer, or Siemens Energy and Automation, Inc., or Owner/Engineer-approved equal.

2.02 Individual Magnetic Motor Starters

A. Individual magnetic motor starters shall be combination type complete with motor circuit protectors (MCP's). Starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be furnished with a minimum of two spare auxiliary contacts.

B. Provide starters in NEMA 1A (gasketed) enclosures when located in clean, dry, conditioned spaces only. NEMA 1A (gasketed) enclosures shall be finished with corrosion resistant epoxy or acrylic paint. Starters to be furnished and installed in indoor damp or wet areas shall be in NEMA 4X Type 304 stainless steel enclosures. Starters to be provided in all outdoor locations shall be in NEMA 4X Type 304 stainless steel enclosures. Individual motor starters located in hazardous areas shall be suitable for the Class, Division, and Group to suit the application.

C. Furnish and install manual reset overload relays in each phase sized in accordance with the NEC. Provide cover mounted overload reset button with metal (not plastic) shaft and pilot devices as indicated and required. Starters shall be provided with all coils and controls for 120 VAC operation, unless otherwise indicated on the Drawings.

D. A control power transformer shall be furnished and installed for each motor controller. The minimum control power transformer VA requirements are as follows:

Size 1	75 VA
Size 2	75 VA
Size 3	200 VA
Size 4	300 VA
Size 5	500 VA

Additional transformer capacity shall be provided when required. The motor controller manufacturer is advised to review the total Contract Documents for additional requirements for space heaters, power factor correction capacitors, and

similar equipment which may not be specified in this Division or shown on the Drawings.

E. Ambient compensated, thermal, bi-metallic type overload relays shall be furnished and installed providing Class 20 operation. Overload relays shall be equipped with one additional normally open (NO) and normally closed (NC) isolated contact for use as specified herein or indicated on the Drawings. Solid state overload relays shall only be furnished and installed if specifically accepted by the Engineer. The Contractor shall furnish and install correctly sized overload heaters based on the rating of the motor installed.

F. Unless otherwise indicated, the pilot devices shall be mounted on the covers of the respective enclosures. Pushbuttons, selector switches, and pilot lights shall be 30.5 mm, heavy-duty, oil tight type with provisions to maintain the NEMA ratings of starter enclosures. Legend plates indicating switch positions shall be provided for each pilot device. Pilot lights shall be LED type.

G. All control wiring shall be No. 14 AWG (minimum) labeled at each end in accordance with the wiring numbers shown on the accepted shop drawings. Power wiring shall be sized to suit the maximum horsepower rating of unit; No. 12 AWG (minimum). Wiring shall be type MTW rated for 105ºC. Wire color coding shall be as specified in Section 16123, Building Wire and Cable.

H. Each motor starter coil shall be equipped with a surge-suppression device for protection of the solid state equipment (e.g. programmable logic controller) wired as part of the control circuit.

I. Where specified in these Contract Documents, indicated on the Drawings, or as required, interposing relays shall be furnished for the motor control circuits. Coil voltage shall be as specified, indicated on the Drawings, or as required. The contact ratings of the relays shall be coordinated with the burden of the motor starter coil. If the burden or other electrical requirements exceed the contact rating of general purpose, plug-in relays, machine tool type relays with adequate contact ratings shall be provided.

J. Individual magnetic motor starters shall be as manufactured by Eaton Cutler-Hammer using NEMA rated Freedom Series starters and contactors, or Siemens Energy and Automation, Inc. equivalent, or Owner/Engineer-approved equal.

2.03 Individual Manual Motor Starters

A. Individual manual motor starters in enclosures as specified above shall be furnished and installed for outdoor and indoor exposed work. Furnish and install manual motor starters in outlet boxes with flush wall plates as required for concealed work.

B. Furnish and install manual motor starters with pilot lights and overload heater elements of correct rating based on motor nameplate data.

C. Manual motor starters shall be equipped with either a push button or toggle operator with reset device or mechanism accessible without opening the enclosure.

2.04 Auxiliary Control Relays

A. Provide auxiliary control relays as required to suit the application and as shown on the Drawings. Control relays shall be as specified in Section 16902 - Electrical Controls and Relays. The number of contacts shall be as shown and as required to suit the application plus two spare normally open (N.O.) and two spare normally closed (N.C.).

PART 3 - EXECUTION

3.01 Installation

A. All individual motor starters shall be installed as indicated on the Drawings and as recommended by the equipment manufacturer.

-END-

SECTION 16500 - LIGHTING

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish and install all lighting fixtures, labor, and material, in accordance with the preceding Specifications, the requirements of this Section, and as shown on the Drawings.

B. Lighting shall be in accordance with the latest requirements of the Illuminating Engineering Society, and all lighting fixtures shall have the Underwriters Laboratories, Inc. label of approval.

C. All wiring shall be placed in conduit and shall comply with the Specifications for conduit, outlet boxes, pull and junction boxes, wires and cables, grounding, and other Sections as set forth in these Specifications and as noted herein.

D. Reference Section 16000, Basic Electrical Requirements.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests
   a. None required.
2. Certified Shop Tests
   a. The lighting fixtures shall be given routine factory tests in accordance with the requirement of ANSI, NEMA and Underwriters Laboratories standards.
3. Field Tests
   a. Field testing shall be done in accordance with the requirements specified in the General Conditions, Division 1, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. In accordance with the procedures and requirements set forth in the General Conditions and Section 01300, Submittals, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings
2. Operation and Maintenance Manuals
3. Spare Parts Lists
4. Special Tools List
5. Reports of Certified Shop Tests

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor for resubmittal without review.

C. Shop drawings shall include but not be limited to:

1. Product data sheets.
2. Catalog cuts for each fixture type showing performance and construction details of standard fixtures, and complete working drawings showing all proposed construction details of special or modified standard fixtures.
3. Photometric curves.
4. Lamp data.
5. Ballast information.
6. Catalog data including applicable coefficients of utilization tables, isolux chart of illumination on a horizontal plane, beam efficiency, horizontal and vertical beam spread, and beam lumens.
7. Pole calculations.

D. Shop drawings shall be submitted to the Engineer for review and acceptance for all fixtures before fixtures and poles are manufactured. Substitutions will be permitted only if acceptable to the Engineer.

E. Manufacturer's catalog number and description in the fixture schedule on the Contract Drawings establishes a level of quality, style, finish, etc. The use of a catalog number describing the various types of fixtures shall be used as a guide only, and does not exclude all the required accessories or hardware that may be required for a complete installation.

1.05 Operation and Maintenance Manuals

A. The Contractor shall submit Operation and Maintenance Manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 Tools, Supplies, and Spare Parts

A. The light fixtures shall be furnished with all special tools necessary to disassemble, service, repair and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor. The following minimum spare parts shall be furnished:

1. A minimum of one (1) ballast and LED Driver for every ten (10) ballasts or LED Drivers (of the same type) installed.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts inventory control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

1.07 Lighting Controls

A. The lighting systems shall be controlled as specified herein and indicated on the Drawings.

B. Lighting contactors shall be furnished and installed for specific lighting control applications as specified herein and indicated on the Drawings.

PART 2 - PRODUCTS

2.01 Manufacturers

A. The equipment covered by this Specification is intended to be standard equipment of proven performance as manufactured by reputable concerns. Equipment shall be designed, constructed, and installed in accordance with the best practices of the trade, and shall operate satisfactorily when installed as shown on the Drawings.

2.02 Lighting Controls

A. Lighting contactors shall be as manufactured by Cutler-Hammer, General Electric Company, or Siemens Energy and Automation, Inc. Lighting contactors shall be heavy duty industrial type with 30A minimum rating, shall have coils with voltages as shown, and shall have the number of contacts required. Contactors shall be housed in enclosures with NEMA rating to match the environment. Contactor ampere rating shall be as required to suit the application. Contactors shall be the electrically held type. Contactors shall include fused control power transformers. Any auxiliary relays, or other devices required for proper operation shall be included.

2.03 Fixtures

A. Each fixture shall bear the Underwriters Laboratories, Inc. label. All lighting fixtures shall be furnished complete with lamps of the size and type as indicated on the Drawings and all fittings and hardware necessary for a complete installation.

Lighting fixtures shall have all parts and fittings necessary to completely and properly install the fixtures.

B. Fixture leads shall be as required by NEC and shall be grounded by the conduit connection to the fixture.

C. All glassware shall be high quality, homogeneous in texture, uniform in quality, free from defects, of uniform thickness throughout, and properly annealed. Edges shall be well rounded and free from chips or rough edges.

D. HID fixture housings shall be finished with a seven-stage phosphate pretreatment and thermal-set, electrostatically applied polyester paint. Color shall be as indicated in the fixture schedule or as selected by the Engineer.

E. Indoor metal halide fixtures shown in non-hazardous locations shall be furnished with a tungsten/halogen lamp and time delay relay as specified in the fixture schedule or indicated on the Drawings. For hazardous locations where this feature is not available, emergency fixtures shall be provided with a time delay feature.

F. Fluorescent fixtures shall be complete with housing, louvers (if required), and accessories of the types and quantities specified herein and indicated on the Drawings.

G. Fixtures shall be as specified in the fixture schedule below.

TYPE	WATTS	TYPE LUMINAIRE	MANUFACTURER
A	3-32 WATT T8	Ceiling mounted, 4ft. fluorescent light fixture, 120 VAC, spread beam, dust and moisture tight, dual concave reflector, wet location ready.	Holophane Controlume CTL series or equal
B	LED	LED EXIT sign. 3 watt LED impact resistant, corrosion resistant, 10 year expected life	Holophane QM LED, or equal
C	100W MH	Exterior Hazardous location wall Pac. Die-cast aluminum housing with polyester powder coated paint to withstand corrosive environments. 120V 100W Medal Halide.	Holophane Wallpack IV hazardous or equal
D	12W HAL	Wall mounted emergency lighting fixture, 120/277 dual voltage AC input, maintenance free 36 Watt lead calcium battery with 12 volt operation. 90 minutes of full light output.	Holophane DeSoto M50 or equal

2.04 Ballasts (LED Drivers)

A. All ballasts shall be designed to a ballast factor of 1.0. Ballasts shall be designed to operate a nominal lamp at nominal wattage given nominal input voltage and have full rated output.

B. Ballasts shall be multi-voltage/multi-tap where available.

C. Where available, ballasts shall be as manufactured by the fixture manufacturer. Ballasts for fluorescent fixtures shall be electronic, high efficiency and high power factor, with certification by ETL, CBM and Underwriters Laboratories, Inc. All ballasts for indoor fluorescent fixtures shall be equipped with an internal, thermally actuated automatic reclosing protection device. Ballasts shall be guaranteed against service failure for a period of five (5) years. Ballasts shall be rated "Class P" to agree with requirements of 410-73 (e) and other applicable articles of the NEC, to conform to the time schedule for this requirement, and shall be Class A sound rated.

D. Ballasts for HID fixtures shall have copper windings and shall be high power factor, constant wattage autotransformer (CWA) (i.e. lead type for high pressure sodium or peak lead type for metal halide), or constant wattage (CW) with certification by ETL, CBM and Underwriters Laboratories, Inc. All ballasts for HID fixtures shall be Class "H" insulated, encapsulated for quiet operation, and shall have an integral thermal protector.

E. All outdoor fixtures and fixtures located in unheated areas shall be furnished and installed with ballasts rated for outdoor installation.

F. Fixtures shown or specified to be controlled by dimmers shall be furnished with suitable dimming ballasts.

G. Ballasts shall be as manufactured by Holophane, Universal, Advance, or Magnetek.

2.05 Lamps

A. The Contractor shall furnish and install lamps in all fixtures. Lamps shall be of the following types:

1. Fluorescent: F32T8
2. LED
3. Metal Halide

B. Lamps shall be as manufactured by General Electric Company, Sylvania Lighting Equipment, or Phillips Lighting Company.

2.06 Poles

A. Poles shall be designed to withstand calculated wind force due to 100 mph winds with a 1.3 gust factor without structural damage.

B. Pole mounted fixtures shall be mounted on poles as designated in the fixture schedule or as indicated on the Drawings. All metal poles shall be bonded to the plant grounding system. Poles shall have adequate handholes and weatherproof receptacles where indicated. All anchor bolts and nuts shall be stainless steel.

PART 3 - EXECUTION

3.01 Installation

A. Lighting fixtures shall be located symmetrically with building lines as shown on the Drawings. The Contractor shall furnish and install the lighting fixtures to allow "convenient" access for maintenance such as cleaning, relamping, and other activities. The fixtures shall be installed to be accessed by a 16 ft. ladder. Where fixtures are shown in locations on the Drawings where maintenance would be difficult, the Contractor shall notify the Engineer for direction.

B. The Contractor shall provide and install all inserts, conduit, structural supports as required, lamps, ballasts, poles, wiring, and any other items required for a complete system. Contractor shall properly adjust and test, to the satisfaction of the Engineer, the entire lighting system. The Contractor shall provide pigtails and flexible conduit connected to an outlet box where necessary or required resulting in a neat and complete installation.

C. The Contractor shall protect all fixtures at all times from damage, dirt, dust, and the like. Before final acceptance, all fixtures and devices shall be cleaned of all dust, dirt or other material, be fully re-lamped and in operating condition to the satisfaction of the Engineer.

D. Circuiting shall be as shown on the Drawings and as follows:

1. Bus loads in all panelboards shall be balanced between phases to within a tolerance of one (1) KVA. Convenience receptacles shall be distributed evenly among all phase buses as much as practical.
2. Voltage drop to the most remote lighting fixture shall be limited to 2 percent.

E. The Contractor shall furnish and install all pendant trapezes and pendant stem hangers with durable swivel or equivalent trapeze hanger permitting normal fixture motion and self-alignment. Fixture pendants shall be Appleton Type UNJ ball type flexible hanger at the fixture and supports from an Appleton JBLX junction box with JBLX hub cover, or equal. Pendant lengths shall be adequate and adjusted to provide uniformity of installation heights above the reference datum. Stems shall be one-piece, with matching canopies and fittings.

F. Fixtures located on the exterior of the building shall be provided with neoprene gasket and non-ferrous metal screws finished to match the fixtures.

G. The finish or exposed metal parts of lighting fixtures and finish trims of all recessed lighting fixtures shall be as directed by the Engineer.

H. The Contractor shall furnish and install recessed fixtures with a separate junction box concealed and located as to be accessible when fixture is removed.

I. The Contractor shall furnish and install all boxes for lighting fixtures such that the box is not the sole support of the fixture. The boxes shall be offset to allow maintenance such that access to wiring within the box can be attained without having to consider supporting (holding) the fixture.

J. All lighting units, when installed, shall be set true and be free of light leaks, warps, dents, and other irregularities. All hangers, cables, supports, channels, and brackets of all kinds for safely erecting this equipment in place, shall be furnished and erected in place by the Contractor.

K. The Contractor shall install fixtures at mounting heights indicated on the Drawings or as instructed by the Engineer. In areas with exposed ducts and/or piping, installation of lighting fixtures shall be adapted to field conditions as determined by the Engineer.

L. The Contractor shall support each fixture securely. Each fluorescent fixture shall be secured to the building structure. The Contractor shall not secure fixtures to the work of other trades, unless specified or noted otherwise, and shall not support fixtures to plaster. The Contractor shall furnish and install all steel members and supports as required to fasten and suspended fixtures from the structure.

M. In all mechanical equipment areas, the Contractor shall install lighting fixtures on the ceiling after all piping and equipment therein has been installed. Exact locations for such fixtures may be determined by the Engineer on the site during the course of the work.

N. Upon completion of work, and after the building area is broom clean, all fixtures shall be made clean and free of dust and all other foreign matter both on visible surfaces, and on surfaces that affect the lighting performance of the fixture including diffusers, lenses, louvers, reflectors, and lamps.

O. All fixtures that require physical adjustment shall be so adjusted in accordance with the directions of the Engineer. The Contractor shall also adjust angular direction of fixtures and/or lamps, as directed.

P. Relamping access shall require no special tools. All optical control surfaces such as lenses and reflectors shall be safely and securely attached to fixtures and shall be easily and quickly removed and replaced for cleaning without the use of tools. No fixture part that may be removed, for maintenance, shall be held in place by metal tabs that must be bent to remove said part.

Q. The Contractor shall furnish and install a concrete foundation for the pole mounted fixtures as indicated on the Drawings and as required. Foundation shall be approved by a professional structural engineer currently registered in the State of Indiana. Pole structure/foundation shall be able to handle fixture/pole weight and withstand wind velocity of up to 100 MPH with a 1.3 gust factor. Provide calculations for review.

R. The Contractor shall furnish and install switches as indicated on the Drawings. Switches shall be single pole, double pole, 3-way, or 4-way as indicated on the Drawings and as required. Switches located outdoors or in wet indoor locations shall be installed in cast boxes complete with yellow, fiberglass weatherproof covers. Reference Section 16141, Wiring Devices.

S. The Contractor shall furnish and install time switches and photocells as specified herein or indicated on the Drawings. Time switches shall be provided with a manual

bypass switch controlling the lights locally and remotely. Time switches shall control contactors, relays, or direct controlling of one, two, or three lighting circuits, as indicated. The Contractor shall furnish and install photocells as specified herein or indicated on the Drawings for automatic "ON/OFF" switching of outdoor lighting.

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SECTION 16902 - ELECTRIC CONTROLS AND RELAYS

PART 1 - GENERAL

1.01 The Requirement

A. The Contractor shall furnish, install, test, and place in satisfactory operation all electric controls and relays as specified herein and indicated on the Drawings.

B. Electrical control and relay systems shall be assembled using NEMA rated components. Components designed and built to International Electrotechnical Commission (IEC) standards <u>are not</u> recognized. Equipment designed, manufactured and labeled in compliance with IEC standards is not acceptable.

C. Motor control circuits shall be wired in accordance with the requirements specified herein or indicated on the Drawings.

D. Reference Section 16000, Basic Electrical Requirements and Section 16195, Electrical Identification.

E. The Contractor shall furnish and install, as specified herein and indicated on the Drawings, all motor control components and wiring for all motor-operated equipment furnished under this Section and all other Sections as indicated. The Contractor shall review the entire Contract Drawings to be totally familiar with his responsibilities.

F. The Contractor shall furnish and install all external power and control wiring to control panels of prewired packaged equipment, unless indicated otherwise.

G. Control wiring requirements are indicated in electrical schematics and descriptions on the Drawings, in control functional descriptions which appear in Section 13600 – Instrumentation and Controls of these Specifications, and in equipment manufacturer's equipment data. The Contractor shall furnish and install all control wiring in accordance with these Contract Documents. The Contractor shall provide all control circuits and wiring for a particular item of equipment in accordance with requirements as set forth by the manufacturer of the particular item of equipment.

H. As specified herein and indicated on the Drawings, furnish and install instrumentation wiring and connections to instrumentation equipment furnished under all Contracts of this Specification. Unless indicated otherwise, motor control switches, pilot lights, relays, and other control equipment for mounting in instrumentation panels shall be furnished, installed, and wired by the Contractor.

I. Where pumps provided by others are furnished with solenoid valves or other devices for control, the Contractor shall wire these valves or devices.

J. Unless otherwise specified herein or indicated on the Drawings, motor controllers shall be wired to drop out and remain dropped out on loss of power to the line side of the controller. Operator action shall be required to restart the motor unless the motor is intended to automatically restart.

K. Motor control components and control wiring shall conform to NEMA Specifications ISC-1970 (Revised, 1975), Industrial Controls and Systems.

L. Where devices are installed on the doors of NEMA 4, 4X, or 3R enclosures, devices shall be selected and installed to maintain the NEMA rating of the enclosure.

M. Wiring in all starters, panels, junction boxes, and similar equipment shall be brought out to numbered terminal strips for interconnection. The Contractor shall be responsible for documenting terminal numbers for all starters, controls, panels, and similar equipment provided under the Contract. At the completion of the project, the Contractor shall submit a complete set of record drawings showing and/or listing all terminals in boxes, panels, starters, and similar equipment in a single, complete bound package for the equipment and control supplied under the Contract. Reference the General Conditions.

N. The Contractor is responsible for coordinating the electrical work under the Contract with all equipment starters, controls, and instruments provided by others. The Contractor shall verify and coordinate with process equipment power supply and voltage, process equipment control power supply and voltage, and details of installation and interconnection. Coordination shall include distribution of approved electrical shop drawings to the General Contractor's equipment suppliers.

O. Electrical control schematic diagrams drawn using a ladder-type format in accordance with JIC standards shall be submitted for all electrical equipment which is being provided under the Contract.

P. Record drawings shall be provided in accordance with requirements in the General Conditions. One complete set of record wiring diagrams encased in plastic or plexiglass envelopes shall be provided for each starter, panel, and similar equipment. The diagrams shall include wire color codes showing connections from numbered terminal blocks to external equipment.

Q. Where space or strip heaters are provided within the enclosures for electrical equipment, the Contractor shall make connections to these heaters from an appropriate power source and operate the heaters with temperature control as necessary until the equipment is installed and operated according to its intended use.

R. Control stations shall be furnished and installed at each motor and at all other controlled devices (e.g. solenoid valves) as specified herein and indicated on the Drawings.

1.02 Testing

A. All tests shall be performed in accordance with the requirements of the General Conditions and Division 1. The following tests are required:

1. Witnessed Shop Tests: None required.
2. Field Tests: Field tests shall be performed in accordance with the requirements specified in the General Conditions, Division I, and Section 16000, Basic Electrical Requirements.

1.03 Submittals

A. In accordance with the procedures and requirements set forth in the General Conditions, the Contractor shall obtain from the equipment manufacturer and submit the following:

1. Shop Drawings.
2. Spare Parts List.
3. Operation and Maintenance Manuals.

B. Each submittal shall be identified by the applicable specification section.

1.04 Shop Drawings

A. Each submittal shall be complete in all respects, incorporating all information and data listed herein and all additional information required for evaluation of the proposed equipment's compliance with the Contract Documents.

B. Partial, incomplete or illegible submittals will be returned to the Contractor without review for resubmittal. The letter and performance affidavit described above must be included in the first submittal.

C. Shop drawings shall include but not be limited to:

1. Equipment specifications and product data sheets.

D. The shop drawing information shall be complete and organized in such a way that the Engineer can determine if the requirements of these Specifications are being met. Copies of technical bulletins, technical data sheets from "soft-cover" catalogs, and similar information which is "highlighted" or somehow identifies the specific equipment items the Contractor intends to provide are acceptable and shall be submitted.

1.05 Operation and Maintenance Manuals

A. The Contractor shall submit operation and maintenance manuals in accordance with the procedures and requirements set forth in the General Conditions and Division 1.

1.06 Tools, Supplies, and Spare Parts

A. The electrical control and relay systems and accessories shall be furnished with all special tools necessary to disassemble, service, repair, and adjust the equipment. All spare parts as recommended by the equipment manufacturer shall be furnished to the Owner by the Contractor.

B. The spare parts shall be packed in containers suitable for long term storage, bearing labels clearly designating the contents and the pieces of equipment for which they are intended.

C. Spare parts shall be delivered at the same time as the equipment to which they pertain. The Contractor shall properly store and safeguard such spare parts until completion of the work, at which time they shall be delivered to the Owner.

D. Spare parts lists, included with the shop drawing submittal, shall indicate specific sizes, quantities, and part numbers of the items to be furnished. Terms such as "1 lot of packing material" are not acceptable.

E. Parts shall be completely identified with a numerical system to facilitate parts control and stocking. Each part shall be properly identified by a separate number. Those parts which are identical for more than one size, shall have the same parts number.

PART 2 - PRODUCTS

2.01 Control Components

A. Pushbuttons (PB) and selector switches (SS) shall be Type E34 as manufactured by Cutler-Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company equivalent, or equal. Pushbuttons and selector switches shall be 30.5 mm, heavy-duty, oil tight NEMA 4X corrosion resistant with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Pushbuttons and selector switches shall be non-illuminated. Pushbuttons shall include a full guard. Panic stop/alarm pushbuttons shall be red mushroom type with manual-pull release.

B. Pushbuttons and selector switches for all electrical equipment shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

C. Pushbuttons, selector switches, and other pilot devices for pump control panels shall be as specified herein.

D. Engraved nameplates shall be securely fastened to the front of each pushbutton station, disconnect switch, and motor starter remotely located from the motor control center. If adequate space is not available, the nameplate shall be mounted below the push button station. Nameplates shall be as specified in Section 16195, Electrical Identification. Identify all switches, control stations, and motor controllers as to their respective equipment.

E. Pilot lights shall be Type E34 as manufactured by Cutler- Hammer, Type 3SBO as manufactured by Siemens Energy and Automation Inc., General Electric Company equivalent, or equal. Pilot lights shall be of the proper control voltage, LED type, heavy-duty, corrosion-resistant NEMA 4X with legend plates as specified herein, indicated on the Drawings, or otherwise directed by the Engineer. Legend plates shall be plastic, black field (background) with white lettering. Pilot light lens colors shall be as follows:

Red	-	"Run", "On", “Open”
Green	-	"Off", “Closed”

Amber - "Alarm", "Fail"
White - “Control Power On”

F. Pilot lights for all electrical panels shall be of the same type and manufacturer unless otherwise specified herein or indicated on the Drawings.

G. Pilot lights for pump control panels shall be round with custom engraved legend plates for each pilot light.

H. Control Relays (CR) shall be Type D3 as manufactured by Cutler-Hammer, Potter-Brumfield equivalent, Allen-Bradley equivalent, Siemens Energy and Automation Inc. equivalent, or equal. Relays shall be general purpose plug-in type with coil voltage as shown on the Drawings and sealed 10 ampere contacts. All relays shall have three SPDT contacts rated 120/240 VAC and 28 VDC minimum. Machine tool relays shall be provided when the contact burden exceeds 10 amperes. Miniature type or "ice cube" relays are not acceptable.

I. Timing Relays (TR) shall be the general purpose plug-in type, Type TR as manufactured by Cutler-Hammer, Allen-Bradley equivalent, Siemens Energy and Automation Inc. equivalent, or equal. Timing relays shall be electronic type with 120 VAC coils unless otherwise specified or indicated on the Drawings. Timers shall be provided with two SPDT timed output contacts. Contact ratings shall be the same as for control relays as specified above.

J. Control Stations (CS) shall be as manufactured by Cutler-Hammer, General Electric Company, Siemens Energy and Automation Inc., or equal. Control stations shall be furnished and installed complete with pushbuttons, selector switches, and other pilot devices as specified herein or indicated on the Drawings. Stop pushbuttons shall be furnished with a lock-out device as specified herein and indicated on the Drawings.

   Control station enclosures shall be cast aluminum with gasketed cover for all indoor dry areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all indoor damp/wet process areas. Control station enclosures shall be NEMA 4X stainless steel with gasketed cover for all outdoor applications.

   Control stations located in hazardous locations shall be suitable for the Class, Division, and Group to suit the application. The pilot devices shall be the factory sealed type mounted in enclosures as specified above.

K. Open type motor starters shall be rated 480 VAC, 3-pole, sized for the intended load unless otherwise indicated. In no case shall a starter smaller than a NEMA Size 1 be used. Each starter shall be able to withstand 20 million operations. Each starter shall be furnished with a minimum of two spare auxiliary contacts in addition to the hold-in contact.

   The motor starters shall conform to NEMA Standard IC1 and shall be for across-the-line starting, unless otherwise indicated. IEC rated equipment is not acceptable and shall be used as a basis for rejection of the equipment.

Starters shall be furnished with manual reset overload relays in each phase sized in accordance with the NEC. Provide door mounted overload reset button with metal (not plastic) shaft. Starters shall be provided with coils for 120 VAC operation, unless otherwise indicated on the Drawings.

Ambient compensated, thermal, bi-metallic type overload relays shall be furnished and installed providing Class 20 operation. Overload relays shall be equipped with one additional normally open (NO) and normally closed (NC) isolated contact for use as specified herein or indicated on the Drawings. Solid state overload relays shall only be furnished and installed if specifically accepted by the Engineer. The Contractor shall furnish and install correctly sized overload heaters based on the rating of the motor installed.

Open type magnetic motor starters shall be Cutler-Hammer Type AN16 or AN56 using NEMA rated Freedom Series contactors, General Electric Company equivalents, Siemens Energy and Automation Inc. equivalents, or equal.

L. Selected motors are indicted as requiring elapsed time indicators. Provide Eagle Signal Type HK210A6, General Time Catalog #ED27NR, Allen-Bradley equivalent, or equal, elapsed time indicators for 120 VAC volt operation mounted flush in the respective motor starter compartment door. Where clearance is not obtainable for compartment door closing, mount timers in a separately mounted enclosure, with each timer nameplated. Wire elapsed time indicator to operate when the respective motor operates.

M. Terminal blocks shall be assembled on non-current carrying galvanized steel DIN mounting rails securely bolted to the enclosure or cabinet subpanel. Terminals shall be tubular screw type with pressure plate for wire size #22 - #8 AWG.

Power terminal blocks shall be single tier with a minimum rating of 600 volts, 30A. Signal terminal blocks shall be single tier with a minimum rating of 600 volts, 20A. Separate terminal strips shall be provided for each type of power and signal used within each cabinet. There shall be a sufficient quantity of terminals for the termination of all spare field conductors.

Terminals shall be marked with a permanent, continuous marking strip. One side of each terminal shall be reserved exclusively for incoming field conductors. Common connections and jumpers required for internal wiring shall not be made on the field side of the terminal. Subject to the approval of the Engineer, a vendor's pre-engineered and prefabricated wiring termination system may be acceptable.

The terminal blocks shall be as manufactured by Phoenix Contact, Inc., Wieland, Inc., or equal.

N. Alarm horns shall be as manufactured by Federal Signal Corporation, Edwards Signaling Company, EST (Edwards Systems Tech) or equal. Alarm horns shall be made for surface, flush, or semi-flush mounting on walls, panels, enclosures, or on square outlet boxes. Alarm horn sound output level shall be of 100 dB (nominal) at 10 feet.

PART 3 - EXECUTION

3.01 Configuration of Controls and Equipment

A. All controls including wiring, control switches, pushbuttons, indicating lights, control interlocks and similar devices, shall be provided at the control voltages specified herein or indicated on the Drawings. Each motor starter shall be provided with a control power transformer mounted in the starter unit. Primary wiring to the control power transformer shall be tapped to two (2) poles on the load side of the circuit breaker or fusible switch. Both primary wires shall be fused with 10- ampere, slow-blow fuses. The fuse on the ungrounded secondary side shall be capable of handling 100 percent to 125 percent of the rated control transformer secondary current. Control power transformers shall be provided with volt-ampere (VA) ratings equal to a minimum of 125 percent of the volt-ampere (VA) load connected to the transformer.

B. All equipment, cabinets, and devices furnished under the Contract shall be heavy-duty type, designed for continuous industrial service. The system shall contain products of a single manufacturer, insofar as possible, and shall consist of equipment models which are currently in production. All equipment provided shall be of modular construction and shall be capable of field expansion.

C. All equipment shall be designed to operate on a 60 Hz alternating current power source at a nominal 117 volts, plus or minus 10 percent, except where specifically noted. All regulators and power supplies required for compliance with the above shall be provided.

D. All switches shall have double-pole, double-throw, contacts rated at a minimum of 600 VA, unless specifically noted otherwise.

E. Materials and equipment used shall bear a U.L. label wherever such labeling of equipment and materials are available.

F. Unless otherwise specified or indicated on the Drawings, all equipment shall be designed, furnished, and installed so that in the event of a power interruption, the equipment must be restarted manually after a power failure.

G. All power terminals shall be insulated and identified.

H. All instruments shall operate at 10 to 125 degrees F unless otherwise specified.

I. Internal wiring within all starters, panels, instruments, junction boxes and similar equipment, shall be brought out to numbered terminal strips for interconnection and field wiring.

J. All control components shall be mounted in a manner that will permit servicing, adjustment, testing, and removal without disconnecting, moving, or removing any other component. Components mounted on the inside of panels shall be mounted on removable plates and not directly to the enclosure. Mounting shall be rigid and stable unless shock mounting is required otherwise by the manufacturer to protect equipment from vibration. Component's mounting shall be oriented in accordance

with the component manufacturer's and industries' standard practices. All internal components shall be identified with suitable plastic or metal engraved tags attached with drive pins adjacent to (not on) each component identifying the component in accordance with the Drawings, Specifications, and supplier's data.

K. The control functional descriptions which appear in Section 13600 indicate interconnections between panels, instruments, and similar equipment. Unless otherwise noted, the Contractor shall provide all interconnecting wiring and conduit for complete control systems. The Contractor shall make all connections to equipment devices, instruments, and all components requiring electrical connection.

L. The shield on each instrumentation cable shall be continuous from source to destination and shall be grounded as directed by the manufacturer of the instrumentation equipment. In no case shall more than one ground point be employed for each shield. All analog control functions shall utilize 4-20 mADC control signals, unless otherwise specified. All analog transmission shall take place within shielded twisted cables which are not susceptible to interference or noise.

M. Lightning/surge protection shall be provided to protect the instrumentation and control system from induced surges propagating along the signal and power supply lines. The protection systems shall be such that the protective level shall not interfere with normal operation, but shall be lower than the instrument surge withstand level, and shall be maintenance free and self-restoring. Equipment shall be housed in a suitable metallic case, properly grounded. Ground wires for all surge protectors shall be connected to a good earth ground and, where practical, each ground wire run individually and insulated from each other. These protectors shall be mounted within the enclosure or in a separate NEMA 4 junction box coupled to the enclosure.

N. Reference Section 13600 – Instrumentation and Controls for additional information regarding lightning/surge protection requirements.

3.02 Field Tests

A. The Contractor shall conduct field tests prior to operation of the equipment. The Engineer shall witness all field testing. Field testing shall be conducted at a time approved by the Engineer. Field tests shall be conducted for all hardware components and shall include a functional check of all items. Field tests shall include a functional check of all instruments and control equipment. All equipment shall be connected and fully operational for field testing. Field tests shall demonstrate that the controls perform according to the Contract requirements and that all equipment, valves, switches, controls, alarms, interlocks, indicating lights, and similar equipment function properly. Based on the results of field tests, the Contractor shall make any required corrections to equipment and controls and shall make any adjustments required to the control logic and control settings to achieve the specified operation or operation otherwise directed by the Engineer. Field tests shall be conducted for the full range of operating modes and conditions specified and as directed by the Engineer. The Contractor shall make modifications and adjustments to the controls as directed by the Engineer for optimizing operation of the overall system. All costs in connection with field tests of equipment provided

under the Contract, shall be borne by the Contractor. The Contractor shall be fully responsible for the proper operation of all motor starters and controls during the tests.

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